METHODS OF MAKING EXCHANGE NOISE SURVEYS

CONTENTS

1. INTRODUCTION

(A) General

1.01 This Section is concerned primarily with a description of methods which have been found useful for making exchange area noise surveys* having for their primary purpose the obtaining of an indication of what the **general** noise conditions are—chiefly at subscriber locations—in any particular central office area. Material concerning surveys of this kind has been assembled herein so that the required detail information may be available when the study of a specific situation indicates that the carrying out of this particular type of survey is warranted. In some specific areas, the conditions may, of course, be such as to warrant the inclusion of certain tests discussed in other sections of practices, in addition to the survey measurements outlined herein. (For example, Section AB63.379** and AB63.080 and other sections of the AB series.)

* For the specific sense in which the term "survey" is used herein, see Paragraph 1.07.

** Many of the tests outlined in Section AB63.379 usually serve primarily to show "why" particular noise conditions exist in a particular area, assuming that the existence of such noise conditions has been indicated by a survey of the kind discussed herein or by other observations.

1.02 In general, the contents and nature of the present issue, together with the methods outlined herein, are substantially the same as those of the previous issue. Practically speaking, the chief difference between the two issues just mentioned is that the material contained in this present issue has been set up on the basis that—in common battery areas—the noise-in-receiver measurements concerned will usually be made on **anti-sidetone** station sets (see Part 3C, etc.,) employing **HA1** receiver units; namely, on a type of station equipment which is now present in large numbers in the subscriber plant and which will be generally employed in the future. This change in the type of noise-in-receiver measurement suggested is in accordance with the trend of the (anti-sidetone, HA1) subscriber station program just mentioned and is made possible at this time because of the fact that apparatus by means of which the 2-type Noise Measuring Set can be so modified* (relatively simply) as to be suitable for measurements of receiver noise directly across receiver units of the "HA" type (in addition to the "144" receiver input regularly provided) is now available.

* These modifications are described in detail in Section AB63.400-E30.459 and in Section AB63.399-E40.458, for the 2B and the 2A Noise Measuring Set, respectively.

1.03 The material contained herein describes "how" a survey such as referred to at the start of Paragraph 1.01 can be made. "When" and "where" to undertake a survey of this kind is a matter which can best be decided on the basis of the specific local conditions. However, it seems reasonable to believe that in establishing local schedules for work of this kind in any particular territory, any areas for which there are indications of questionable or adverse exchange or rural noise conditions (such as from service reports, etc.,) would generally be expected to be among the first of the earliest candidates to be considered for such a survey.

1.04 In view of the fact that certain parts of the material contained herein pertain to testing methods, while other parts are concerned with a number of items which should be of assistance in connection with the subsequent summarization* and technical review of the assembled data, this Section has been assigned two numbers; namely, one in the K series and one in the AB series.

* A subject which is discussed in more detail in Section AB63.081.

1.05 The Section includes information on the selection of the test locations, stations, trunks and P.B.X.'s which are to compose the survey sample. Details of the noise measurements are given in Parts 4, 5 and 6.

1.06 Since it usually is impracticable to make such tests on all subscriber lines, the survey described herein is set up on a **sampling** basis.

1.07 Generally speaking (and as will be noted from Paragraphs 4.10, 5.07 and 6.05), such a noise survey** will include measurements of noise in the receiver of a subscriber station set with bridged and grounded ringer—at various selected test locations—as well as a measurement of the corresponding noise-metallic and noise-to-ground, together with suitable frequency analyses. A more detailed indication of the general nature, types, etc., of such noise survey measurements is given in the three paragraphs just referred to. In the case of subscriber lines, for instance, the attention of the reader is called to the summarized information given in Table 1 (Page 21). For such survey measurements the central office end of the circuit is usually terminated—through the regular office equipment—in a resistance to simulate the "called" subscriber circuit. In this way, any "internal" noise which may be arising from central office sources† —such as in the office battery supply and equipment—at the time of the survey tests will be included in the measurement, along with noise due to induction from power exposures. Similar measurements are made on trunk circuits.

** As noted in Paragraphs 1.01 and 1.15b, various other tests (in addition to the measurements described herein), may also be made in conjunction with such a noise survey of any particular area, such "special" tests being carried out to the extent considered necessary and practicable for the specific area concerned.

† See Paragraphs 1.11 and 1.12.

1.08 In a survey of the nature outlined herein it is generally, of course, impracticable to make receiver noise measurements directly on a multiplicity of various types of subscriber station sets;

that is, upon station sets which are representative of **all** of the subscriber sets which are in use—or whose early future use may be contemplated—in any given complex area. Hence, as indicated in Part 3C, etc., of this Section, it is usually necessary to confine such field measurements to a relatively few types of subscriber set (namely, those which are in most common commercial use) and the material contained here is set up on this basis. However, the tests covered by this material are of such a nature that—if need be—they will provide data from which the noise corresponding to types of subscriber sets other than the specific ones used (for test purposes) in any particular survey can be readily estimated.

1.09 In every case, the objective of tests of the nature referred to in Paragraph 1.07 is to measure the noise under the circuit conditions which would be encountered when an actual call is made (in so far as the simulation of such circuit conditions is reasonably practicable). It follows that, to be representative of this condition, the proper place at which to make such measurements on subscriber circuits is at (or in the immediate vicinity of) various selected individual subscriber locations.

1.10 For this purpose, there are decided advantages (such as avoiding "time out of service," etc.) in selecting **spare** pairs **in a good condition of maintenance***, as pointed out in Paragraphs 1.16, 1.23 and 2.04, thus minimizing the use of "working pairs." Such selection will undoubtedly be found practicable in a considerable number of cable areas but it is, of course, to be expected that the possibility of a choice of this kind will seldom be offered in open wire sections (see Item 7 of Paragraph 1.16 and Paragraph 2.04).

* See Paragraph 1.23.

1.11 It does not follow that a survey of the nature described herein (and referred to in Paragraph 1.07) will always give a reasonably accurate picture of **"internal"** noise conditions (in particular areas where such noise is of importance), since (a) it has been found that the season of the year has much to do with the amount of noise due to central office sources—particularly so in the case of panel offices—and (b) in addition the circuit conditions which are contemplated for such a survey are not **completely** "typical" of the several types of connections which may exist on various actual calls by the customers (although the "survey" circuit conditions **will** be substantially typical in a large number of instances).

1.12 As noted in Paragraph 1.29, **indications** of the noise due to internal sources in the telephone plant may, of course, be observed in such a survey. (The existence of such noise might also be indicated by service reports, observations by the operating forces, etc.) However, the most practicable procedure for determining its approximate magnitude, sources, etc., would usually be by means of investigations along certain of the lines discussed in several sections of the AB65 series, Section AB65.225, Section AB63.379, etc.

1.13 **The chief purposes** of exchange noise surveys **confined** to the specific types of measurements described herein would usually be one or more of the following:

(a) To determine the over-all noise conditions in a particular area, or

(b) To determine the over-all effect on exchange noise of some change in the telephone plant (such, for example, as a change from magneto or common battery to dial operation), or

(c) To determine the over-all effect, on noise, of some change in power system conditions.

In such cases, the results would usually be chiefly indicative of the noise conditions resulting from induction experienced **outside** of the central office.

(B) Choice of Types of Measurements for Specific Situations

1.14 This Section describes certain types of tests which have been found useful in making a relatively simple survey of the noise conditions in specific exchange areas. The material herein is presented as a matter of technical information, and should not be construed as being in the nature of a recommended general engineering procedure or as specifying the measurements herein described to the exclusion* of any others (for example, such a survey as contrasted with a detailed investigation or the inclusion of a number of tests pertaining specifically to "internal" noise). Such recommendations are outside of the scope of this Section.*

* Note Item "b" of Paragraph 1.15.

1.15 The **specific** sense in which the term "exchange noise survey" is used **herein** is indicated in more detail in Paragraphs 1.06, 1.07 and 1.09. However, it will not be amiss at this point to call attention to the following:

(a) Other types of noise surveys are beyond the scope of this Section. They are outlined in Section AB63.080 and other sections listed therein.

(b) Due to the wide range of conditions which may be encountered in the field, it follows (as indicated by Paragraph 1.01) that in any particular situation, "survey" measurements **do not** have to be confined merely to the tests outlined in detail herein. That is, **other** measurements* can, where desired, be included (in one "combined" survey) to an extent which is considered to be **best adapted** to the needs of the conditions and circumstances concerned in the specific case.

* Even of a "special" nature, if such are considered advisable.

(c) It follows, from Item "b" of this paragraph that in some situations, the "survey" may even be intermediate between a "specific investigation" and a simple "survey" of the particular type described in this Section.

(d) If it is desired to take reasonably full account of noise conditions arising from "internal" noise sources in any specific area (including seasonal variations thereof, etc.) certain sections in the AB65 series, rather than this particular Section,** should be consulted.

** Also see Paragraphs 1.11 and 1.12.

(C) Summary of Some General Features

1.16 Parts 1A and 1B of this Section include a discussion of a number of general matters concerning exchange noise surveys. To sum up, there are certain of these general features, together with other important items, which need to be borne definitely in mind when considering the detail information given in the subsequent subdivisions of this Section. Among these features and items are the following:

(1) Attention is called to the **specific** sense in which the term "exchange noise survey" is used herein. (Paragraphs 1.06, 1.07, 1.09 and 1.15.)

(2) **Selection of Areas for Survey.** It does not follow that each and every exchange area in a particular territory will require a noise survey. As pointed out in Paragraph 1.03, **"when"** and **"where"** to make such surveys can best be decided on the basis of the local conditions specific to the particular area concerned. For example, in some areas, surveys of rural line noise would need to be considered first—as a basis for possible programs of improvement; in other situations, particular central office areas in large cities would be selected as the first candidates for surveys; in still other localities, noise surveys of this kind might be made before and after (and primarily because of) a change in power supply conditions or a conversion of the telephone facilities; and so on.

(3) **Choice of "Type" of Survey.** It should be understood that there is no hard and fast distinction between different "types" of noise surveys. Furthermore a survey of the type discussed herein can, of course, be extended to include any additional measurements which may be considered advisable to meet the needs of a particular situation. (See Paragraph 1.15b.)

(4) **"Internal" Noise.** Attention is called to Item (d) of Paragraph 1.15, regarding noise from sources internal to the telephone plant.

(5) **"Special" Tests.** It follows, from Item (3) just above—and from Paragraphs 1.15b and 1.15c—that as much "special" testing as may be considered necessary and desirable can be carried out along with the measurements specifically described herein.

(6) **Point of Noise Measurement.** Practically all of the subscriber circuit noise measurements referred to in detail herein would be made at (or in the immediate vicinity of) representative subscriber locations. (See Paragraphs 2.12-2.15.) The noise-in-receiver measurements would be made on subscriber set arrangements carried by the test crew, rather than in the subscriber premises. (See Paragraphs 1.07, 1.08, 1.09 and 1.17.)

(7) **Use of Spare Pairs.** In the interests of avoiding (or at least minimizing) "out of service" time, it is suggested herein (see Paragraphs 1.10, 2.02, 2.04, 2.06-2.10) that the noise measurements referred to in Item "6" be made on spare pairs in so far as practicable. Many cable areas will undoubtedly offer such a choice but it is questionable whether spare pairs will often be available in open wire sections (Paragraphs 2.06, 2.09 and 2.10).

(8) **Opening of Drops on Working Pairs.** In those instances where **working** pairs having "only one-party working" are used for the survey noise measurements in question, it is essential to remove the drop to the working party's location if a grounded ringer is normally used at that station. This removes the effect of the grounded ringer (Paragraph 2.08). (Also see Item 9 of this Paragraph, below.) In the case of a circuit having several stations with grounded ringers—such as in multi-party cable areas or (often) in rural open wire areas—it is seldom practicable to thus remove the combined effects of the grounded ringers (see Paragraphs 2.08, 2.09 and 2.10).

(9) **"Advance" Notice to Subscriber.** In cases where it is planned to remove the drop per the procedure mentioned in Item "8" it will, of course, be desirable to make suitable advance arrangements with the particular subscribers concerned with the test pairs employed and to carry out the testing procedure in such a manner (Paragraphs 4.02, 4.05, 4.16, etc.) that any given test pair is properly and promptly returned to service immediately upon the completion of the noise measurements thereon.

(10) **Cooperation with Power Companies.** As discussed in more detail in Part 1E of this Section, cooperation with the power company (or companies) concerned in a particular area under survey is, of course, desirable—both in planning and carrying out the survey.

(D) Nature of Measurements

1.17 A brief outline of the general nature of the measurements which are included in a survey of the kind described herein is given in Paragraph 1.07, while details of the measurements are discussed in Parts 4, 5 and 6. For obvious reasons, it is generally inconvenient, impracticable and inadvisable to make these readings at a set in a subscriber's premises, in the case of subscriber line noise. In contrast to this, there are decided advantages in making these "subscriber set" measurements at certain selected, representative, nearby locations. In addition to the few subscriber set arrangements which need to be carried by the test crew (Paragraphs 3.15-3.22), one or two pairs, in good order,* from each such test location to the exchange, are all that are usually required in so far as connections from the test location to the central office are concerned.

* Also see Paragraphs 1.23 and 2.06.

(E) Cooperation with Power Companies

General

1.18 The contents of this Section are concerned chiefly with noise survey measurements on telephone circuits since it is probable that in most exchange noise surveys of this kind the tests will be wholly, or almost entirely, confined to such measurements. As indicated in Paragraph 1.20, an exception to this will be presented in a considerable number of situations where the noise on **rural** telephone circuits is being surveyed. In this connection it may be noted that in the case of rural circuits the traveling time can usually be expected to constitute a relatively larger item, in comparison with the total testing time, than in the case of exchange circuits in urban or suburban areas.

1.19 However, it would seem advisable and helpful in most cases to let the power company know (through the usual channels) that an exchange noise survey is about to start in a particular area and to inquire whether they are interested. Thus their wishes as to possible participation (or close contacts with the progress of the survey) by some of the power people may be ascertained in advance. In some areas, it may be found desirable, if the power company is so inclined, to include a fairly simple survey of power system influence along with the noise survey. It is, of course, desirable that such a survey of the influence be conducted cooperatively (i.e., by joint participation) or at least by agreement with the power company.

