# CLASSES OF PROGRAM SERVICE

# TYPE 6001 PROGRAM CIRCUITS

# TESTS AND ADJUSTMENTS

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## 1. GENERAL

1.01 This section provides instructions for establishing and operating type 6001 program transmission services.

1.02 Whenever this section is reissued, the reason(s) for reissue will be given in this paragraph.

1.03 Type 6001 provides for the occasional use of program transmission facilities, for the transmission of program material within the frequency range of approximately 300 to approximately 2500 Hz, and is suitable for the transmission of speech only. Type 6001 covers the provision of interchange channel facilities and services, including the neces-

sary bridging connections.

1.04 Message circuits ordinarily transmit a band width sufficient for the frequencies required for type 6001 program service. No specific limits of deviation from the 1000 Hz values are imposed on circuits suitable for this service since itis not contemplated that the transmission frequency characteristic of such circuits should be modified. In selecting circuits, some consideration is given to distortion transmission impairment as discussed in Section 320-190-120 to insure that the proper service is given. When circuits are so selected, there is no restriction on the maximum length of type 6001 program circuits.

1.05 Since type 6001 is a 1-way service, the opposite direction of transmission is blocked on carrier and repeatered circuits to insure proper stability of the circuit under program service opating conditions. This should be done on voice-frequency repeatered circuits by turning the potentiometer of



the first transmitting and last receiving repeater on the circuit to zero. If it is necessary to block transmission in other repeaters to insure stability or if it is more convenient from an operating standpoint to block all repeaters, this is satisfactory. Carrier circuits should be blocked in one direction as discussed in paragraph 2.20.

1.06 Echo suppressors that are associated with the message facilities should be removed or rendered inoperative to avoid the possibility of interruption from false operation of this equipment, and signaling equipment also should be removed if feasible.

1.07 The signaling circuits working on message facilities used for type 6001 service should not be removed unless objectionable noise results from the signaling operation. If objectionable noise is observed, the signaling circuits should either be rerouted or another circuit satisfactory from this standpoint should be used.

2. ESTABLISHING TYPE 6001 SERVICE

A. General

2.01 Before a message circuit is placed in program transmission service, it is desirable to check the circuit from an overall operation standpoint to determine that it is suitable for program service. A detailed investigation should not be made at this time but rather a brief monitoing check for line troubles, noise, crosstalk, or interruptions should be made. If preliminary observations indicate trouble, it should be investigated further and cleared, or another circuit should be used.

2.02 A 1000 Hz net loss measurement should be made on each circuit assigned to type 6001 service to insure that the circuit is properly lined up for message service before it is set up for program service. Should the circuit be outside the message limits,

it should be adjusted and any indicated trouble cleared. When two or more message circuits are used in tandem for a type 6001 Program Circuit, a 1000 Hz net loss measurement should be made on the overall program circuit after level adjustments are made as outlined in this section to insure satisfactory volume levels and transmission.

B. Noise and Crosstalk

2.03 After a program service has been set up with levels adjusted as discussed later, the transmitting office should terminate the input of the circuit at a convenient point such as at the drop of the repeating coil, line of the transmitting repeater of carrier hybrid line, and each receiving office should listen at least 5 minutes, if practicable, at the output of the circuit nearest to the loop for noise, crosstalk, babble, or other disturbances. Where noise, crosstalk, or babble appear excessive, measurements should be made in accordance with practices for message circuits to determine the cause and nature of the interference. Should measurement indicate unsatisfactory conditions, the trouble should be cleared or another circuit used.

2.04 It is desirable to establish a circuit as free from noise and crosstalk as possible consistent with the effort required to do so. It is contempleated that circuits which meet message requirements generally will be satisfactory. Noise on message circuits used for type 6001 should not exceed the values given in Table A. When noise is measured at a point having a level other than those shown in Table A, a correction should be made in the limits. This is done by adding to or subtracting from the limit given the difference between the level shown and the level at the point measured.



TABLE A

NOISE REQUIREMENTS

A -- Measured on Message Circuit at the Switchboard Receiving Level:

| WEIGHTING | REQUIREMENT |
|---|---|
| C-Message (3C NMS) | 35 dBrn |

B -- Measured at + 8 vu Point on Program Circuit of + 14 vu on open wire facilities or +8 vu on cable facilities:

| WEIGHTING | REQUIREMENT |
|---|---|
| C-Message (3C NMS) | 44 dBrn* |

(2) On circuits operated with transmitting level of 0 vu the transmitting switchboard.

| WEIGHTING | REQUIREMENT |
|---|---|
| C-Message (3C NMS) | 52 dBrn |

*This requiment is based primarily on open wire considerations

but has also been extended to cover cable facilities since the noise on these is usually less than open wire.

