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PART I

Series O Recommendations

SPECIFICATIONS FOR MEASURING EQUIPMENT

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SECTION 1

GENERAL

Recommendation O.1

SCOPE AND APPLICATION OF SERIES O RECOMMENDATIONS

(Melbourne, 1988)

1 Scope of Series O Recommendations

The CCITT establishes various Recommendations covering:

a) essential specifications for telecommunications equipments, and

b) operational matters, e.g. procedures for bringing circuits into service and routing checks of performance.

The type of tests for checking compliance with these two categories of Recommendations are essentially different, and this often leads to a different choice of test equipment.

Category a) tests will normally be more comprehensive. Their purpose (often based upon measurements of sample or prototype equipments) is to certify compliance with design objectives and they may therefore be a prerequisite to equipment being accepted for installation in an Administration's network. Such tests are unlikely to be employed routinely and in general CCITT does not produce Recommendations for test equipment intended specifically for this purpose.

Category b) tests, however, are used systematically and repetitively and their widespread application may necessitate additional considerations, in particular the need for:

1) conformity of results when tests may be performed using test equipment supplied by more than one manufacturer, and

2) a common measurement technique to ensure compatibility when a test requires test equipment at both ends of an international circuit.

It is primarily for these circumstances that CCITT issues the Series O Recommendations.

The above remarks apply quality to analogue and digital techniques.

2 Application of measuring equipment for use on digital transmission systems

This section is presented as an aid to selecting and applying specifications in the Series O Recommendations concerning test and measuring equipment for use on primary PCM and data multiplexers and digital transmission systems.

Applications are divided into two categories:

a) measurements and indications on primary PCM multiplexers;

b) measurements and indications on digital transmission systems including digital line systems, digital circuits and digital multiplexers.

Figures 1/O.1 and 2/O.1 illustrate the range of test and measurement capabilities applicable to primary PCM multiplexers, in the send and receive directions, respectively.

Tables 1/O.1 and 2/O.1 illustrate the range of test and measurement capabilities applicable to digital transmission systems.

The figures indicate the relevant Series O Recommendations to be applied for each test and measurement parameter, and also show the connection interface for the test instrument.

Example :

To measure quantising distortion on a primary PCM multiplexer:

Figure 1/O.1 shows that instruments conforming to Recommendations O.131 and O.132 can be employed, connected to the audio input interface of the send encoder.

Figure 2/O.1 shows that similar instruments are connected to the audio output interface of the receive decoder to complete the measurement path.

Figure 1/O.1, p. 1

Figure 2/O.1, p. 2

H.T. [T1.1]

TABLE 1/O.1

List of tests and measurements applicable to digital transmission systems in the send direction

System hierarchical level		First order	Second order	Third order	Fourth order
Bit rate 32 | 64 34 | 68 44 | 36 kbit/s }	. . 64 kbit/s . . 139.264 Mbit/s	. 1544 2048 kbit/s	. 6312 8448 kbit/s	{	
Parameter	Recommendation				
Error performance	O.152	O.151	O.151	O.151	O.151
Timing jitter	O.171	O.171	O.171	O.171	O.171

Tableau 1/O.1 [T1.1], p. 3

H.T. [T2.1]
TABLE 2/O.1
List of tests and measurements applicable to digital transmission systems in the receive direction

System hierarchical level		First order	Second order	Third order	Fourth order
Bit rate 32 | 64 34 | 68 44 | 36 kbit/s }	. . 64 kbit/s . . 139.264 Mbit/s	. 1544 2048 kbit/s	. 6312 8448 kbit/s	{	
Parameter	Recommendation				
Error performance	O.152	O.151	O.151	O.151	O.151
Code violations		O.161	O.161		

{
Frame alignment
Signal monitor
}
		O.162 (2 Mbit/s)			

Timing jitter	O.171	O.171	O.171	O.171	O.171

Tableau 2/O.1 [T2.1], p. 4

3 Application of measuring equipment for use on analogue transmission systems

Under study.