Rural Areas

1.20 In the event that cooperation such as mentioned in Paragraph 1.19 has been agreed upon, it seems that, in the case of rural areas, the additional data which would be of most value in conjunction with the noise survey would be those which could be secured by making:

(a) "Probe wire" tests* to obtain an indication of the ground-return I·T (including frequency analyses), and

(b) Measurements of voltage TIF (including frequency analyses of the voltage),

at certain selected "strategic" locations along the power circuit (or circuits) concerned in such exposures as may exist. If such measurements of influence are to be incorporated in the survey, it is, of course, highly desirable that they and the noise survey measurements be made on the same testing trip since this is one of the important reasons which facilitates the inclusion of such additional tests. Every reasonable effort should, of course, be made to identify these measurements closely with the power system operating conditions. A detailed discussion of probe wire tests* and measurements of voltage TIF** (or KV·T) is omitted from this Section, since they are described elsewhere in the AB series.

* See Section AB63.130.

** The voltage TIF is, of course, derived from the measured "KV·T," as per Section AB63.477.

1.21 Certain other, more general, features which apply particularly to noise surveys on telephone circuits in rural areas are mentioned in Paragraph 1.22.

(F) Hours Selected for the Survey

1.22 Ordinarily, it should be feasible to carry out the noise survey during normal working hours. However, experience indicates that in some situations—particularly in the case of exposed telephone circuits in rural areas—it is decidedly helpful to have some idea as to what happens to the noise during various parts of the day. It usually is desirable, therefore, to make measurements on a few circuits at various times of day and night and, in some such situations, to obtain a 24-hour record of the noise on one or more selected telephone circuits by means of a recording meter as per the methods outlined in Section AB63.400.

(G) "Balance" of Outside Plant

1.23 Throughout this Section it is, of course, assumed that the circuits selected for the noise survey test purposes are in a good condition of balance. In other words, it is assumed that such cable or open wire test circuits have been checked for insulation resistance and resistance unbalance —**prior** to starting the actual noise survey.

(H) Frequency Analyses

1.24 In some of the earlier exchange noise surveys of the general nature discussed herein, the tests were confined largely to noise measurements on selected sample telephone circuits—without corresponding frequency analyses on such circuits. However, a knowledge of the frequency make-up of the induced noise* has become of in-

creased importance in connection with matters of inductive coordination. In the case of exchange circuits for example, the frequency make-up of the induction along a given cable or open wire route—together with the wide variety of subscriber set arrangements which are (or may be) employed in the plant and their differing degrees of susceptiveness at various frequencies—may be usually expected to have a considerable bearing upon the noise actually experienced in calls along that route. Then too, a knowledge of the frequencies present and (at least) their respective orders of magnitude will usually be of material assistance in formulating estimates as to what effects station equipment having various degrees of susceptiveness may have upon the general noise conditions—either as existing at the time of survey or as may be expected to exist in certain areas subsequent to the remedying of any adverse noise conditions which may be unearthed by such a survey.

* Either the noise-to-ground, or the noise-metallic, or both—depending upon the particular type of subscriber facility concerned (i.e., whether a subscriber loop or a trunk, etc.)—as outlined in more detail in Paragraphs 4.16, 5.07, 5.10, 5.14, etc.

1.25 It is, therefore, suggested that a limited number of frequency analyses** be included in the noise survey in those instances where a 10A Noise Analyzer Attachment can be made available for this purpose. For example, such analyses might be included at perhaps 20 to 25 per cent. or so of the locations selected for survey noise tests along any particular route. Among the advantages of such an analysis are the following:

(a) Positive identification of frequencies present in the induction.

(b) Furnishes quantitative data as to the magnitude of each frequency component present.

(c) In cases where it is desired to formulate estimates of receiver noise for types of station set on which direct noise measurements have not been made in the survey, the data mentioned in Items "a" and "b", just above, generally enable more reliable determinations to be made of the receiver noise (either "144" or "HA1") corresponding to particular station sets than it is usually feasible to obtain with the method referred to in Paragraph 1.26.

It is, of course, possible that some specific exchange areas will be encountered where only one or two types of subset will be generally installed (either at present or in the contemplated future) throughout such an area. In a case of this kind, it might, therefore, so happen that a knowledge of the receiver noise corresponding solely to the one or two specific types of subset just referred to is all that would be of particular importance. (Also see Paragraphs 1.08 and 3.20.) In a general noise survey on such an occasional individual exchange area, therefore, suitable data obtained by measuring directly on the one or two types† of subsets which are (or which are expected to be) customarily installed in that area may practically eliminate the need for **estimates** of the receiver noise therein—and hence obviate the need for frequency analyses for this particular use, or at least make it possible to reduce materially the number of such analyses required.

** Discussed in Paragraphs 4.11, 4.16, 5.01, 5.07, 5.13, 5.14, etc.

† Instead, perhaps, of one or more of the particular subsets shown in Fig. 1.

1.26 Paragraph 4.10 indicates that in noise surveys such as discussed herein it will usually be feasible to confine the measurements of **receiver** noise, on common battery station sets, to the anti-sidetone "302" arrangement employing a B1A permalloy core ringer and the anti-sidetone "684A" arrangement employing an 8A ringer—these measurements being made across an HA1 receiver unit in the case of the "302" arrangement and for **both** the 144 receiver **and** the HA1 receiver unit in the case of the 684A arrangement. (For the next several years, the inclusion of "144" receiver noise measurements on the common battery sidetone "584A" arrangement employing an 8A ringer may, of course, be justified in occasional instances, as mentioned in Paragraph 3.22.) As explained in more detail in Section AB63.239, such receiver noise measurements — as obtained for the "grounded" condition of the ringer—can, of course, be used to obtain a more or less rough "approximate" classification of the wave shape for cases where an analyzer attachment is not available. Such approximate classification can be made by consulting the information on "relative susceptiveness" given in Table 1 of Section AB63.240 (Eng. Report No. 46) and in Tables A, B, and C of Section AB63.239. If the general frequency composition of the noise-to-ground corresponds fairly well with one of the types ("A" or "B") indicated in Table 1 of Section AB63.240, this method will provide reasonably good estimates of the receiver noise for the various types of grounded-ringer station sets existing in the particular area. However, where situations are encountered in which the frequency make-up departs considerably from types "A" or "B", the composite-frequency susceptiveness comparison of the various sets tends to become less reliable and of a more empirical nature if dependence is placed solely on the results of the receiver noise measurements (and the accompanying noise-to-ground) on the grounded ringer 302 and 684A sets just referred to (or even on grounded-ringer 584A sets also).

(I) Review of Survey Data

1.27 It is generally desirable to include in the survey data such notations (Part 7) as, in the discretion of the testmen, will be of importance and assistance in the interpretation of the results

of the noise survey. It is, of course, particularly desirable that these notations contain pertinent information regarding observed plant situations or conditions, and any special comments on the test results.

1.28 The review of the survey data may, of course, result in scheduling specific areas for further detailed investigation based on the conditions disclosed by the survey. Methods of making such additional investigations of specific situations are outside the scope of this Section. They are covered in various Sections of the AB63 series, including Section AB63.379, which discusses methods of making supplemental noise measurements on exchange circuits.

(J) Internal Noise

1.29 As pointed out in Paragraph 1.12 it is, of course, to be expected that, in certain areas at least, indications of the existence of noise due to internal sources in the telephone plant (such as noise from power plant equipment in the central office, contact noise in dial areas, etc.), will be encountered when making exchange noise surveys of the kind discussed herein. Naturally, it is desirable that suitable brief notations regarding the existence of such indications be made on the survey data sheets. However, as mentioned briefly in Paragraph 1.11, the survey sample will be entirely inadequate for determining what portion of the observed noise is due to internal sources and a survey of this kind is not intended for such a purpose. The details and nature of tests which can be used for investigating noise conditions arising from battery supply circuits, etc., are described in Section AB63.379 and several sections of the AB65 series. Furthermore, in order to determine definitely the contact noise conditions, it will usually be necessary to make the tests outlined in Section AB65.225 and other sections of the AB65 series covering contact noise measurements.

2. SELECTION OF SAMPLE

(A) General

2.01 It has been found impracticable to follow absolutely rigid, quantitative rules in selecting the number and type of test locations for survey measurements on exchange circuits and in the case of any particular area such selection must, therefore, be guided to a considerable extent by the exercise of good judgment. The following general suggestions may be found helpful in this connection. As indicated in Paragraphs 1.06 and 2.03, the object is, of course, to obtain sufficient sampling to be adequately representative of the local noise conditions in the particular area but, at the same time, to keep the actual survey measurements down to the minimum consistent with the obtaining of such a representative picture.

2.02 When planning a survey of this kind an advance inspection of the plant layout records, including the cable layout—and other—maps, general or specific exposure data, etc., which are available for the particular area concerned can be expected to be of important assistance in selecting the test locations, including the obtaining of an indication as to the accessibility of proposed test points. (Single line diagrams and geographic layouts of the power systems involved—without too much detail—are often helpful also.)

2.03 It has been found by experience that, in urban and suburban areas, a sampling which is representative of perhaps 5 to 10 per cent. of the subscriber lines concerned may usually be expected to give sufficient information for the purpose of a preliminary exchange noise survey. In occasional instances, of course, a greater proportion may need to be included, depending upon the particular circumstances.

2.04 It is assumed herein that, as per Paragraph 1.23, advance checks will be made to insure that the circuits selected for test purposes are in a good state of maintenance.

2.05 In rural areas, the basic test procedure will not be greatly different from that for urban or suburban areas, except for example to the extent that a majority of the rural exchange circuits will generally be in open wire or U wire. In some such areas, particularly if the noise is high, it may be desirable to measure on substantially all of the rural telephone circuits. Furthermore, the distances involved will usually be greater in rural areas and the inclusion of a limited number of probe wire and voltage TIF measurements may often be warranted (as per Paragraph 1.20) in the case of rural routes.

(B) Stations

2.06 For each noise measuring location selected in a cable area, it has been found desirable to pick out two lines (i.e., two pairs) for test purposes. For such use, there are decided advantages (Paragraph 1.10) in selecting spare pairs in a good condition of maintenance if such pairs are readily available but in a considerable number of instances it will undoubtedly be found necessary, as already pointed out in Paragraph 1.16, to employ "working" pairs (as, for example, in many rural—or other—areas having almost entirely multi-party service). As indicated in Paragraphs 1.07 and 1.09, the chief function of such a pair (whether "working" or "spare") is to serve simply as a normally exposed means of connection from the central office to the test location. That is, a pair so used serves to pick up experimentally any noise*, arising in the central office or along the line (as would be encountered under service conditions), **up to** the terminals of the testing apparatus; in other words, the noise which otherwise would ordinarily be impressed on the **line*** terminals of a subscriber set regularly located in the vicinity of the test location—i.e., during the course of an actual subscriber call over the route followed by the test pair.

* Namely, the noise-metallic and the noise-to-ground on the line itself but **not** the subscriber receiver noise. (Also see Paragraph 1.11.)

2.07 As indicated in Paragraph 3.20, the approximate **receiver**** noise corresponding to the various possible ringer arrangements and certain different types of subscriber sets which are customarily used in an area† is usually arrived at with the aid of estimates† based on measurements on subsets incorporated in the testing apparatus which is connected to the test pair by the survey crew. With this arrangement, it is, of course, highly desirable that the station connections—and particularly the ringer connections—which are thus simulated on the test pair be under the immediate control of the tester, in so far as necessary and practicable.

** More particularly, the component resulting from the susceptiveness of any particular subscriber station set.

† The preceding statement as to estimates—in this particular paragraph—applies specifically, of course, in the case of types of sets which are basically different (electrically) from the particular types of subsets on which the survey noise measurements are made in the given area. (For 302 and 684A common battery anti-sidetone sets, the survey noise measurements would, of course, show the receiver noise directly; that is, without "estimates.")

2.08 To help in obtaining the essential flexibility of such "test" control of the ringer and station conditions it has been found preferable, generally, in **cable** areas to select (for test purposes, per Paragraph 2.06) lines furnishing individual service in those cases where it is considered advisable to use working pairs—instead of spare* pairs—for the survey tests. In occasional instances in such areas, it may be necessary to employ lines having "only one-party working" and in the latter event it will be advantageous (per Paragraph 4.04b and Item 9 of Paragraph 1.16) to open the drop to the working party's location so as to remove† the effect of the grounded ringer if such a ringer is normally used at the subscriber station in question. The procedure mentioned in this paragraph can usually be followed in urban areas and in many suburban areas, where much of the exchange plant is in cable. On multi-party lines in cable areas (as well as on many open wire extensions and particularly in the case of rural exchange circuits—see Paragraphs 2.09 and 2.10) the disconnection of the relatively numerous drops to all of the several subscriber stations on a "working" test pair is generally impracticable. This (considered in conjunction with the first sentence of Paragraph 4.04b) is the main reason why the avoidance of working multi-party lines, in selecting test pairs in cable areas, is suggested in this paragraph and in Paragraph 4.02.

* Where "spare" cable pairs are used for such test purposes the opening of drops will, of course, be largely avoided.

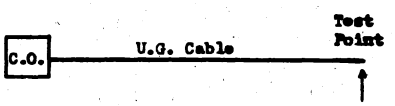
† It is, of course, assumed that suitable advance arrangements will be made with the subscriber, for carrying out this purpose, as per Item 9 of Paragraph 1.16. (The importance of subsequently restoring the subscriber loop to normal—including the reconnection of the drop or drops—and of getting a check test from the local test desk, **before** the "noise" tester leaves any particular test location, are emphasized in Paragraph 4.16.)

2.09 In the case of specific **open wire** test locations at which it is impracticable to make tests covering each and every existing pair, there are usually advantages in measuring the noise on at least one pole pair and on one non-pole pair, if this is feasible, since the coefficients of direct metallic-circuit induction are usually considerably greater for pole pairs than for non-pole pairs (particularly in joint use). At open wire test locations in areas where multi-party service is prevalent, it is often impracticable to obtain, for test purposes, lines furnishing individual service or having "only one-party working"—even in many suburban areas. In rural areas, where multi-party service with grounded ringers is generally common, it is seldom practicable to make such a selection.

2.10 It would, of course, be possible to disconnect all of the ringers (or stations) from a "grounded-ringer" multi-party line, for temporary testing purposes, in order to control the distribution of grounded signaling apparatus present on the test line during the test period. However, experience indicates that this would be an undesirable and time-killing procedure in addition to interrupting the subscriber service seriously for a considerable period of time. Hence, it will often be necessary to select multi-party lines for test purposes in open wire areas—and particularly in rural territories—with the full realization that grounded ringers at stations other than the test location may have an important effect upon the survey noise measured at the latter point. The measurements can, however, be made in such a manner (see Paragraphs 4.09b and 4.10) as to obtain some indication of this effect.