2.05 If intelligible crosstalk or direct conversation type 6001 services vary somewhat in the volume levels they are capable of handling without overloading. For this reason, the volume transmitted into a message circuit used on type 6001 service must be limited to a value which will not cause overloading of the particular system used for this service nor result in excessive crosstslk to other facilities.

Transmiting Volume

2.07 Voice-frequency facilities will handle a somewhat higher volume level than carrier systems will handle without overloading, as is discussed later. When type 6001 ciruits are established over voice-frequency facilities only, it is possible to take advantage of the relatively high levels which may be handled. The maximum volume level which may be transmitted into a voice-frequency circuit is determined by the maximum levels permitted in the line facilities or in some cases by the repeaters or amplifiers used. The maximum level which may be transmitted into open wire +14 vu and for cable is +8 vu.

2.08 To determine the volume which may be transmitted into a type 6001 circuit comprised of voice-frequency facilities, it is necessary to make a specific check of volume levels at various point on the circuit for a proposed transmitting level to determine that no portion of the circuit is overloaded. The transmitting level then may be determined as a specific value which will result in favorable levels in the line facilities (up to +14 vu in open wire +8 vu in cable) and at the same time not overload repeaters or amplifiers. A level diagram will be found convenient in such a check.

2.09 To facilitate setting up the longer complex circiut involving the use of mixed facilities, including carrier and voice-frequency systems, it has been found convenient to transmit into such circuits at a uniform level that will not result in overloading of any of the facilities. This, of course, eliminates the need for making a specific level check which would tend to be rather involved in some cases. It has been point of a circuit, or the equivalent of this level at other point circuit, or the circuit, will not result in overloading.

2.10 There is no identical point on all circuits at which a volume level equivalent to 0 vu at the transmitting point can be fed to a type 6001 circuit, except the transmitting point, because there are different types of terminal equipment used at the various telephone offices. The proper volume level for feeding a circuit at the particular point cjosen must be determined. Thuis, transmitting level is determined by subtracting from 0 vu the net loss of the circuit between the transmitting switchboard and the point chosen or, if there is a gain, by adding the gain to 0 vu. For example, if the net loss from the trans-



mitting point to the secondary point, transmitting

toward the line equipment, is 3.7 dB, as determined from the toll circuit layout record card, the proper volume level to feed at this point is --3.7 vu.

2.11 It is the usual practice for a customer to transmit into a loop at a +8 vu level. The volume received from the loop should be coordinated with the value required to feed the interexchange type 6001 circuit at the proper level as discussed above. The level received from a loop feeding a type 6001 circuit may be determined by subtracting the 1000-Hz net loss, including equipment and equializer losses, from the volume level transmitted into the loop. The level received from the loop can be padded down, or amplified if necessary,to equal the level required for feeding the type 6001 circuit at the point chosen.

Example: If it has been determined that type 6001 circuit should be fed at a volume level of -3.7 vu at the secondary point, what adjustment of valume level received from the loop is necessary if a customer feeds +8 vu over a 6 dB (1000-Hz loss unequalized) loop? The level received from the loop would +8 vu minus 6 dB or +2 vu. A level of +2 vu would have to be reduced 5.7 dB to equal -3.7 vu and would require the use of a 6 dB pab (the nearest unit value). An alternate method would be to reduce the gain of the transmitting repeater by 5.7 dB if a transmitting repeater is employed.

2.12 Some of the broadcasters use amplifiers which transmit volumes other than +8 vu into the loop. The level at which a loop will be fed should be determined from the customer and adjustments made for coordinating with this level in the same manner as discussed in paragraph 2.11. The use of +4 vu is the most common variation from +8 vu.

Receiving Volume

2.13 Since the level in a loop should not fall below -4 vu at the receiving end of the loop ahead of the equalizer if any is used, it is often necessary to make a special adjustment of the interexchangne facility receiving level to feed a receiving loop at the proper level. The application of the equivalent of 0 vu at the transmitting point will not always afford satisfactory volume at the receiving end of a circuit unless some adjustments are applied. For example, in the case of a 9 dB message toll circuit with the receiving end drop and a 3 dB switching pad removed, the volume level at the point of connection to the loop at the receiving telephone office will be approximately -6 vu. Obviously, this level is not sufficient to feed a loop, and additional gain must be added to the circuit before it will be sufficient. Methods of obtaining additional gain are discussed below.

