MAXIMUM ELECTRICAL SUBSCRIBER LOOPS ATTAINED WITH LONG LINE ADAPTERS

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1. GENERAL

1.1 This section provides REA borrowers, contractors, consulting engineers, and other interested parties with technical information for use in the design and construction of telephone systems. It discusses in particular a technique for using long line adapters (LLA's) to extend the operational limits of subscriber lines. This section replaces Issue No. 3 dated October 1965. The use of loop extenders is covered in TE & CM 332, "Guide for Utilization of Central Office Loop Extenders."

1.2 REA Specification (REA Form 558a, Revised September 1966) requires new central office equipment installations to operate satisfactorily over subscriber loops up to 1900 ohms including the telephone set. It also permits special adapters for operation on loops over 1500 ohms where the 1900 ohm limit cannot be met with regular equipment. Many older switchboards which were designed to operate on maximum resistances less than 1500 ohms are still in service. This section considers subscriber loops which have a resistance greater than the normal maximum which the switchboard was designed to accommodate.

1.3 Subscriber lines having loop resistance in excess of the maximum limit of the switchboard must be equipped with devices to increase their signaling range. These devices, in conjunction with the use of proper ringing machines and long loop ringers and telephone sets as provided in the "List of Materials Acceptable for Use on Telephone Systems of REA Borrowers," REA Bulletin 344-2, assure proper dialing, ringing, and supervision over loops beyond the normal range of the central office equipment.

1.4 The devices for increasing signaling range fall in two categories. The first is the electro-mechanical long line adapter whose operation is described in this section of the manual and the other is the loop extender described in REA TE & CM 332, "Guide for the Utilization of Central Office Loop Extenders." The long line adapter equipment which has pulse correcting ability will extend the subscriber loop limit of the central office equipment without regard to the normal loop range of the particular type of central office equipment. This is not the case with loop extenders.

2. SUBSCRIBER LOOP LIMIT

2.1 The following limitations apply to subscriber loop design when long line adapters are employed:

2.11 The loop resistance must be limited to a maximum of 4500 ohms, including the telephone instrument. The resistance of loading coils, voice frequency repeaters, bridge tap isolators (saturable reactors), and impedance compensators, when used, should be included as a part of the outside plant conductor loop resistance. The 4500 ohms is the maximum permissible loop resistance at the highest temperature to be encountered.

2.12 The line leakage resistance should be no less than 100,000 ohms as measured between conductors or from either or both (conductors in Parallel) conductors to ground.

2.13 It is sometimes necessary to maintain a minimum loop resistance of about 1000 ohms on loops equipped with long line adapters. This should not be done unless pulsing difficulty is encountered, or unless recommended by the manufacturer. To maintain the minimum loop it is necessary to add a series resistor (two watts or larger) in each individual station drop between the protector and the instrument, where the loop to the station in question is less than 1000 ohms. This pulsing difficulty is usually encountered only on open wire plant, as transmission end section considerations with loaded plant would preclude mixing long and short subscriber loops on the same cable pair. It is caused by the design of some long line adapters, which give pulse correction through electrical bias stabilization of the pulsing relay.

3. RINGING CONSIDERATIONS

3.1 Long line adapters do not regenerate ringing current on multi-frequency ringing systems; they merely provide means to bypass the long line adapter equipment when ringing current is applied. Therefore, the use of long line adapters has no material effect on the type of ringing nor on the response of the ringers to the ringing signal as such.

3.2 The requirement for tripping during the ringing period is waived on multiparty lines equipped with long line adapters, as the adapter does not extend the range of this feature. With station ringers connected divided, cross-ringing from one side of the line to the opposite may result when a call is answered during the ringing period. If this is encountered, the ringers must be bridged. In a situation which has more than five parties with frequency ringing, this means using one and two-ring codes.

4. BOOSTER POWER SUPPLY REQUIREMENTS

4.1 A "Booster Power Supply" can be inserted in the positive side of the long line adapter.

4.2 REA now requires that all long line adapters be arranged so that the additional booster power supply may be inserted by changing optional wiring.