2.11 Subject to the limitations discussed in Paragraph 2.01, the contents of Paragraphs 2.12 to 2.15 inclusive, which are based on experience in surveys, may be found helpful in selecting suitable test locations. In these paragraphs, the basic principles involved are, in general, illustrated schematically rather than by detailed quantitative discussion. Each of the illustrative sketches shows only a single route. In any particular central office area consideration must, of course, be given to the various routes extending from the office.

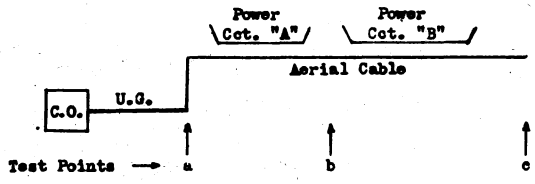
2.12 **Served Directly from Underground Cable:**



In making measurements in the underground sections, there are some advantages in having the test locations cover the general range of lengths of underground cables existing in each central office area. In an "entirely-underground" cable, the noise at its outer end may usually be considered chiefly as made up of such components as may

be contributed by sources internal to the telephone plant. Where exposed aerial cable extensions—or, particularly, exposed open wire extensions of the cable circuits—exist, the possibility of resulting "secondary" induction in the underground cable will tend to be indicated by the survey noise measurements on such extensions themselves. In general, therefore, comparatively few test locations are needed in the case of underground cable sections.

2.13 **Served from Aerial Cable:**



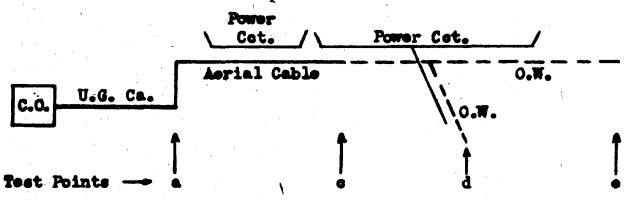
Test Point "a"—Located at outer end of underground cable, if such exists and is over perhaps 1 mile or so in length. (Where U.G. terminals do not exist, the noise measurements might, of course, be made at the first aerial terminal away from the junction of the aerial and underground plants.)

Test Point "b"—Chosen because of some major discontinuity, such as a large change in cable size or size of cable run, an important junction in the cable or a discontinuity in exposure conditions, etc.

Test Point "c"—Outer end of aerial cable section.

Attention will, of course, need to be paid to **exposed** lateral feeds or branches from the main cable. In specific instances, it may be found desirable to include terminals at the outer ends of 1 or 2 (or sometimes more) of these laterals—choosing the more severely exposed ones—(particularly those branching near the outer end of the main cable) if such laterals are exposed to power circuits or electric railway systems for perhaps 1/2 mile or more. The choice of test locations on any exposed open wire branches should be based on local conditions.

2.14 **Served from Open Wire Extensions:**

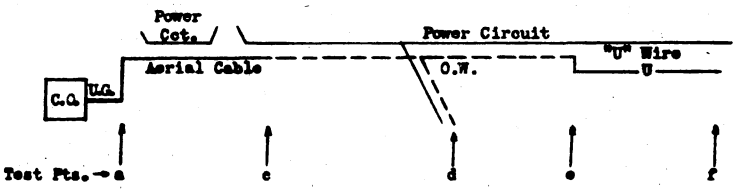


Test Point "a"—Located at or near outer end of underground cable, if any considerable length of such cable exists (see Paragraph 2.13).

Test Point "c"—Located at or near outer end of aerial cable, if any considerable length of such cable exists (see Paragraph 2.13 as to possibility of an intermediate test point "b", between "a" and "c").

Test Point "d" or "e"—Located at outer ends of open wire. (At a particular test location, might be only one pair—usually the longest and most severely exposed—instead of the 2 pairs referred to in Paragraph 2.09.)

2.15 **Rural Areas:**



Test Points "a" to "e"—See Paragraph 2.14.

Test Point "f"—Located at outer end of "U" wire section.

The noise tests at location "e" may include measurements to determine the effects of the buried wire. See Paragraphs 3.04 and 4.16.

(C) Trunks

2.16 In testing the trunks it is desirable, of course, to select first the trunk group—either open wire straightforward (or call circuit) or ring-down, or all cable straightforward (or call circuit), etc., on which—due to exposure conditions, traffic reports, etc.—the likelihood of noise is suspected.

2.17 The extent to which other trunk groups will need testing can be pretty well determined after having tested* completely one or more circuits from the group referred to in Paragraph 2.16. In the general case, it may be found advisable to confine such further attention chiefly to those trunk groups most likely to have noise, rather than making any extensive sampling of perhaps all of the several trunk groups from an office.

* By the methods discussed herein and in other Sections.

(D) P.B.X.'s

2.18 It is usually helpful to defer measurements on P.B.X.'s until the measurements on subscriber circuits have been completed. In this way, by noting the zones in which the higher values of longitudinal-circuit induction (higher noise-to-ground) exist, those P.B.X.'s most likely to have noise from outside sources can be roughly spotted.

2.19 For survey purposes it would seem best to start with, perhaps, a half dozen P.B.X.'s selected either as outlined above or on the basis of reports from attendants, repairmen, etc. From the tests on this small sample it can be determined whether a more extensive survey is desirable.

3. TESTING APPARATUS

3.01 The testing apparatus required will consist essentially of a noise measuring set, and certain auxiliary apparatus in the form of substation equipment, central office test terminations,

and miscellaneous items of equipment. Each of these classes is discussed below.

3.02 The inclusion of a 10A Noise Analyzer Attachment with the testing apparatus is not imperative. However, if such an instrument is available, the data obtained therewith in the survey will be found to be very helpful in the interpretation of the noise data—as pointed out in Part 1H of this Section.

3.03 In the event that some supplementary measurements of power circuit influence are to be included in the survey—in accordance with the suggestions contained in Paragraph 1.20—a Voltage TIF Coupler* will be needed, together with the ground rods, auxiliary resistance box, etc., required for "probe wire"** measurements.

* Described in Section AB63.477.

** Covered in Section AB63.130.

3.04 The component parts of a network† for simulating the impedances of various lengths of buried "U" wire will also be needed (chiefly in rural areas) if the survey is to include any measurements to determine the noise effects of such buried wire (see Paragraph 2.15 and Item 3 of Paragraph 4.16).

† See Appendices I and II of Section AB63.379.

(A) Noise Measuring Set

3.05 The 2-type Noise Measuring Set is used in making the survey measurements of noise. This noise set also constitutes an important part of the apparatus which is needed when making frequency analyses or the supplementary measurements of influence referred to in Paragraph 3.03.

3.06 Section AB63.399-E40.458 and Section AB63.400-E40.459 cover the description and operation of the 2A and 2B Noise Measuring Set, respectively. The method of using these 2-type Noise Measuring Sets in conjunction with the 10A Noise Analyzer Attachment, the Voltage TIF Coupler, probe wire measurements, etc., is covered in Sections AB63.430, AB63.477 and AB63.130.

3.07 Care should be taken to guard against the possibility of injuring the meter on the 2-type noise set. The "FIL" key should be kept non-operated (pushed in) at all times when the set is not in use, and should not be operated until all connections preparatory to the measurements have been made. Careful handling of the set is particularly important in survey work, where the apparatus is transported between various locations.

3.08 A No. 716A receiver* **and** a 144 receiver will usually be required, as indicated in Paragraphs 1.26 and 3.15. Each of these receivers is to be connected across its proper "REC" terminals of the apparatus of Fig. 1 (on Page 12), so that—by means of the "receiver" key shown in Fig. 1—the "IN" terminals of the noise measuring set can be bridged across either of these receivers, as desired, when measuring "receiver" noise. These two receivers will serve, individually, for monitoring purposes (on an "HA1" or on a "144" basis, as desired) but the primary purpose of each of them is, of course, to provide a proper receiver across which to measure "receiver" noise when using the REC weighting input of the 2-type Noise Measuring Set; namely, an HA1 receiver unit* when using the "HA1" receiver weighting of the (modified) measuring set and a 144 receiver when using the regular "144" receiver weighting of the latter.

* As noted on Fig. 1, the 716A Receiver consists of an **HA1** Receiver Unit in an 11A Receiver Holder.

3.09 During the "station set" noise measurements (including the "bridged" condition), each of the receivers referred to in Paragraph 3.08 should be placed on its cap end, preferably on a piece of felt or similar material. This precaution is necessary to minimize the pickup of any local noises which might influence the accuracy of the measurements being made.

Use of "Modified" Noise Sets

3.10 For reasons which are summarized in Paragraph 1.02 this Section is set up chiefly on the basis that in common battery areas the noise-in-receiver measurements concerned in an exchange survey of the kind described herein will be made on anti-sidetone station sets which employ **HA1** receiver units. Furthermore, in the case of the corresponding measurements of line noise-metallic and noise-to-ground, it is suggested that the noise at each test point be measured with both "F1A" and "144" line weighting.

3.11 As pointed out in Section AB63.399-E40.458 and in Section AB63.400-E40.459, however, the arrangements **regularly** furnished in the 2-type Noise Measuring Set (i.e., in the set as normally manufactured) are, of themselves alone, unsuitable for "line" noise measurements with F1A LINE weighting or for "receiver" noise measurements—across a receiver of the "HA" type—with "HA1" RECEIVER weighting. Information for so modifying 2B (or D-157641) Noise Measuring Sets as to incorporate F1A **line** weighting therein has, of course, been available for some time previous to the present issue of this Section. However, if only a "regularly" arranged (unmodified) 2-type Noise Measuring Set or a set of this kind embodying solely the F1A LINE weighting just referred to (plus the "normal" 144 weightings) were used in an exchange noise survey, the **HA1** receiver noise corresponding to a given test location would have to be arrived at from estimates (per the methods of Section AB63.239, etc.) rather than by direct measurement.

3.12 It is emphasized in Paragraph 1.02 that information and apparatus is now available by means of which the 2-type Noise Measuring Set

can be so modified as to be suitable for measurements of receiver noise directly across receiver units of the "HA" type, while still retaining the regular "144" LINE and RECEIVER weighting inputs and providing the "F1A" LINE weighting referred to in Paragraph 3.11. With a noise measuring set thus modified, both the noise-to-ground (N_G) and the line noise-metallic (N_M) at a given test location can be measured on the new "F1A" basis, as well as on the older "144 line weighting" basis and—furthermore—the "HA1" receiver noise can be measured **directly.** The inclusion of noise measurements on this "1941" (F1A*-HA1) basis will have decided advantages, particularly if it is desired to obtain the maximum usefulness out of the survey noise data—and this Section has been set up accordingly. For example, this procedure will provide a direct measurement of the receiver noise on a now commonly used subscriber set, such as the "302", etc., thus tending to minimize the number of noise "estimates" required and to simplify the process of estimation. In the latter connection, it may be reemphasized here that—as stressed in Part 2 of Section AB63.080—**estimates** of noise should never be used in place of **measurements,** where suitable tests are practicable.

* Certain other reasons which make the "F1A" measurements of value are outlined in Part 7 of Section AB63.477.

3.13 In measuring F1A LINE noise, or **HA1 RECEIVER** noise, with the appropriate weightings of a 2-type Noise Measuring Set which has been suitably modified as referred to in Paragraph 3.12, an adjustment factor of **7 db should,** of course, **be added to the meter reading**—in order to express all noise results in "dba." [In the event that any receiver noise measurements are made across an HA2, HA3 or HA4 receiver unit with such a modified 2-type Noise Measuring Set (using HA1 receiver weighting), the corresponding adjustment factors would be about +4 db, +2 db and —2 db, respectively.] These adjustment factors, together with the reasons which make them necessary, are discussed in detail in Section AB63.399-E40.458 and Section AB63.400-E40.459 (and particularly in the last mentioned Section).

(B) 10A Noise Analyzer Attachment

3.14 Section AB63.430 covers the description and operation of the 10A Noise Analyzer Attachment. The section includes a description of methods of making frequency analyses of noise currents and voltages induced on telephone circuits, as well as for measurements of voltages, etc., on power circuits. Analyses on "probe wires" are covered in Section AB63.130.

(C) Subscriber Station Apparatus

General

3.15 Fig. 1 illustrates, as a matter of information and in a somewhat general way, an arrangement of apparatus which has been found convenient, useful and adequate for facilitating extensive survey work involving various types of offices, both manual and dial. As contrasted with the arrangement shown in the corresponding figure of the immediately preceding issue of this Section, the common battery sidetone (584A) 337-144-46-8A subscriber set has been omitted from Fig. 1 of the present issue (see Paragraphs 1.02 and 3.22) and the following items have been added to the figure: (a) arrangement simulating the 302 subscriber set, (b) a 716A receiver (in addition to the 144 receiver) and (c) a "receiver" key for selecting, at will, the 716A or the 144 receiver across which to measure receiver noise. The 144 receiver has been retained for the present, since this will be needed with the magneto (315H) set, namely, a type of set which will undoubtedly be of importance in many rural areas for some time to come.

3.16 The usefulness of the arrangements shown in Fig. 1 applies also to areas having local battery talking-common battery signaling stations, even though no station set of the latter type is included in the apparatus of Fig. 1. This may be seen from a comparison of the data given for the 684A and 302 subsets in Part 1 of Table A of Section AB63.239 with the information given (for local battery talking-common battery signaling subsets) in Table B of that Section.

3.17 It is not vital that such a test box* be used for the purposes mentioned herein and, furthermore, as indicated in Paragraph 3.15, Fig. 1 is included herein chiefly for purposes of illustration. In this connection it may be noted that in some instances various kinds of switching arrangements, of varying degrees of complexity*, have been used for the purpose in question. On the other hand, a number of the Operating Telephone Companies have found it advantageous to make up test boxes of the same general kind as the one illustrated in Fig. 1, this having been done—in such cases—not only for the sake of convenience and compactness but also to minimize the possibilities of damage and incipient apparatus trouble which always accompany the transportation of numerous individual pieces of equipment loosely in the testing truck or other vehicle.

* Note particularly Paragraph 1.08 and Item "b" of Paragraph 1.15.