2.14 Specific measures often are necessary to provide sufficient receiving volume to feed a local loop. Examples of the means of providing additional volume are:

(a) Removal of switching pads

(b) Removal or adjustment of terminating pads in 4-wire circuits

(c) Adjustment of pads in carrier system terminating circuits or adjustment of the demodulator circuit

(d) Connection of a supplementary receiving repeater

(e) Adjustment of the gain a receiving repeater

(f) Adjustmenmt of the gain of a receiving repeater ate repeater if additional gain is available.

2.15 The choice between the different methods depends upon the condition applying to each case. It should be noted that when additional gain is required, it is necessary to increase the gain only to the point that the -4 vu limit will be observed. The maximum volume limits for various amplifiers as discussed in paragraph 2.07 also should be observed.

Circuits With Terminal Repeaters

2.16 Where a voice-frequency receiving repeater normally is assigned to message circuit use, the gain of this repeater should be increased for feeding the loop by an amount determined by calculations according to the following formula, provided that the output level does not exceed the values given in paragraph 2.07.

RGI = (N--D) + (L-4)

= (N+L) - (D+4)

Where:



RGI = Required Gain Increase

N = Net loss of message circuit including switching pads

L = 1000-Hz unequalized loss of receiving loop

D = Total drop equipment loss including switching pads removed at the receiving end of the message circuit when connected to the loop.

2.17 When the gain increase determined by the formula requires more gain than is available in the repeater, an additional repeater may be used in tandem with the normal receiving repeater.

Example: Determine the required gain increase necessary for a circuit having a 9 dB net loss with a 3 dB switching pad and 0.3 dB drop equipment loss removed from the circuit. The 1000-Hz unequalized loop loss is 7 dB.

N = 9 (Net loss of circuit)

D = 3.3 dB (3 dB pad plus 0.3 dB drop loss)

L = 7 dB (Loop loss)

RGI = 9 + 7 - (3.3 + 4) = 8.7 dB.

Check for Repeater Overloading

2.18 The possibility that the calculated gain increase might overload a repeater should be investigated before a circuit is set up for this gain. This may be checked according to the following formula for the condition where 0 vu is applied at the transmitting point.

OV = TL + RGI

where:

OV = Repeater output volume level

TL = Transmission level of the receiving terminal repeater as determined from the toll circuit layout card

RGI = Required gain increase obtained from preceding calculations.

Example: Check a 4-wire circuit receiving terminal repeater for overloading for a required gain increase 8.7 dB.

TL = +7 dB (from circuit layout record)

RGI = 8.7 dB (from previous example)

OV = 7 + 8.7 = 15.7 vu.

Since +15.7 vu is over the +14 vu allowable level of a 4-wire repeater, this gain increase cannot be obtained without overloading the repeater, and some additional measure listed in paragraph 2.14 should be applied.

Circuits Without Terminal Repeaters

2.19 If a message circuit has no terminal receiving repeater, the increase in gain required for satisfactory receiving level still can be calculated as discussed for circuits equipped with a terminal receiving repeater. The required gain increase can be introduced into the circuit at the repeater nearest the receiving terminal or a supplementary repeater can be placed at the terminal giving the required gain increase. The check for overloading must be made by adding RGI to the transmission level determined from the toll circuit layout card for the repeater nearest the receiving terminal.

Example: Determine the required gain increase at the intermediate repeater nearest the terminal for a 9 dB circuit having no terminal repeater nor switching pad. A ringer loss of 0.3 dB and a drop loss of 0.2 dB may be removed from the circuit. The unequalized loss of the receiving loop is 3 dB.

N = 9

D = 0.3 + 0.2 = 0.5

L = 3.0

RGI = (9 + 3) - (0.5 + 4) = 7.5 dB.

Checking the repeater for overloading when the transmission level from the layout record card is +1 dB:

TL = +1

RGI = 7.5 (from above)

OV = +1 + 7.5 = 8.5 vu.

This is satisfactory for a 2-wire repeater having a +11 vu allowable output level.



Carrier Systems

2.20 The use of carrier channels for type 6001 program service, in general, will be simplified by transmitting into them at a point as near the modulator and receiving from them at a point as near the demodulator as feasible. Where the level adjustments discussed in the following paragraphs for carrier systems do not afford satisfactory volume conditions for the loops involved, other measures previously discussed in paragraph 2.14 will be necessary.