References

[1] CCITT Recommendation *Characteristics of 60-channel transmultiplexing equipments* , Vol. III, Rec. G.793.

[2] CCITT Recommendation *Characteristics of 24-channel transmultiplexing equipments* , Vol. III, Rec. G.794.

Recommendation O.3

CLIMATIC CONDITIONS AND RELEVANT TESTS FOR MEASURING EQUIPMENT

(Melbourne, 1988)

1 General

The Recommendations of the Series O specify measuring equipment for a wide range of applications. Reliable test equipment is an important prerequisite when maintaining telecommunication equipment and telecommunication networks. The reliability of measuring equipment can be affected by the environmental conditions to which the equipment is exposed to during its use.

This Recommendation gives a range of climatic conditions for the operation of measuring equipment specified in the Series O Recommendations. In addition, climatic conditions for transportation and storage of measuring equipment are defined.

In order to be able to prove that the requirements of this Recommendation are fulfilled, test conditions simulating the various environmental parameters are specified.

Where possible, this Recommendation is based on standards produced by other bodies such as the international electrotechnical commission (IEC) [1]; (CEPT) [2].

2 Climatic conditions for the operation of measuring equipment

2.1 *Operation in indoor rooms*

Considering that measuring equipment will be used in most of the cases in weather-protected locations, the normal operating conditions specified in Figure 1/O.3 define the range of climatic conditions under which the equipment specifications shall be met. These conditions may be found in normal working areas, offices, telecommunication centres or storage rooms for sensitive products, etc.

The normal operating conditions are maintained by heating, cooling and, where necessary, by forced ventilation. Humidity may normally not be controlled.

Figure 1/O.3 implies that the measuring equipment is usually operated at a temperature of approximately 25° | at a relative humidity of 45%.

The dotted field in the centre of the climatogram of Figure 1/O.3 specifies the climatic conditions which will be experienced during 90% of the time.

The exceptional operating conditions shown in Figure 1/O.3 may exist, e.g. following failure of the climate controlling system. Under these conditions the measuring equipment shall still operate without irreversible faults. However, the measurement may be less accurate.

In some instances the measuring equipment may be exposed to solar radiation and to heat radiation from other sources (e.g. from room heating). Direct solar radiation should be avoided and the temperature in the vicinity of the equipment shall not exceed the limits of Figure 1/O.3

The equipment may also be exposed to movements of the surrounding air due to draughts in buildings (e.g. through open windows). It shall not be subjected to condensation or precipitation.

Figure 1/O.3, p.

2.2 *Operation of measuring equipment in other environments*

Under study.

3 Transportation and storage

During transportation and storage the measuring equipment shall tolerate temperatures between —40 | (deC and +70 | (deC without irreversible failure. For relative humidities higher than 45% and temperatures higher than 25 | (deC the limits of the climatogram of Figure 1/O.3 shall not be exceeded for any humidity/temperature combination. In this case the (uninterrupted) exposure time is limited to 2 months.

Note 1 — It is assumed that the measuring equipment is packed in its usual shipping container and that the ambient conditions mentioned above are those outside the package.

Note 2 — This requirement is provisional and requires further study.

4 Test conditions

4.1 *Testing conditions for indoor climates*

It is assumed that the measuring equipment meets the requirements of § 2.1 if it tolerates the basic environmental testing procedures in accordance with IEC Publication 68-2-3 [3].

During these testing procedures, the mesuring equipment shall be placed in the testing chamber for 4 days. After a recovery time of 2 hours the test specimen shall properly function and the specified error limits shall not be exceeded.

Note — This requirement is provisional and requires further study.

4.2 *Testing conditions for other environments*

Under study.

References

[1] IEC Publication 731-3 *Classification of Groups of Environmental Parameters and their Severities* .

IEC-Publication 721-3-3 *Stationary Use at Weather-Protected Locations* .

[2] CEPT Recommendation T/TRw, Part B-3 *Environmental Conditions and Environmental Tests for Telecommunications Equipment* . (October 1987).