3.18 In further connection with the contents of Paragraph 3.17, it is obvious that it might in some cases be practicable to subject the arrangement in Fig. 1 to more or less simplification, depending upon the extent of its proposed field of application and the needs of the specific area to be surveyed. (Also see Paragraphs 1.25, 1.26, 3.12, 3.19, 3.22, etc.) For example, if only one type of subscriber facility needed to be surveyed in that territory, the corresponding subset—and its dial, if a dial is required therewith—might be directly connected between the Line and Ringer keys on one side and the Test key on the other. (Under this

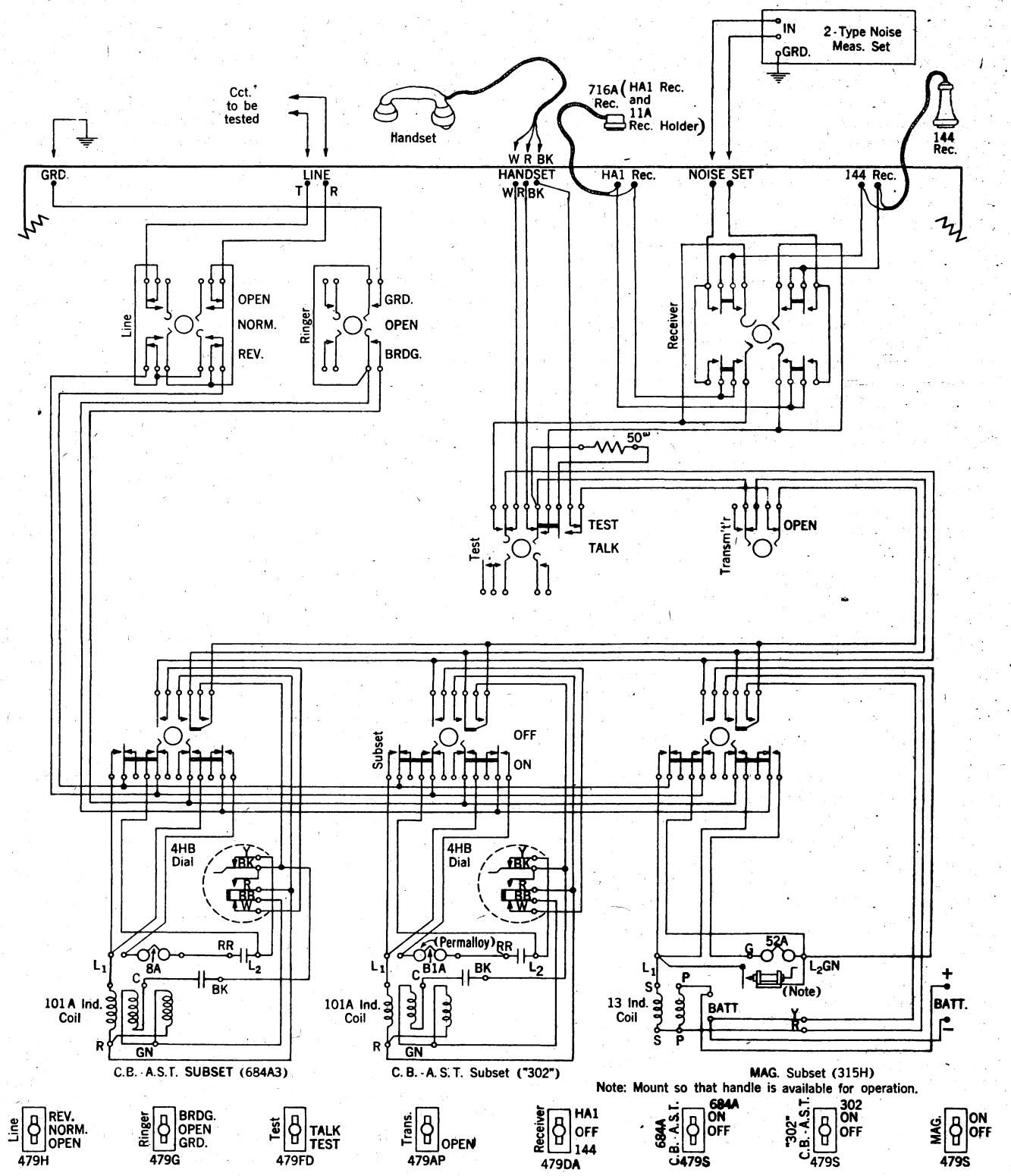

IN
GRD.
2-Type Noise Meas. Set
Cct. to be tested
Handset
716A Rec. (HA1 Rec. and 11A Rec. Holder)
144 Rec.
W R BK
HANDSET
GRD.
LINE
T R
HA1 Rec.
NOISE SET
144 Rec.
Line
OPEN
NORM.
REV.
Ringer
GRD.
OPEN
BRDG.
Receiver
50ω
Test
TEST
TALK
Transm'tr
OPEN
Subset
OFF
ON
4HB Dial
RR
8A
BK
101A Ind. Coil
GN
C.B.-A.S.T. SUBSET (684A3)
(Permalloy)
B1A
C.B.-A.S.T. Subset ("302")
52A
G
L2GN
(Note)
13 Ind. Coil
BATT
MAG. Subset (315H)
Note: Mount so that handle is available for operation.
Line REV. NORM. OPEN 479H
Ringer BRDG. OPEN GRD. 479G
Test TALK TEST 479FD
Trans. OPEN 479AP
Receiver HA1 OFF 144 479DA
684A C.B.-A.S.T. 684A ON OFF 479S
"302" C.B.-A.S.T. 302 ON OFF 479S
MAG. ON OFF 479S

Fig. 1.

condition the three individual subset keys and the other two subsets could be omitted.) However, there usually are advantages in employing the several station set arrangements of Fig. 1, as pointed out in Paragraphs 3.19 and 3.20, and as indicated by the considerations outlined in Paragraph 1.08.

3.19 **Measuring Conditions:** In most common battery exchange areas—where the service nowadays can be expected to be furnished largely via **anti**-sidetone* subscriber station sets—the inclusion (in every such area surveyed) of "HA1" receiver noise measurements with the ringer of the 684A (anti-sidetone) station set of Fig. 1 "grounded" and "bridged," respectively, will usually give the extremes of the possible "HA1" receiver noise range, for anti-sidetone conditions, in the particular area concerned. However, the inclusion of measurements of the **"144"** receiver noise with this same (684A) set will often be helpful (particularly in obtaining some general indication as to the frequency composition of the noise, etc.) when interpreting the significance of the survey data. Accordingly the inclusion of such "144" noise measurements is suggested in subsequent parts of this Section. As indicated in the footnote associated with Paragraph 1.02, the inclusion of measurements of the "HA1" receiver noise on the "302" subset of Fig. 1—a type of set which is now frequently installed—will usually be helpful also, in that a direct measurement of this quantity will be obtained, thus avoiding the necessity of estimating** it from other data. Measurements on common battery subscriber sets of the kind mentioned in this Paragraph—instead of on the "magneto" set alone—will undoubtedly be helpful in rural areas which are to be converted from magneto to common battery or which have already been so converted.

* See Paragraph 1.02.

** See Paragraph 2.07.

3.20 With further, and more detailed, reference to the contents of Paragraph 3.19, it may be noted that the results of the measurements of "receiver" noise on the 684A set alone (of the nature mentioned in that paragraph), when examined **in conjunction with** the corresponding "line" noise-metallic and noise-to-ground measurements (144 and F1A weighting), might—by themselves—often prove reasonably adequate for further engineering considerations in so far as survey results can generally be employed for this purpose. In these subsequent engineering considerations, **estimates*** of the HA1 or 144 receiver noise for various types of anti-sidetone subscriber set having various degrees of susceptiveness intermediate between that of the "bridged" condition and the "common battery anti-sidetone grounded 8A" condition (684A Set) just mentioned may be made with the aid of Table 1 of Section AB63.240, etc., as explained briefly in Paragraph 1.26 (and as mentioned in Paragraph 2.07), particularly where suitable frequency analyses are included in the survey. The inclusion of measurements under the simulated "302 station set" condition of the test box should, however, be of considerable value in minimizing the number of noise quantities which have to be arrived at by means of estimates* (rather than "test"), as already mentioned in Paragraph 3.19.

* The **process** and methods of making such estimates—where they are necessary—are outlined in Section AB63.239.

3.21 All of the measurements mentioned in Paragraph 3.19 can be made with a 2-type Noise Measuring Set which—per Section AB63.399 (for the 2A) or Section AB63.400 (for the 2B)—has been modified to include F1A LINE and HA1 RECEIVER weighting.

3.22 In occasional areas there may still exist, possibly for some time, a considerable number of common battery **sidetone** 534A sets, with grounded 8A ringers. In such instances, measurements of **144** receiver noise with the 8A ringer "grounded" and "bridged," respectively, would usually give the extremes of the possible **"144** receiver noise" range. In the event that it were desired to include measurements of this latter kind—for surveys of such possible sidetone areas—

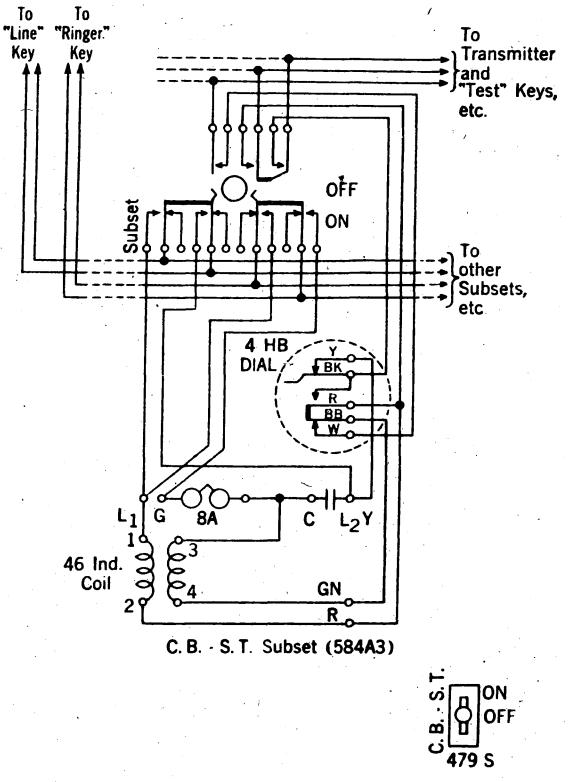


Fig. 1A.

the arrangement shown in Fig. 1A might be added to the test box illustrated in Fig. 1 (or, perhaps, substituted for one of the "subsets" shown thereon if the over-all needs of the particular territory concerned would justify such "substitution"). For reasons which are outlined in Paragraph 1.02, further suggestions as to noise measurements under the "sidetone" subset conditions just mentioned—which were covered in the previous issue of this Section—are omitted from this issue. However, the text material contained in this Paragraph (3.22), as well as the schematic circuit arrangement shown in Fig. 1A, is included herein as a matter of general information.

Details of Test Box

3.23 Further details of the arrangement shown schematically in Fig. 1 are given in Paragraphs 3.24 to 3.30, inclusive.

3.24 The "Line," "Ringer," "Test," "Transmitter" and "Receiver" keys are required in connection with setting up the circuit to be tested and controlling the test condition.

3.25 **Line Key:** This key in the NORM position, connects the circuit through; in the OPEN position, opens the circuit; and in the REV position, reverses the tip and ring. The key contacts are arranged to prevent a break in the connection when the line is reversed.

3.26 **Ringer Key:** This key controls the condition of the ringer, and its three positions GRD, OPEN and BRDG are self-explanatory.

3.27 **Test Key:** This key in the normal position, designated TALK, connects the test subset through to the transmitter and receiver of a hand set, permitting the tester to communicate with the central office operator or distant testman. In the TEST position this key transfers the circuit from the hand set receiver to the noise measuring set, and substitutes a 50-ohm resistance for the transmitter, during the measuring interval. The key contacts are arranged to prevent a break in the transmitter circuit when the resistance is substituted.

3.28 **Transmitter Key:** This key corresponds to the switchhook in a telephone set. In the normal position the transmitter is connected; in the OPEN position, the transmitter circuit is opened. Where the apparatus of Fig. 1 is being assembled for tests exclusively on common battery subscriber lines, this key will not be required, as the OPEN position on the Line key will serve the purpose of disconnecting the set.

3.29 **Receiver Key:** This key serves primarily to select either the HA1 receiver unit* or the 144 receiver (as desired) across which the REC input of the 2-type Noise Measuring Set is connected (per Fig. 7) via the "Noise Set" terminals of the apparatus of Fig. 1. When this key is operated to either the "HA1" or the "144" position, the receiver in question is thereby connected (first) into the receiver circuit of the subscriber set arrangement under test and (then) also across the "Noise Set" terminals of the apparatus of Fig. 1. (For use in a territory in which the "HA" type of receiver is employed exclusively, this key could, of course, be omitted. Under this condition the two connections from the receiver circuit of the subset arrangements could go directly to the "Noise Set" terminals just mentioned and the 716A receiver shown on Fig. 1 could then be bridged directly across these "Noise Set" terminals.)

*Note that, with the arrangement shown on Fig. 1, the HA1 receiver unit is held by the 11A Receiver Holder; these two pieces of "receiver" apparatus—when so assembled—constitute the "716A Receiver."

Check of Ringer Impedances

3.30 There is considerable variation in the impedance of 8A ringers, or of B1A ringers, used with common battery sets and of 52A ringers used in magneto sets. As an aid in selecting suitable ringers for the testing work and also as a check on the apparatus connections it is important that preliminary noise tests of the following nature be made on the station apparatus assembly of Fig. 1 or of any other similar assembly.

(1) Connect the apparatus as shown in Fig. 2 and adjust the oscillator frequency to 420 cycles.

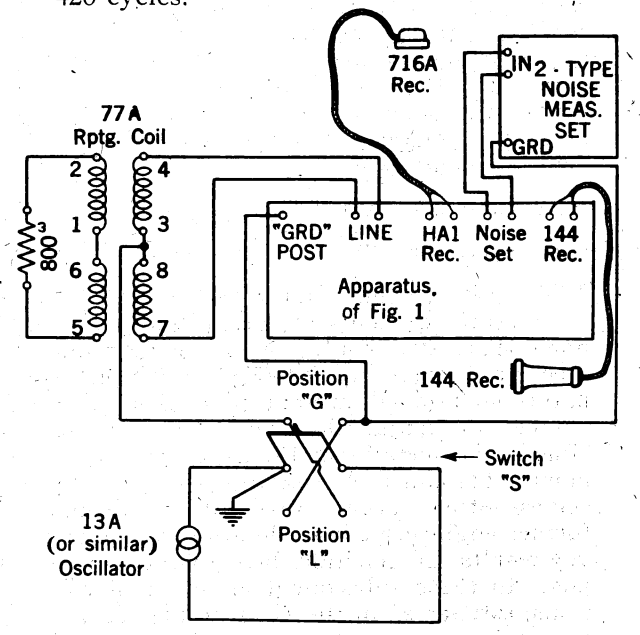


Fig. 2.