Types K and L Systems

2.21 Types K and L broadband carrier channels may be used for type 6001 program service. To eliminate certain interfering tones, as discussed in Section 320-190-120, a message filter should be inserted at the output of the last carrier link unless a voice-frequency message circuit is included between the carrier circuit output and the receiving loop. The channels generally are lined up for --13 dB modulator input and a +4 dB demodulator output on message service. On Schedule E service, the input volume for the equivalent of 0 vu at the transmitting switchboard should be --13 vu at the modulator input (--13 dB transmission level point) with a resulting +4 vu demodulator output volume.

D. No. 4 Switching Office

2.22 At a No. 4 toll switching system office, type 6001 program circuits generally should be established at the No. 17C toll testboard since this is the only place where all the circuits terminating at the office contain jacks to permit patching.

2.23 When patches are made at the 17C testboard on 2- or 1-way outgoing circuits, the circuits should be "locked out" from control of the switches as follows:

(a) With the test cord connected to the test jacks of the circuit and the TALK key of the cord circuit operated, momentarily operate the LO key. Observe that the circuit LO lamp lights. This makes the circuit busy to outgoing traffic.

(b) Disconnect the test cord from the test jacks and observe that the LO lamp remains lighted.

(c) If the circuit appears at the Assignment Patch Board, a dummy plug should also be inserted

in the OT jack as an added safeguard against seizure of the circuit by the crossbar selectors.

(d) Attach shielded target to the LO lamp as required.

For a circuit that is incoming only, no busy arrangements are provided since this circuit is controlled from the distant toll office and cannot be seized by the selectors of the No. 4 switching equipment.

2.24 When a circuit which has been used for type 6001 service at a No. 4 toll switching office is returned to the message layout, the following restoration tests should be made. After the patch cords of the 17C testboard have been removed, proceed as follows:

(a) Connect the cord to the test jacks of the circuit in the 17C testboard, operate the TALK key of the cord circuit, and momentarily operate the RES key. If the circuit appears at the Assignment Patch Board, remove the dummy plug from the OT jack.

(b) Observe that the LO lamp in the 17C testboard is extinguished.

Volume Considerations

2.25 Table B shows the relationship between the transmission levels at the jacks in the 17C testboard and the terminal net loss for typical circuits of various types.

The input or output level of any toll circuit at the 17C testboard may be determined from the relationships indicated above. "Low-loss" generally refers to circuits equipped with terminal VF repeaters or with carrier frequency terminals. "High-loss" circuits have no gain permanently associated with the circuit at the No. 4 office terminal.

Through Circuit Patching

2.26 If the level of the incoming circuit at the 17C testboard is within about 1 dB of the level of the outgoing circuit, they may be patched directly by a 4-wire patch cord. Thus, a low-loss circuit having a terminal net loss of 7 to 9 dB may be patched directly to any outgoing low loss circuit. If the incoming level is too high, it may be reduced by decreasing the gain of the receiving repeater. If the incoming



TABLE B

17C TESTBOARD TRANSMISSION HEADS

| TYPE OF CIRCUIT | TERMINAL NET LOSS | TRANSMISSION LEVEL AT 17C TESTBOARD (REFERRED TO EQUIVALENT TRANSMITTING SWITCHBOARD LEVEL) INCOMING | OUTGOING |
|---|---|---|---|
| Low Loss | 7 dB | - 3 dB | -4 dB |

| | | | |
|---|---|---|---|
| | 8 dB | - 4 dB | -4 dB |
| | 9 dB | - 5 dB | -4 dB |
| High Loss | 10 dB | -12 dB | +2 dB |
| | 12 dB | -14 dB | +2 dB |
| | 14 dB | -16 dB | +2 dB |

level is too low, it may be raised by increasing the gain of the receiving repeater or by inserting an additional amplifier.

Local Pickup

2.27 For a pickup from a local loop, a patch should be made from the local loop circuit to the No. 17C testboard transmitting jack of the desired circuit. As noted in paragraph 2.32, all low-loss circuits (circuits containing terminal repeaters at the No. 4 switching system location) will be at an outgoing level of --4 dB at this point. If it is assumed that the broadcaster is transmitting at +8 vu into the local loop, the 1000-Hz loss of the local loop, including equalization, should be subtracted from the +8 vu level to determine the level at the transmitting jacks of the No. 17C testboard. Since the required level for program service at a --4 dB transmission level point is --4 vu, the program coming from the subscriber should be adjusted to a --4 vu level. If the level from the subscriber is higher or lower than this, a gain adjustment of the transmitting amplifier can be made, subject to the maximum output levels given in paragraph 2.07, so that the level into the toll circuit will be proper.