4.3 The booster power supply consists of a source of either a nominal 24 volts or 48 volts as required, with the negative terminal ground. The specifications for the source are contained in REA Specifications for Central Office Equipment, REA Form 558a.

4.4 The 24-volt booster power supply may be used for loops up to 3200 ohms and the 48-volt booster power supply for loops up to 4500 ohms, including the telephone set. Where one or more lines require additional voltage, it is desirable to put this same higher voltage on all the long line adapters in order to avoid confusion.

4.5 A booster power supply is used because:

4.51 It increases the loop current.

4.52 It improves the ability of the long line adapter to signal over longer loops in approximately proportionate relationship to the current in the loop.

4.53 It permits the proper operation of bridged tap isolators.

4.54 It permits the proper operation of telephone sets, especially on revertive calls.

4.55 It provides adequate current for proper operation of pushbutton telephones.

5. LONG LINE ADAPTERS FOR PAYSTATIONS

5.1 Paystation long line adapters for semi-postpay paystations are similar to regular long line adapters except (a) they must maintain a minimum of .026 ampere in the line to properly operate the supervisory relay in the paystation instrument. (This is done by a booster power supply arrangement similar to that described in Item 4); and (b) they have components which detect and repeat reverse battery answer supervision to the paystation line. There is at least one supplier of long line adapters for both full prepay paystations and local prepay paystations. The loop limits of paystations are shown in TE & CM 703, "Paystation Services."

6. OTHER USES

6.1 Long line adapters are being used in Common Mode Operation (CMO) applications. To date all manufacturers of central office equipment which supply CMO use them. Here they are made an integral part of the switching system so that a few can take care of a large number of lines. See TE & CM 331, "The Application of Common Mode Operation to Central Office Equipment."

6.2 While the primary function of the long line adapter is to ensure proper central office operation on lines in excess of the normal resistance range, there are several miscellaneous applications on lines which are not necessarily beyond the resistance range.

6.21 In recent years the impedance balance standards of central office equipment have been significantly improved. There are, of course, many older switchboards still in service. Where noise problems exist on only a few lines, it may be more economical to add long line adapters to the lines in question rather than rebuild the switchboards. The long line adapter, in such cases, must be equipped with a repeating coil bridge, and a battery feed relay conforming with the balance standards specified in the Central Offic Equipment Contract, REA Form 525a, Revised 9-66.

6.3 Off-premises extensions of dial PBX's sometimes exceed the range of the PBX (often only 500 ohms). Rather than double the cable pairs, which would be undesirable from a transmission standpoint, a long line adapter can be used to extend the range of the PBX. However, the long line adapters of some manufacturers pulse with a 500-ohm resistor in series with the loop into the switching equipment, which makes the long line adapter inoperative on a PBX. The solution is simple: the long line adapter can be modified to use a smaller resistor.

6.4 When a dial PBX is located at a sufficient distance from the central office to require long line adapters in the central office trunks, a long line adapter of special design is required for this purpose. The chief difference is that the long line adapter must be arranged to pass the signals associated with the instantaneous busy feature, which busies the trunk to the central office as soon as the connector seizes it (before ringing) so as to avoid collisions of incoming and outgoing calls.

6.5 At least one manufacturer of long line adapters makes a version which will pass the resistive ground tip party mark from the telephone set used in one and two party Automatic Number Identification (ANI). Presently there are no long line adapters designed to pass other types of ANI party marking with the exception of circle digit. This information is important in considering the design of systems with ANI.

6.6 Long line adapters are normally used in place of the less expensive loop extenders on the following applications: (a) for loops beyond the capability of loop extenders as LLAs will permit the design of subscriber loops to 4500 ohms without regard to the signaling limit of the particular central office serving the area, (b) for situations where pulse correction may be required because of outside plant conditions or special switching considerations.