(2) Throw Switch "S" to position "G"* and adjust the oscillator output until the noise-to-ground measured with 144 line weighting of the 2-type Noise Measuring Set, connected as shown, is 30 dba. (Check this reading from time to time during the remain-

ing tests to be sure that the oscillator output has not changed.) Under this condition, substantially the following magnitudes of noise should be measured in the receiver of the station sets (using the respective "receiver" weightings indicated in the following):

Station Set	Ringer	Measured Receiver Noise With (Receiver)	(Wtg.)	Meas'd Noise
684A	Grounded	716A	"HA1"	35 dba
"	"	144	"144"	31 dba
"	Bridged	716A	"HA1"	nil
"	"	144	"144"	nil
302	Grounded (Permalloy)	716A	"HA1"	22 dba
"	Grounded (Mag. Iron)	716A	"HA1"	27 dba
"	Bridged	716A	"HA1"	nil
Magneto	Grounded	144	"144"	31 dba
"	Bridged	144	"144"	nil

Note: If, for any reason, a common battery sidetone 584A set with 8A ringer were to be used (per Paragraph 3.22), the "144" receiver noise with the ringer grounded and 30 dba (144 weighting) of 420-cycle noise-to-ground should be about 43 dba, with the test condition covered by this table, and the corresponding "bridged" noise should be nil.

(3) It is important that the ringers be selected such that the measured receiver noise will be very close to the values listed above, (particularly if the survey will not include extensive frequency analyses), since otherwise the subsequent estimates of noise (per Section AB63.239, etc.) for at least some of the types of subsets not included in the tests may be seriously in error. Also if the receiver noise is not negligible in the bridged ringer condition check for incorrect wiring, crosses, etc. However, since in this test all wiring except that associated with the "ringer" key is at ground potential, a better check of the overall wiring is furnished by the test described in Paragraph 3.31.

***Caution: For reasons which are discussed in Part 4 of Section AB63.240, it is highly important that care be taken to place Switch S in position "G" when checking the ringer impedances (and the apparatus connections) by the methods outlined in this paragraph (3.30). With this switching position, the midpoint of the repeating coil shown in Fig. 2 is grounded and the ungrounded side of the oscillator is connected to the GRD post of the test box (corresponding to the terminal of the ringer normally grounded). In connecting up the apparatus of Fig. 2, the GRD post of the 2-type Noise Measuring Set is connected to the GRD post of the test box (instead of to ground); this means that both of these GRD posts are left ungrounded (except through the oscillator) for the "ringer" tests in question. (Also keep case of noise set free from accidental grounds in this test.)**

Check of Wiring "Balance"

3.31 To check the balance of the wiring (including possible adverse coupling effects therein), throw Switch "S" to position "L". In this test the bulk of the wiring is at oscillator output potential and the ringer ground is at ground potential. The measured noise for the grounded and bridged ringer conditions (with the same noise to ground; i.e., 30 dba) should be essentially the same as read above with Switch "S" at position "G". The more critical part of this test (assuming that a ringer of proper impedance has been selected) is the receiver noise observed in the bridged ringer condition. Every reasonable effort should be made to reduce the receiver noise under this condition to an unmeasurably low value.

(D) Central Office Test Arrangements

Note: Test terminations of 800 ohms are shown in this Section because there are many now in the plant. However, any value between 600 and 800 ohms will be satisfactory. In the magneto office termination, the value of the resistance between the midpoint of the termination and ground may be retained at 100 ohms for any value of the termination without affecting the results.

3.32 **Manual Office Test Termination:** Figs. 3 and 8 show the arrangement which may be employed in manual central offices for terminating the circuits.

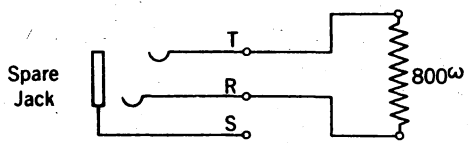


Fig. 3.

3.33 The termination consists of an 800-ohm resistance wired to the tip and ring of a jack. The particular type of jack to be used depends upon the type of switchboard and the following is suggested for certain of the various types of manual switchboards.

(1) Nos. 9C, 9D, 11 and 12 switchboards. Use a spare answering jack and remove the equipment normally connected to the tip and ring before connecting the 800-ohm resistance.

(2) Nos. 1, 1C, 1D and 10 switchboards. Use a spare subscriber line multiple jack in the "A" board and provide a suitable sleeve resistance depending upon the type of switchboard.

(3) Nos. 1, 1C, 1D and 10 switchboards having partial or 100 per cent. trunking. Use a spare interposition or local terminating jack

at the "A" board and provide a suitable sleeve resistance depending upon the type of switchboard.

3.34 **Dial Office Test Termination—General:** Figs. 4 and 8 show an arrangement which can be employed generally, in the various types of dial central offices (whether step-by-step,* panel or crossbar), for terminating a circuit on which exchange survey noise measurements are being made. If—for example—the arrangement shown

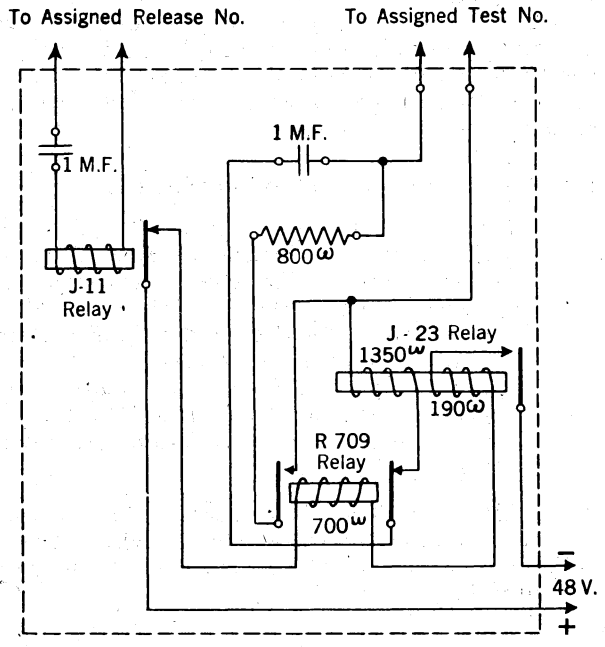


Fig. 4.

in Fig. 4 were to be transported by the test crew (that is to accompany them in their travel from one central office to another), this assemblage of relays, 800-ohm resistance, etc., might be of the "bread-board" type.

* Also see Paragraphs 3.39-3.40.

3.35 Where use is made of the terminating arrangement shown on Fig. 4, two spare final multiple, directory number or connector multiple terminals are required at the central office; namely, one to be assigned to the 800-ohm termination (assigned test number) and the other to the J-11 Relay and 1 mf condenser (assigned release number) required for releasing the 800-ohm test termination at the completion of the test. The normal 48-volt office battery supply should be connected to the apparatus. Proper sleeve connections, not shown in Fig. 4, should be made at the I.D.F. when using the arrangement illustrated on the figure just mentioned. The nature of these sleeve connections, as well as certain important items concerning the other wiring which needs to be associated with Fig. 4, at the central office, are summarized in the following:

(a) In **panel** offices, the sleeves of the assigned test and release numbers, respectively, should be cross-connected to spare cut-off relays wired for "individual service." Do not cross-connect the tip and ring leads to the line relay equipment.

(b) In **cross-bar** offices, the assigned test and release numbers should be wired to spare line equipment arranged for "terminating service only."† The assigned directory numbers should be connected on the block relay frame, as a "ring party" designation.

† Omit "R" and "RR" wiring.

(c) When the arrangement shown on Fig. 4 is used in **step-by-step*** offices, the sleeve of the assigned test and release numbers, respectively, should be cross-connected to spare cut-off relays wired for the "idle line" condition. Do not cross-connect the tip and ring leads to the line relay equipment.

* Also see Paragraphs 3.39-3.40.

3.36 With further reference to details of the operation of this arrangement (of Fig. 4) in the course of the survey noise measurements on any particular pair (test circuit) at any given test point, it may be noted that when the tester "hangs up"—as, for example, by opening the "line" key of Fig. 1—after completing his noise measurements on the test circuit, the 800-ohm termination can, when desired, be released by reconnecting one of the dial subset arrangements of Fig. 1 to this **same** test circuit and then dialing the assigned "release" number therewith. This is due to the fact that, under the "hang up" condition just mentioned, all of the central office equipment drops off except the final selector or connector corresponding to the assigned **"test"** number (and hence, of course, the 800-ohm termination associated therewith). Therefore, the subsequent dialing of the assigned "release" number—via the "noise-test" circuit in question—will actuate the J-11 Relay shown on Fig. 4 and thus release the R709 Relay and hence the 800-ohm termination shown in Fig. 4.

3.37 CAUTION: In "FLAT RATE" areas, the arrangement illustrated in Fig. 4 may be connected directly to the subscriber line circuit. In "MESSAGE RATE" areas, or areas having some message rate lines, direct connection of the 800-ohm test termination to the subscriber line circuit would set up charge conditions against each "working" message rate line from which a noise test of the nature discussed herein is made. If it is practicable to make use solely of spare pairs* in any such specific area, the setting up of this charge condition can, of course, be avoided therein. (Also see Paragraph 3.38.) Where a spare pair is used it must, of course, be cross-connected—in the central office—to a spare line relay equipment. This must be a different spare relay equipment than that used for cross-connection of the sleeve

circuit associated with either the "assigned test number" or the "assigned release number." (IMPORTANT: Do not **multiple** spare pairs for such test purposes. In general, this means that the tip and ring cross-connection—at the M.D.F.—from a given spare pair "A" to the assigned test number will have to be changed from test pair "A" to spare "test" pair "B" when the tester has finished his "outside" measurements on pair "A" and is moving to a test location involving measurements on spare pair "B".)

* That is, in accordance with the general suggestion contained in Paragraph 1.10.

3.38 In the event that it is necessary, or desired, to employ some "working" message rate lines, as test circuits, for exchange noise survey measurements it will be necessary—in areas of the kind just mentioned in Paragraph 3.37—to provide a "free line" circuit; this circuit to be connected between the 800-ohm test termination (of Fig. 4) and the subscriber line circuit, so as to prevent setting up a charge condition, such as referred to in Paragraph 3.37, against the message rate subscriber lines on which the survey tests are made. In **step-by-step** offices,** special free line levels are usually available which may be used for this purpose. In **panel** offices, a free line circuit per SD-21296-01, or its equivalent must be provided. As panel equipment is usually confined to the larger metropolitan offices, a spare free line circuit may usually be found or one may be made available for the definite period required for the survey. In either step or panel offices it will not be necessary to use a free line circuit in connection with the release line assignment; as this is only a ringing bridge and will not establish a charge condition.

** Also see Paragraphs 3.39-3.40.

3.39 **Step-by-Step Offices—Specific:** In certain specific step-by-step office areas—namely, in step-by-step areas where no exchange noise measurements are to be made on message rate subscriber lines—it will be feasible, if desired, to employ a simplified test termination (at the central office) which obviates the necessity of having the separate assigned "test" and "release" numbers referred to in Paragraph 3.35. The simplified termination just referred to requires only one spare connector terminal but it **is essential** that this connector terminal be located in a group which **is arranged for calling party control.** (Also see Paragraph 3.40.)

3.40 With the termination arrangement mentioned in Paragraph 3.39, the termination itself is essentially the same (electrically) as the one already illustrated in Fig. 3. In brief the tip and ring connections "T" and "R," are brought from the "assigned test number" at the I.D.F. to the "T" and "R" connections of the 800-ohm termination shown in Fig. 3. (Do not cross-connect the tip and ring leads to the line relay equipment.)

In addition, proper sleeve connections (details omitted in Fig. 3) should be made at the I.D.F. when using this simplified arrangement and, in this regard, it may be noted that this sleeve connection should be arranged for the "idle line" condition.

3.41 **Magneto Office Test Termination:** Figs. 5 and 8 show the arrangement employed in magneto switchboards for terminating the circuits.

3.42 A spare jack in the switchboard is used and two 400-ohm* resistances are connected in series across the line terminals of the jack at the main frame. A 100-ohm resistance is connected from the midpoint of the 800-ohm termination to ground. The figure indicates the condition for non-multiple magneto boards where the line is connected across the tip and sleeve of the jack. In multiple magneto boards the line is connected across the tip and ring of the jack.

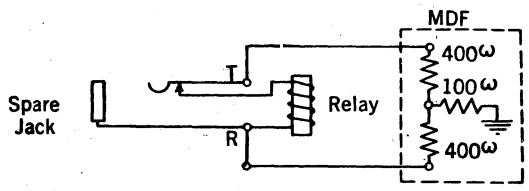


Fig. 5.

* It is unnecessary that the respective values of these two resistances be exactly 400 ohms apiece. However, to minimize the possibility of metallic-circuit noise arising from longitudinal currents flowing in the termination shown in Fig. 5, it is desirable for the respective actual values of the nominal 400-ohm resistances not to differ from each other by more than about 0.5 ohm. (A small "building-out" resistance may thus be required for such purposes, in some instances.)

3.43 **Test Cord Circuit:** Fig. 6 shows a schematic of a test cord circuit required in connection with tests on interoffice trunks equipped with long outgoing trunk equipment.

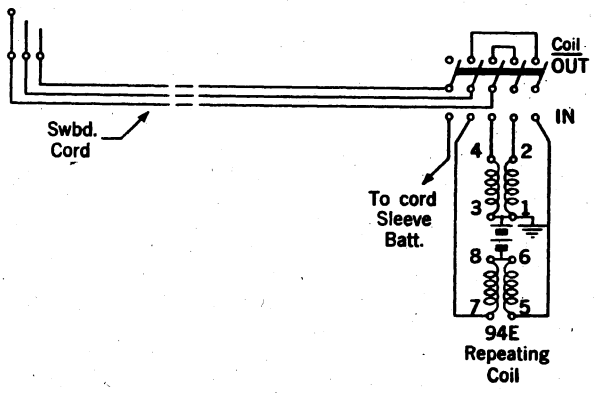


Fig. 6.

3.44 The equipment shown in Fig. 6 consists of a 94E repeating coil, a five pole DT switch and a switchboard cord. Mounting this assem-

blage on a suitable board will be found to be of convenience. When this arrangement is in use, leads from the regular cord battery bus can be connected to the midpoints of the coil so as to supply the talking battery.