Bridging Arrangements

2.28 When a number of low-loss circuits are to be interconnected by means of a bridging multiple, patch the transmitting legs of the outgoing circuits to the output of the bridge. Since the level of the outgoing circuits is --4 dB, the required level at the input of the bridge will then be higher than --4 dB by the loss of the bridge. Raise the level at the receiving jacks of the incoming circuit (see paragraph 2.32) to the required bridge input level by increasing the gain of the receiving repeater and connect the incoming circuit to the bridge input. If the loss of the bridge is more than about 10 dB, it will be necessary to use an additional amplifier between the receiving jacks and the program bridge input in order to avoid overloading the message repeater. [The 7 or 8 dB(A) pad located between the terminal repeater and the 17C testboard jacks, which cannot easily be removed, permits a second amplifier to be used on the drop side of this pad without consequent overloading.]

2.29 If the incoming circuit is of the high-loss type and all outgoing circuit are low-loss type, the procedure outline in paragraph 2.35 should be followed except that all gain between the incoming high-loss circuit and the bridge input will need to be provided by the use of an additional amplifier.

2.30 If both high-loss and low-loss circuits are to be connected to the output of a single program bridge, the 4-wire branches of a hybrid coil should be patched to the receiving and transmitting jacks of each outgoing circuit, and the 2-wire sides of the hybrids should be patched to the bridge output. The hybrid coils should have a 1:1 impedance ratio and

may be of the type employing 173-type repeating coils. They may be wired to suitable jacks in the 17C testboard. With this arrangement, the level at 2-wire side of hybrid coils of both the high-loss and low-loss circuits is equivalent to 0 dB or switchboard reference level, and the required level at the bridge input will be higher than 0 dB by the loss of the bridge. The incoming circuit should be patched to the bridge input by means of the receiving 17C testboard jacks. (No hybrid coil is required for patching this circuit to the input of the bridge.) The gain of the receiving repeater may be adjusted as necessary, subject to the overload limitations given in paragraph 2.07, or an additional amplifier may be employed on the drop side of the 7 or 8 dB(A) pad. (The required gain increase in the case of the 9 dB low-loss incoming circuit will be equal to the loss of the bridge +5 dB.)

3. TANDEM AND BRIDGING ARRANGEMENTS

3.01 When message toll circuits are used in tandem for type 6001 service, the net loss of each circuit would tend to add to the net loss of the overall



circuit if some measures were not applied to prevent such accumulated loss. The accumulation of circuit net losses is avoided by introducing added gain at the junction point of each message circuit with another message circuit. This gain is most conveniently obtained by increasing the gain of each transmitting terminal repeater, except the first transmitting repeater, by an amount equal to the net loss of the preceding circuit minus the net loss of any terminal equipment removed from either of the circuits at the junction point. If terminal repeaters are not used, repeaters may be added to the circuit to obtain the necessary gain. With this method of operating circuits in tandem, overloading will not occur since the increased gain only makes up for the loss of the preceding circuit.

3.02 When it is necessary to feed stations or more than one extended circuit at a junction point, the arrangement for bridging will be governed largely by the local conditions at the bridging point. The overall gain introduced to each extended circuit should be made equal to the normal equivalent of the preceding circuit, plus the loss of the bridge, less the sum of all pads, and other losses removed at the junction points in the same manner as for tandem circuits.

3.03 The simplest method of bridging one or two outlets to a principal circuit is by the high impedance method requiring a repeater for each bridged circuit. The bridging repeaters should be connected to the principal circuit through a 1000-ohm resistance in each side of the repeater input. The other methods of bridging discussed and illustrated in Section 320-190-110 for types 6002 and 6003 services are applicable to type 6001 service where they result in a saving in time or where the handling of service may be facilitated through the use of such arrangements.

4. MONITORING

4.01 It is not contemplated that full time monitoring will be given to type 6001 service. A circuit should be monitored during the preliminary tests and at intervals during the service period. It is essential that the service be monitored the first few minutes at the start of the service and a few minutes prior to the close of the service to assure that the program is completed before the circuit is restored to message use. Other intermittent monitoring should be done as indicated to be necessary by experience to detect trouble that may arise.

4.02 Monitoring on type 6001 program circuits may be done, in general, in the same manner as on-the-message circuits. This may be done at the repeaters from the monitoring jacks using the regular telephone set panel or at the secondary point using a transmission measuring set. Where the telephone set panel is employed, it is essential that the keys be arranged for the listening only condition. If the above equipment is not available, a telephone test set in monitoring position may be bridged across the circuit. Monitoring equipment associated with program bridging amplifier equipment may be used to monitor on a spare outlet.