(E) Miscellaneous Apparatus

3.45 The following miscellaneous apparatus will be found necessary and convenient in the conduct of the tests made on cable terminals and open wire extensions on subscriber lines.

Direct-current blocking device shown in Fig. 11 of Section AB63.379. The corresponding discussion in the Section just mentioned pertains primarily to the use of this device in frequency analyses on exchange circuits in general. Two of the main purposes of using the device in preliminary exchange noise surveys of the nature discussed herein are:

(a) The "make-before-break" contact arrangements of its switching key prevent a break in the connection when switching the noise measuring apparatus from the receiver of the subset to the line itself, thus retaining the supervision during the operation of the key.

(b) The retard coil "L" (of the device in question) serves as a holding coil when frequency analyses are being made or when the plug of the 2-type Noise Measuring Set is being moved from the LINE to the N-GND jacks, and vice versa.

The purpose of the blocking condensers (when frequency analyses are being made) is outlined in Part 3.6 of Section AB63.379.

Other Apparatus: Test leads for connecting test set in a test car to the cable terminal—at least 30 feet of paired lamp cord.

A D-81760 hand test set in common battery areas, and a 17-type test set in magneto areas.

Ground leads for connecting apparatus to ground at test locations—say about 20 feet long, of lamp cord.

Ground rods and tools for driving and pulling at locations where other suitable grounds are not available.

Caution: In choosing subscriber set or noise measuring set grounds, care must be taken to keep such test connections away from power-circuit connections to earth, and from grounds used for cable-sheath shielding (or sheath grounding) purposes, since any harmonic currents in grounds (or ground electrodes) of the latter nature will tend to result in ground potential effects giving misleading results in the noise measurements.

4. MEASUREMENTS ON SUBSCRIBER CIRCUITS

(A) General

4.01 The subsequent paragraphs of this subsection contain suggestions which are based upon previous experience with a considerable number of surveys. These suggestions should not be considered as rigid rules, as they are in part included for illustrative purposes. The exercise of good judgment is still necessary for each specific instance and individual survey.

4.02 While there will undoubtedly be a number of instances where it will be necessary to use "working" pairs in noise surveys, an effort needs to be made, as previously emphasized in Item 9 of Paragraph 1.16, to minimize the time during which such circuits are out of service. Only individual lines or "one-party-working" lines are chosen in so far as practicable (Par. 2.08). (This latter statement applies more particularly to urban and suburban areas, in which types of area there is usually some chance of selecting such circuits; in rural areas, on the other hand, such a choice is not always offered.)

Cable Areas

4.03 After the cable terminals to be used as test locations have been determined, the telephone numbers of two or three subscriber lines working from those terminals are selected from the central office records and a note made of the pair count of these lines at each such cable terminal.

4.04 In setting up a circuit for test at a particular cable terminal:

(a) It is usually unnecessary* to open the drop on a pair which furnishes **individual line** service **except** where the drop is an open wire extension which is exposed to a power circuit.

* However, it is important to note that if the drop is **not** disconnected, a false noise reading can result under the BRDG condition of the subset in the test box in the event that the receiver at the subscriber station itself becomes removed from its support.

(b) On a pair furnishing party line service it is highly desirable to eliminate** the effect of the grounded ringers at the subscriber stations, during the survey measurements on that pair, and this can be done by disconnecting** the drops temporarily. In the case of "one-party-working" lines, or even in the case of a line feeding two-party service with both drops originating at the same aerial terminal, such disconnection** should present little difficulty.

** Also note contents (re multi-party areas) of last part of Paragraph 2.08, together with Item 9 of Paragraph 1.16 (re previous arrangements before opening drops).

(c) The treatment of drops on rural open wire circuits and long **open wire** extensions in suburban areas is outlined in Paragraph 4.09.

4.05 After the completion of the measurements at any particular location it is, of course, desirable that the test desk be called and notified of the lines measured so that they can be tested to make sure that the disconnected drops have been reconnected properly and any irregularities found can be corrected immediately.

4.06 If when making measurements, it is observed that the noise varies widely (as for example, in areas involving exposure to trolley feeders or where the noise is affected by trolley or railroad rectifier harmonics, trolley current through power transformers, etc.) data of the following types should be obtained.

(a) Frequency of occurrence of noise peaks.

(b) Maximum, minimum and "sight average" noise ("sight average" being the value which it is estimated is expected about 50 per cent. of the time).

In such areas also it is particularly desirable to make a few measurements at various times of the day to be certain that the total range of noise is covered.

4.07 In making noise measurements at night on telephone circuits the data should include a qualitative note as to the relative magnitudes of the inductive effects from the street lighting circuits.

Open Wire Extensions

4.08 **From Cable:** Normally, several open wire extension locations will have been selected for test in the basic survey plan, as outlined in Paragraph 2.14. It may be found desirable to augment these locations, depending on the results of measurements at cable terminals which serve open wire extensions, based on the following considerations:

Where a test location on an open wire line, served from a cable terminal having a measured noise-to-ground greater than perhaps 20 to 23 dba or so, has not been included in the list of survey locations, make noise measurements at a point near the "far end" of the longest extension.

4.09 In making the noise measurements on open wire extensions, including rural exchange circuits, the procedure will be essentially the same as covered in the following paragraphs for cable terminals, **except** that with the open wire:

(a) The drops on working party lines will usually remain connected and

(b) It will generally be advisable to measure the receiver noise with the "line" connection to the ringer both "normal" and "reversed" when the ringer key is in the GRD position.

(B) Station Conditions Simulated

4.10 Experience to date indicates that, at each test location, it is desirable to make noise measurements covering the conditions listed in Table 1, on Page 21.

4.11 Where an analyzer attachment is available, it is advantageous to analyze both the line noise-metallic and the noise-to-ground, as a component part of the noise measurements covered by Table 1—at least at a substantial portion of the test points. [When a given frequency has been detected, the inclusion of **both** of these components—instead of only the noise-to-ground—usually involves merely the changing of the "circuit switch" of the analyzer from "ANAL N_G" to "ANAL 600^W" (or vice versa) and the readjustment of the "db" dial of the noise set, the frequency setting of the analyzer remaining practically unchanged in the case of any individual frequency.]

(C) Connections of Testing Apparatus

4.12 Fig. 7 (on Page 20) shows schematically the connections of the 2-type Noise Measuring Set, the 10A Noise Analyzer Attachment, the blocking device referred to in Paragraph 3.45 and the apparatus of Fig. 1 for noise measurements, as well as for frequency analyses of the line noise, on subscriber circuits.

4.13 The method of operating the noise measuring set and the analyzer attachment is described in other information already referred to herein (Paragraphs 3.06, 3.14, etc.) but is summarized, for convenience in reference, in the tabulation following Fig. 7. The method of calibrating the analyzer attachment—noise measuring set combination, and of computing the single-frequency noise contributions from the results of the harmonic analysis, is described in Section AB63.430. The importance of making an immediate field computation of the contribution of each frequency observed in the harmonic analyses of noise-to-ground and line noise-metallic is stressed in Part 7.2 of Section AB63.379, which also outlines the reasons for making such check computations.

4.14 In the event that a noise analyzer attachment is not available, terminals 7 and 8 of the blocking device shown in the middle of the left-hand side of Fig. 7 should, of course, be connected to the IN terminals of the noise measuring set.

(D) Testing Procedure

4.15 Fig. 8 shows an over-all schematic of the apparatus, cable pair and central office circuits for noise tests on subscriber lines made at a

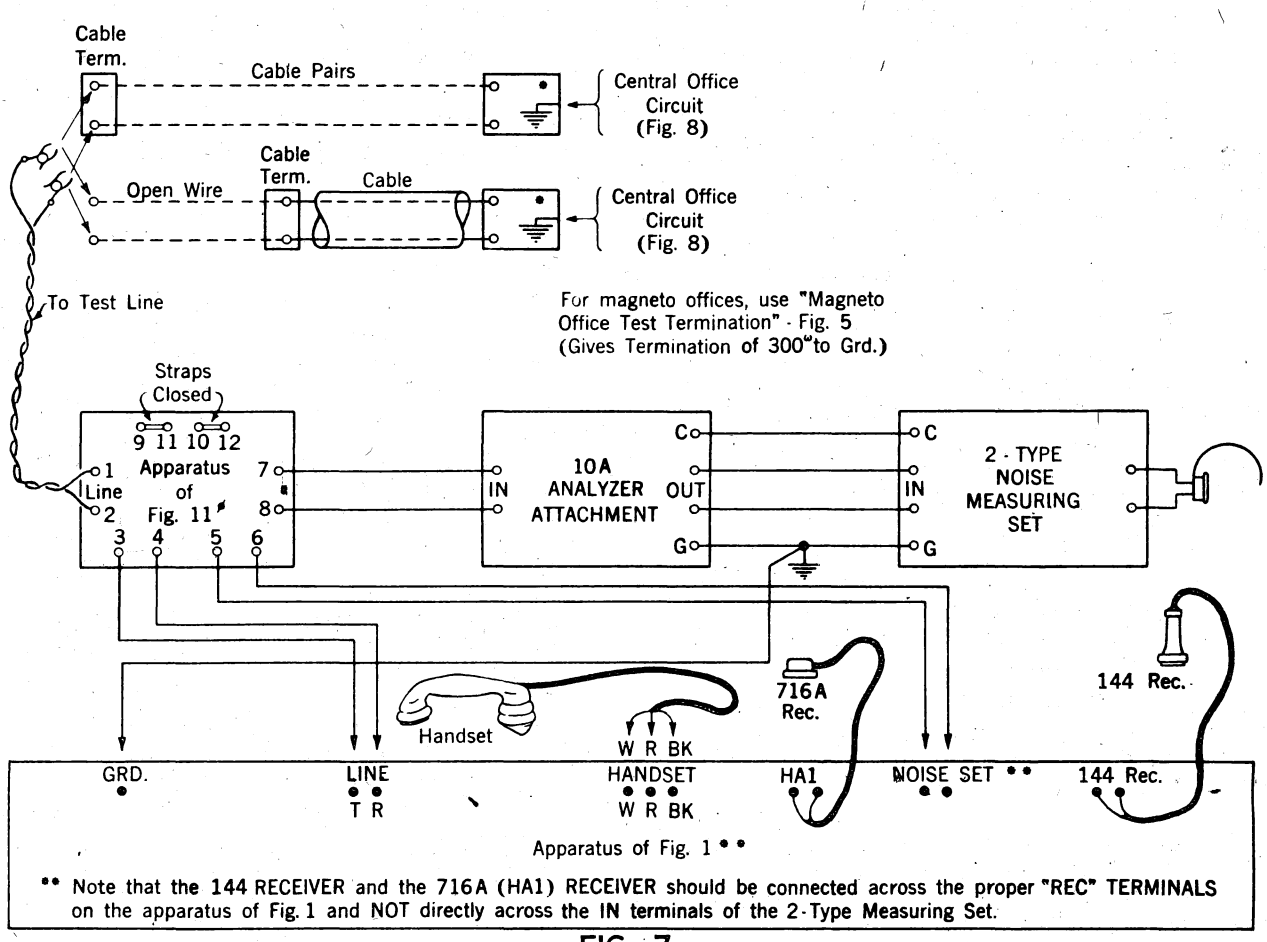


FIG. 7

Operation	Key of D - C Blocking Device (Fig. 11)⸗	Cct. Switch of Analyzer Attachment	2B Noise Measuring Set † Input Plug	K3	2A Noise Measuring Set Input Plug
CALIBRATING NOISE SET	—	Noise Cal.	Line	Normal	Line
NOISE MEASUREMENTS					
SUBSET: §					
Meas. RECEIVER NOISE	Normal	Noise Meas.	Receiver	Normal	Receiver
LINE NOISE					
Meas. Noise - to - Ground	ANAL. OR MEAS. LINE NOISE	Noise Meas.	N - GND	Normal	N - GND
Meas. Noise - Metallic	ANAL. OR MEAS. LINE NOISE	Noise Meas.	LINE	Normal	LINE
HARMONIC ANALYSES					
CALIBRATING ANALYZER ATTACHMENT	—	ANAL. CAL. (Tuned for 1020 Cycles M - 2 - 1 - 80)	LINE - with Dummy Plugs in SOUND	FLAT	SOUND
ANALYSIS of LINE NOISE					
Anal. Noise - to - Ground	ANAL. OR MEAS. LINE NOISE	ANAL. N_G	LINE - with Dummy Plugs in SOUND	FLAT	SOUND
Anal. Noise - Metallic	ANAL. OR MEAS. LINE NOISE	ANAL. 600Ω	LINE - with Dummy Plugs in SOUND	FLAT	SOUND

† Also Applies to the D - 157641 Noise Measuring Set.
§ Refers to Settings for Measuring Receiver Noise (a) with Ringer BRIDGED or (b) with Ringer GROUNDED, as may be Required by the Detailed Procedures of Parts 4, 5 and 6 of this section.
⸗ Fig. 11 of Section AB63.379.

Fig. 7.

TABLE 1

Noise To Be Meas'd On	Test Box Ringer Connection	2-Type Noise Meas. Set Weighting		
		Kind	Character	
144 Receiver of 684A Subset	GRD*	Receiver	"144"**	—
" " " " "	BRDG*	"	"144"	—
716A " " " "	GRD*	"	—	"HA1"***
" " " " "	BRDG*	"	—	"HA1"
716A Receiver of "302" Subset	GRD*	"	—	"HA1"
" " " " "	BRDG*	"	—	"HA1"
Line (Pair itself) Metallic-Circuit†	—	LINE	"144"	"F1A"
Noise-to-Ground†	—	N-GND	"144"	"F1A"

* In general, it will be helpful to measure receiver noise (under the GRD and BRDG ringer condition) with both 684A and "302" sets in all areas, for the specific "receiver" conditions indicated above. Also include 315H (with 144 receiver weighting) in magneto areas. (On test pairs where it is impracticable to remove existing grounded ringers—Paragraph 4.09—measure with ringer in test box both "normal" and "reversed," under the GRD condition.)

** 144 "line" or "receiver" weighting regularly incorporated in all 2-type Noise Measuring Sets.

*** F1A "line" weighting or "HA1" receiver weighting (as may be required) in sets modified for these weightings per Section AB63.400 or Section AB63.399. (See Paragraphs 3.10-3.13 of this Section.) Note that when using these F1A-HA1 weightings, **the corresponding meter reading should be corrected by +7 db** before recording the **"F1A"** LINE noise measurements or the HA1 RECEIVER noise measurements in the field data. This is done in order to express all noise data in "dba."

† "Line" noise-metallic and "noise-to-ground" to be measured directly on the pair itself, with the aid of the switching arrangement referred to in Items (a) and (b) of Paragraph 3.45 and in Paragraph 4.12.

cable terminal. This setup and the following test procedure are, in general, equally applicable for such tests when made from open wire extensions or open wire rural exchange circuits. [A simplified 800-ohm terminating arrangement which might, in some cases, be employed in certain specific **step-by-step** areas (rather than using the termination for a "DIAL C.O." illustrated schematically in Fig. 8) is described in Paragraphs 3.39-3.40.]

4.16 **Test Procedure:** The following items are included to illustrate, in general, the successive operations which might, for example, be taken in carrying out the survey noise measurements on an exchange line at a test location.

(1) Bridge the apparatus on the circuit and, with the transmitter key "open," monitor to insure that the circuit is not busy. As soon as the circuit can be secured, verify the telephone number and type of service and have the central office termination set up (or dial it, as the case may be).

(2) Open the subscriber loop, if necessary, (as outlined previously) and make the measurements as called for in Table 1, above.

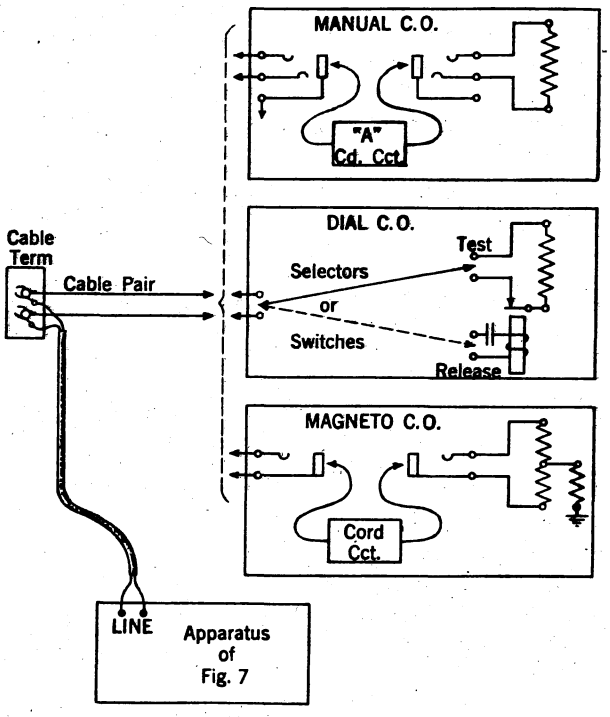


Fig. 8.

While the order in which these tests are made can be changed to suit local conditions, it is believed that the following order will often be found to be convenient in common battery areas.

Test No.	Type of Subset	Type of Receiver	With Ringer	Measure	Noise Set Weighting
1	*	—	*	N-Gnd.	144
2	*	—	*	N-Gnd.	F1A
3	*	—	*	N-Met.	144
4	*	—	*	N-Met.	F1A
5	684A	144	Gr.	N-Rec.	144
6	684A	716A	Gr.	N-Rec.	HA1
7	684A	716A	Br.	N-Rec.	HA1
8	684A	144	Br.	N-Rec.	144
9	"302"	716A	Gr.	N-Rec.	HA1
10	*	*	*	Analyze N_M & N_G	**

* With 479-FR key in Fig. 7 thrown to "Analyze or Measure Line Noise."

** See Fig. 7 for noise set arrangements.

(3) In addition, if the test point is at the "near" end of a section of buried U wire (such as point "e" in Paragraph 2.15) make tests to determine the effect of the U wire as discussed in Part 3.5 of Section AB63.379.

(4) Disconnect central office termination, restore the subscriber loop to normal and get a check from the test desk on conditions as left.

(5) Repeat for second test pair.

(6) Before leaving a test location where frequency analyses are made, it usually is desirable to check the r.s.s. of the individual components against the measured over-all noise to insure against errors, as described in Section AB63.379.

4.17 The nature of the corresponding noise measurements for magneto areas is indicated in the single-starred footnote accompanying Table 1 (Page 21).

5. MEASUREMENTS ON TRUNK CIRCUITS

(A) General

5.01 The survey measurements which are made on trunk circuits usually consists of:

(a) "Bridged" noise-in-receiver measurements on a subscriber telephone set (684A* set in the test box) connected through the regular central office facilities to an outgoing trunk which at the distant end (i.e., the "distant" central office) should be connected through to another subscriber station set. (For details, see Part 5B.)

* Note: The 684A set is suggested, since from the measurements on this set which are outlined in Part 5B of this Section, reasonably good approximations can, if required, be obtained of the corresponding BRDG noise in various other types of set which employ either the HA1 type of receiver unit or 144 or 557 receivers. This is particularly true of estimates of this kind which may be made for common battery subsets of the anti-sidetone type employing 101-type induction coils. (For details regarding estimates of the nature referred to in this footnote, see Sections AB63.375 and AB63.239.)

(b) Measurements of "line" noise-metallic* (i.e., noise at subset, in "measuring" office)—See Part 5B. The inclusion of frequency analyses in these measurements is desirable as indicated in Paragraph 5.07.

* Note: These measurements will be helpful not only as a means of obtaining a cross check upon the measured values of "BRDG" receiver noise referred to in Item "a" of this Paragraph (by the methods outlined in Section AB63.239) but also in any estimates which are to be made of the BRDG receiver noise for various types of set (referred to in the footnote accompanying Item "a") by means of the methods outlined in Section AB63.375 (particularly when using Table 4 of that Section).

(c) Noise-to-ground measurements on the trunk conductors. Such measurements may include frequency analyses, as indicated in Part 5C of this Section.

5.02 It will be necessary to have an associate tester in the distant office to attend the telephone set in that office, so that he can:

(1) provide a termination for the measurements on outgoing trunks or

(2) originate calls to the measuring station for the purpose of measuring the incoming trunks.

5.03 The apparatus of Fig. 7 will be found convenient for use in the "subscriber station" setup at the measuring office.

5.04 In the measurements the tester should be on the alert for evidence of noise from internal sources. Where the receiver noise is high and the noise-to-ground is quite low, or where the noise on incoming trunks is about the same or higher than on outgoing trunks, internal noise would be suspected. Monitoring tests made during the measurements should also help to indicate the presence of such noise.

(B) Measurements of Noise-in-Receiver, Noise-Metallic and Frequency Analyses

Interoffice Trunks Not Having Long Outgoing Trunk Equipment

5.05 Fig. 9 shows a schematic of the over-all layout for tests on interoffice trunks having long outgoing trunk equipment. This arrangement is applicable between all types of offices at the "A" office end. It is advisable to connect the testing apparatus to a spare subscriber line which is

connected to normal equipment, so that calls may be placed or received on this line.

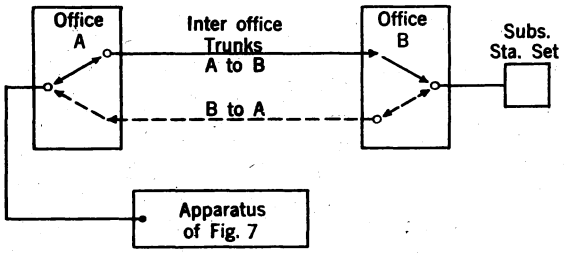


Fig. 9

5.06 At both offices, the substation apparatus used for the test purposes in question should be so located as to minimize the length of wiring (corresponding, substantially, to "zero loop").

5.07 **Test Procedure:** The following items are illustrative of the general procedure and the successive operations which might, for example, be employed in carrying out the measurements (of receiver noise and noise-metallic) on trunks of the kind referred to in Paragraph 5.05:

(1) At office "A" (Fig. 9), connect the line terminals of the blocking device (Fig. 7) to the spare subscriber jack which has been assigned (for such test purposes) in the switchboard. Connections corresponding to "outgoing" and "incoming" call conditions are then to be set up—for the respective tests outlined in Item 2—about as follows:

(a) To simulate "outgoing" call conditions, call the "test" station location in Office B in the usual manner. Obtain the position number of the operator at A, together with the cord and trunk number which she is using in completing the test call.

(b) When "incoming" calls to Office A are being simulated, the associate tester in Office B calls the test location in Office A and secures from his operator (Office B) (if a manual office) the position, cord and trunk number she is using to complete the call. This information is, of course, passed to the tester at Office A as soon as practicable, to complete the test data.

(2) When the desired call condition has been set up, the tester at Office A will make the measurements outlined in the following tabulation. The order in which these tests are made may vary with local conditions, although the following order has been found to have advantages.

Test No.	Type of Call	Subset Condition in Test Box at "A" Type	Ringer	Rec.	Measure	Noise Set Wtg.
1	Outgoing	684A	Brdg.	144	N-Rec.	144
2	Outgoing	684A	Brdg.	716A	N-Rec.	HA1§
3	Outgoing	*	*	—	N-Met.	144
4	Outgoing	*	*	—	N-Met.	F1A§
5	Outgoing	*	*	—	Analyze N_M†	**
6	Incoming	*	*	—	Analyze N_M†	**
7	Incoming	*	*	—	N-Met.	144
8	Incoming	*	*	—	N-Met.	F1A§
9	Incoming	684A	Brdg.	144	N-Rec.	144
10	Incoming	684A	Brdg.	716A	N-Rec.	HA1§

Caution: For all of these tests, request the associate tester at Office B to hold his hand over the transmitter, and also to muffle the receiver, for the intervals during which the measurements at "A" are being made.

* With 479-FR key in Fig. 7 thrown to "Analyze or Measure Line Noise."

** See Fig. 7 for proper arrangement of noise set, analyzer attachment and d-c blocking device.

§ As per Paragraph 3.13, the meter reading of line noise with **"F1A"** LINE weighting—as well as the meter reading of receiver noise across the 716A receiver (**HA1** receiver unit) with **"HA1"** RECEIVER weighting—**should be corrected by +7 db** before recording such measurements in the field data. This is done in order to express all noise data in "dba."

† In the case of trunk circuits, it is advisable to make the frequency analyses of noise-to-ground separately from those of noise-metallic. Noise-to-ground analyses on trunks are discussed in Part 5C of this Section.

(3) Before releasing the trunk under test it is usually desirable—as a part of the frequency analyses—to check the r.s.s. of the individual components against the measured over-all noise-metallic so as to insure against errors, as described in Section AB63.379.

(4) Repeat tests of Item 2 for a second trunk in the group, etc., as may be considered necessary or desirable in the particular case (see Part 2C).

Interoffice Trunks Equipped With Long Outgoing Trunk Equipment

5.08 Where the interoffice trunks are equipped with long outgoing trunk equipment, it is necessary to provide for making the measurements with and without the regular switchboard cord circuit at the testing end on outgoing trunk connections. Some auxiliary equipment, shown in Fig. 6, is needed at the "A" office end, in addition to the usual testing apparatus shown schematically on Fig. 9.

5.09 As indicated in Fig. 10, it is advisable that the testing apparatus be set up at a spare position in the "A" switchboard. At the office "B" end, the arrangement is the same as that indicated in Fig. 9.

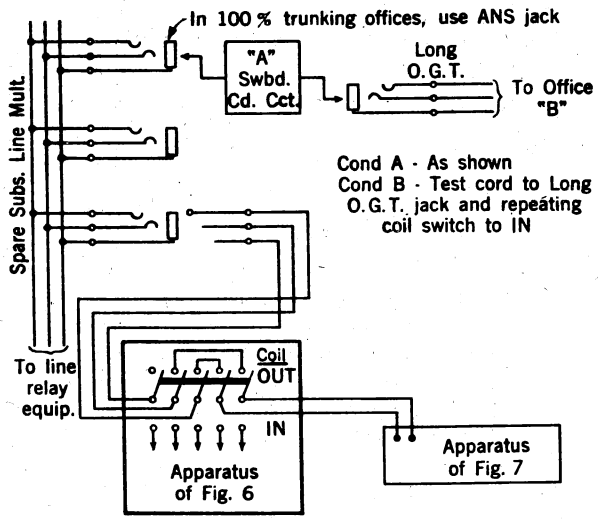


Fig. 10.

5.10 **The Test Procedure,** etc., will be about as shown in Table A, below.

5.11 With further regard to the tests listed in Paragraph 5.10, it may be noted that in Tests 1-5, where the repeating coil switch is in the OUT position, the talking battery at the "measuring" end—Office "A"—is supplied by the regular "A switchboard cord circuit" indicated in the upper part of Fig. 10. On the other hand in Tests 6-9, where the repeating coil switch is in the IN position, the talking battery at the measuring end is supplied through the repeating coil arrangement shown in Fig. 6. The reference to "Subscriber Multiple Jack for Assigned Test Number" which appears in the third column of the tabulation—namely, opposite Tests 1-5—signifies a jack associated with a spare subscriber line multiple which also appears in the "B" positions at the testing Office "A" (so that this multiple may be used in Tests 10-13, as well as in Tests 1-5).

5.12 It is evident that Tests 1-5, listed in Paragraph 5.10, involve the condition referred to as "Condition A" on Fig. 10, while tests 6-9 involve "Condition B" per that figure.

Tandem Trunks

5.13 Measurements are also made on outgoing and incoming tandem trunks at the testing office, in the same general manner as for interoffice trunks described in preceding paragraphs. Suitable arrangements will have to be determined in

TABLE A

Test No.†	Type of Call	Connect Test Cord Into	Position of Rptg. Coil Sw.	Subset Condition in Test Box at "A" Type	Ringer	Receiver	Measure	Noise Set Weighting
1	Outgoing	Sub. Mult.	OUT	684A	Brdg.	144	N-Rec.	144
2	"	Jack	"	684A	Brdg.	716A	N-Rec.	HA1§
3	"	for	"	*	*	—	N-Met.	144
4	"	Assigned	"	*	*	—	N-Met.	F1A§
5	"	Test No.	"	*	*	—	Analyze N_M	**
6	Outgoing	Jack of	IN	*	*	—	N-Met.	144
7	"	Long O.G.T.	IN	*	*	—	N-Met.	F1A§
8	"	Used for	IN	684A	Brdg.	144	N-Rec.	144
9	"	Test	IN	684A	Brdg.	716A	N-Rec.	HA1§
10	Incoming	Sub. Mult.	OUT	684A	Brdg.	144	N-Rec.	144
11	"	Jack for	OUT	684A	Brdg.	716A	N-Rec.	HA1§
12	"	Assigned	OUT	*	*	—	N-Met.	144
13	"	Test No.	OUT	*	*	—	N-Met.	F1A§

Caution: For all of these tests, request the associate tester at Office "B" to hold his hand over the transmitter, and also to muffle the receiver, for the intervals during which the measurements at Office "A" are being made.

* With 479-FR key in Fig. 7 thrown to "Analyze or Measure Line Noise."

** See Fig. 7 for proper arrangement of noise set, analyzer attachment and d-c blocking device.

§ See note under Item 2 of Paragraph 5.07, regarding the need of applying a correction of +7 db to meter readings obtained with **F1A** line weighting—as well as with **HA1** receiver weighting—with 2-type Noise Measuring Sets which have been modified to provide these "1941" weightings.

† Tests 1 to 9, inclusive, will all be made on the same trunk, i.e., a particular long outgoing trunk (from Office "A") which is selected for test. However, Tests 10, 11, 12 and 13 will not usually be made on this same trunk, since the call for setting up the connection (to Office "A") for these four tests will be originated by the associated tester (Office "B"). It is important that the associate tester secure from his operator the position, cord and trunk number used in completing this call to Office "A" and that this information be entered promptly on the proper data sheets.

each case for the method of terminating, at the tandem office, the outgoing trunks to be measured and setting up at the tandem office the incoming trunks to be measured.

(C) Noise-to-Ground Measurements and Analyses

5.14 Fig. 11 shows the general arrangement for making noise-to-ground measurements on all types of interoffice trunk circuits. These measurements are needed for the subsequent interpretation of the survey data, the general analysis of the situation, etc. When making these tests it will be necessary to remove the trunks from service, and the assistance of a tester at office "B" will be required. Talking facilities which are usually available at the main frames can be utilized for communication between the two testers.

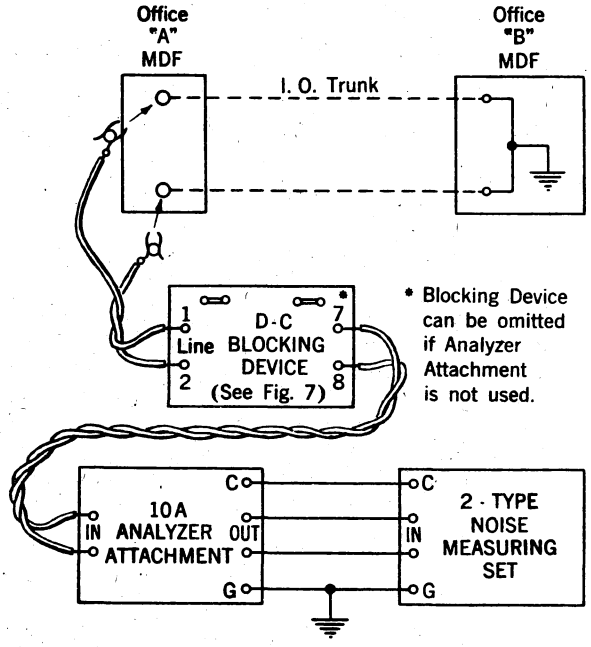


Fig. 11.

5.15 Frequency analyses on trunk circuits are also helpful in the interpretation of the survey data. Hence an analyzer attachment and direct current blocking device* are shown in Fig. 11. The switch and key positions (of the apparatus of Fig. 11) for such analyses are indicated in the tabulation following Fig. 7.

* Blocking device needed only when analyzer attachment is used.

5.16 The test procedure which might, for example, be carried out in making these frequency analyses on trunk circuits is illustrated by the following:

(1) Call the tester at office "B" and request him to remove protector blocks at the main frame on the pair to be tested.

(2) Remove heat coils at the testing end and connect the noise measuring apparatus to the pair to be tested.

(3) Arrange the noise set for a **noise-to-ground** condition and **measure the noise** with both the "144" and the "F1A" weighting referred to in Table 1 (Page 21).

(4) Where analyzer attachment is available, arrange it—together with the noise set, etc. (Fig. 7)—for analysis of noise-to-ground and proceed with such analysis.

(5) Request the tester at office "B" to replace the protector blocks.

(6) Disconnect the noise set from the pair tested and replace the heat coils at office "A."

6. MEASUREMENTS ON P.B.X. CIRCUITS

(A) General

6.01 Since the measurements on P.B.X. circuits involve a visit to the subscriber's premises, advance arrangements should be made, whenever practicable, to conduct such tests at such time as will meet the subscriber's convenience. Contact with the subscriber, for this purpose, should be made through the usual organization channels.

6.02 The measurements which will usually be made at P.B.X.'s, for survey purposes, consist of:

Measurements of receiver noise (BRDG—684A subset—measuring on a 144 receiver and on a 716A receiver)—and "line"* noise-metallic ("144" and "F1A").

These apply to extension-to-extension connections, as well as to extension-to-trunk connections.

* Refers to line noise existing at terminals of the subset at the location of the extension.

6.03 The extension-to-trunk tests are usually confined to those situations not already simulated in the tests on subscriber lines in the same central office area.

(B) Extension-to-Extension Measurements

6.04 Fig. 12 shows a schematic layout of the apparatus and circuits for extension-to-extension measurements.

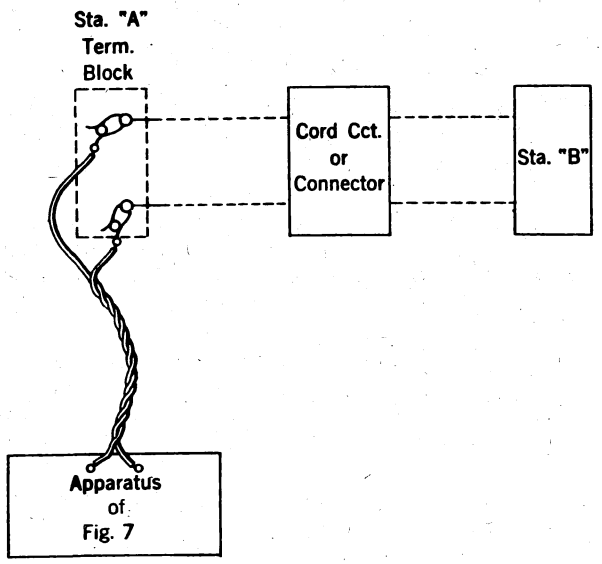


Fig. 12.

6.05 The **Test Procedure** is usually about as follows:

(1) Connect the testing apparatus (with all keys normal) to the pair on the terminal block of the extension to be tested and dial, or request the P.B.X. operator, to connect the test line to a previously selected extension which will serve as Station B. As soon as the connection is completed, request the tester at Station B to muffle receiver and to hold hand over transmitter during period of measurement.

(2) Make the following measurements:

Test No.	Subset Condition in Test Box Type	Ringer	Receiver	Measure	Noise Set Wtg.
1	684A	Brdg.	716A	N-Rec.	HA1§
2	684A	Brdg.	144	N-Rec.	144
3	*	*	—	N-Met.	144
4	*	*	—	N-Met.	F1A§

* With 479-FR key in Fig. 7 thrown to "Analyze or Measure Line Noise."

§ Apply a correction of +7 db to the meter readings obtained with the "**F1A**" line weighting or with the HA1 receiver weighting (across **HA1** receiver unit). (See Paragraph 3.13.)

(3) Release connection by disconnecting testing apparatus from terminal block.

(C) Extension-to-Trunk Measurements

6.06 Extension-to-trunk measurements will usually be necessary at only those P.B.X.'s which **do not** employ repeating coils in the trunk circuits at the P.B.X., and which for extension-to-trunk connections retain a ground on the circuit at the P.B.X. In general such tests will apply to the Nos. 4, 601 and 604 P.B.X.'s.

6.07 An 800-ohm termination will be required at the central office. This may be the same one as used in the tests on subscriber lines. Fig. 13 shows a schematic layout of the apparatus and circuits for this test.

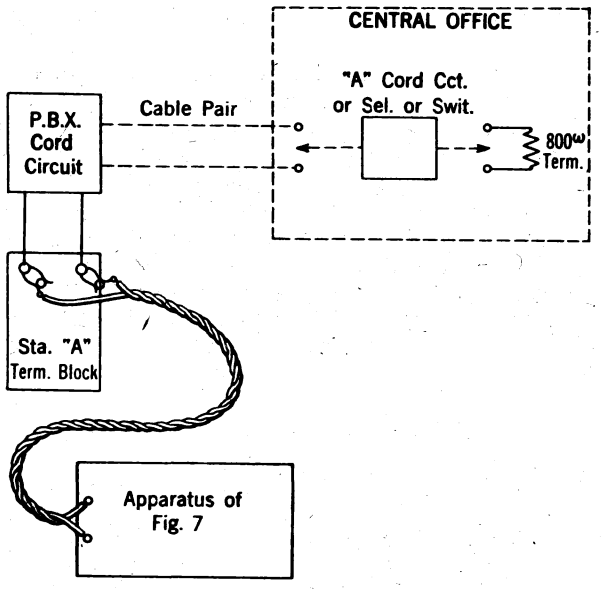


Fig. 13.

6.08 The general test procedure which has often been used is illustrated by the following:

(1) Connect the testing apparatus (with all keys normal) to the pair on the terminal block of the extension from which the test is to be made and have the P.B.X. operator request the central office operator to connect the trunk to the test termination. (In dial areas, have the P.B.X. operator dial the number of the test termination.)

(2) Make measurements of receiver noise and line noise-metallic as per Item 2 of Paragraph 6.05.

(3) Operate the test key to TALK and request the P.B.X. operator to disconnect the central office connection. (In dial areas, request the P.B.X. operator to disconnect temporarily from the trunk and then to reconnect thereto and dial the number assigned for releasing the central office termination.)

(4) Disconnect testing apparatus from the terminal block.

7. RECORDING RESULTS OF MEASUREMENTS

7.01 Paragraphs 7.02-7.10, inclusive, summarize the nature of the contents of the data sheets for subscriber circuits, trunk ciruits and P.B.X. circuits. In each of these instances, there are advantages in using the reverse side of the data sheet (or possibly the margin at the bottom of the sheet)

for any extensive or general notations pertinent to the test results, the plant conditions, the exposure conditions and any other important information regarding the specific situation concerned.

(A) On Subscriber Circuits

7.02 It is advisable to use a separate data sheet for each terminal at which subscriber circuits are tested and each data sheet should be numbered. The advance preparation of data sheets containing common items for entry is advantageous. Such items for each terminal would be about as follows:

Terminal No..... (Approx. Geog. Loc.)

Aer. Ca.: No....., Ga.....
No. of Pairs.....(At U.G. Box)
Feet from Term. to U.G. Pole.....

U.G. Ca.: No....., Ga.....
No. of Pairs.....(At U.G. Box)
Feet from U.G. Pole to C.O.....

Date and Observer:

7.03 As a record of the **noise** measurements on each subscriber circuit a tabular arrangement may be made of the following items:

Cable Pair
Telephone Number
Type of Service

Noise-in-Receiver

(684A and "302" Set in all areas—plus 315H in magneto areas.)

(a) With 684A Set

8A (T) in Cable Areas—for both the 144 and the 716A receiver (which has an HA1 receiver unit).
8A (T) and 8A (R) in O.W. Areas—for both the 144 and the 716A receiver.

(b) With "302" Set

B1A (T) in Cable Area—for the 716A receiver.
B1A (T) and B1A (R) in O.W. Areas—for the 716A receiver.

(c) With 315H (magneto) Set

52A (T) and 52A (R) in O.W. magneto areas. BRDG—with 144 receiver.

Line **noise-metallic** (144 and F1A weighting)
Line **noise-to-ground** (144 and F1A weighting)
Time of day
Date
Remarks
Reference to identifying numbers of frequency analysis data sheets for the particular pair—or route—concerned.

7.04 **Results of Frequency Analyses:** Sample data sheet "A," attached to Section AB63.379, illustrates the general nature of the data which are usually needed in connection with frequency analyses on local telephone circuits.

(B) On Trunk Circuits

7.05 It is usually desirable to use a separate data sheet for each central office, the trunks to and from which are tested at the survey office. It is helpful to enter the measurements and data for both directions of the trunks on the same sheet. The advance preparation of data sheets containing common items for entry is generally helpful.

7.06 Items of general data to be covered are essentially as follows:

Central Office (A).....: Type Swbd.....

Central Office (B).....: Type Swbd.....

Trunk Data: [For both (A) to (B) and (B) to (A) trunks]

Type of Trunk Circuit—
No. of Trunks in Group—
Outside Plant Details (Cable No., Length and Gauge, Length Aerial Cable)—

Date and Observer:

7.07 The following items should be recorded for **each** measurement:

(a) Measurements on (A) to (B) trunks.
Trunk No. } Manual (A)
Pos. & Cord No. } Offices Only
Noise-in-Receiver— Local Station (684A—BRDG—with 144 receiver and also with 716A receiver)

ALSO:

Noise-in-Receiver— Sta. at O.G.T. Jack (684A—BRDG—with 144 receiver and also with 716A receiver)

Line **noise-metallic** ("144" and "F1A")
Line **noise-to-grd.** ("144" and "F1A")
Reference numbers of data sheets covering any frequency analyses which are made.
Time of day Date
Remarks

(b) Measurements on (B) to (A) Trunks.

Trunk No. } Manual (B)
Pos. & Cord No. } Offices Only
Noise-in-Receiver— (684A—BRDG—for both the 144 and the 716A receiver)
Time of day Date
Remarks

(C) On P.B.X. Circuits

7.08 It is usually advisable to use a separate data sheet for each P.B.X. tested. Data sheets containing common items of entry can be prepared in advance.

7.09 Items of general data to be covered are about as follows:

Type of P.B.X.....
Name and Location of Subscriber.....
Number of Trunks to C.O.....
Number of Ext. Stas. on P.B.X.....

Method of Supplying P.B.X. Battery:

(A) Ground Return .....
(B) Local Battery & Grd. Return.....
(C) Local Power Plant.....: Type.....

Pairs Used for Batt. Supply:

	U.G. Section	Aer. Section
No.		
Gauge		
Length (ft.)		

Date and Observer:

7.10 The following items should be recorded for **each** measurement:

(a) Extension-to-Extension Calls

Station A (Ext. No.)
Station B (Ext. No.)
Cord No. (Man. P.B.X. only)
Noise-in-Receiver—(684A — BRDG—for both the 144 and the 716A receiver)
Line **noise-metallic** ("144" and "F1A")
Time of day Date
Remarks

(b) Extension-to-Trunk Calls

Station No.
Cord No.
Trunk No.
Noise-in-Receiver—(684A — BRDG—for both the 144 and the 716A receiver)
Line **noise-metallic** ("144" and "F1A")
Time of day Date
Remarks