[3] IEC-Publication 68-2-3 *Basic Environmental Testing Procedures. Part 2: Test Ca: Damp heat, steady state* .

Recommendation O.6

1020 Hz REFERENCE TEST FREQUENCY

(Melbourne, 1988)

1 Introduction

The intent of this Recommendation is to specify a single nominal reference frequeny of 1020 Hz in order to provide guidance to manufacturers and Administrations in the design and operation of new equipment and systems. This Recommendation is not intended to have an effect on existing equipment or systems except where modifications are required to allow for interworking. For instance, an older analogue exchange would need to be provided with new reference frequency capability if circuits were provided between it and digital exchanges.

2 Test frequencies on circuits routed over PCM systems

The selection of a suitable test frequency is a major consideration when testing circuits routed over PCM systems. An error in level measurement can arise on circuits routed over PCM systems if the test frequency is a sub-multiple of the PCM sampling rate. This error can be nearly as great as ± | .15 dB at 800 Hz and ± | .20 dB at 1000 Hz with a sampling rate of 8000 Hz employing 8-bit coding. In addition, errors in other parameters, such as total distortion, may be even more significant.

Therefore, it is recommended that the use of a reference test frequency that is a sub-multiple of the PCM sampling rate should be avoided. Studies within CCITT reveal that some Administrations have employed nominal reference test frequencies offset from 800 Hz or 1000 Hz by varying amount but within the ranges 804-860 Hz or 1004-1020 Hz. These studies have confirmed that where interworking is not required, no significant problems in maintenance have been encountered by Administrations and existing test procedures and equipment may continue to be used.

In the case of interworking and for new equipment and systems, the Administrations expressed a strong preference for the selection of a reference test frequency of 1020 Hz.

3 Considerations for new measuring equipment specifications

The following should be considered for new measuring equipment specifications in the Series O Recommendations:

i) A reference test frequency of 1020 Hz is recommended for test frequency generating circuits or instruments that provide reference test frequencies. The specified frequency tolerance should be +2 to —7 Hz

ii) The nominal level of the reference test frequency when used on in-service equipment should not be greater that —10 dBm0 ± | .1 dB.

iii) Measuring circuits or instruments which utilize the reference test frequencies should provide, if possible, for measurements of any frequencies within the nominal range of 1000 to 1025 Hz.

By agreement between the Administrations concerned, in the absence of the required sending or measuring apparatus, the use of a measuring frequency in the range of 800 to 860 Hz is admissible. Other considerations about the deployment and use of reference test frequencies are given in Recommendation M.20 [1].

References

[1] CCITT Recommendation *Maintenance philosophy for analogue, digital and mixed networks* , Volume IV, Recommendation M.20.

Recommendation O.9

MEASURING ARRANGEMENTS TO ASSESS

THE DEGREE OF UNBALANCE ABOUT EARTH

(Geneva, 1972; amended at Malaga-Torremolinos, 1984, and at Melbourne, 1988)

1 General

This Recommendation describes arrangements for measuring the following parameters:

— longitudinal conversion loss;

The negative tolerance of 7 Hz is intended to allow the use of digitally generated test signals that are generated by a sufficiently high number of samples to achieve the measurement accuracy specified in certain Series O Recommendations (e.g. Recommendation O.133).

— transverse conversion loss;

— longitudinal conversion transfer loss;

— transverse conversion transfer loss;

— input longitudinal interference loss;

— common-mode rejection;

— output signal balance.

In practice, the above parameters are the seven most significant unbalance parameters considerations for test terminations and the measurement frequencies to be used are given in the relevant Recommendation for the item under test.

This Recommendation is in agreement with the principles, the nomenclature and the definitions, addressed in Recommendation G.117 [1], which considers the transmission aspects of unbalance about earth. References are made in the following sections, to the appropriate paragraphs/figures of Recommendation G.117 [1].

In § 3, guidance is given regarding the construction of a test bridge along with values of the required components.

2 Measuring arrangements

2.1 *Longitudinal conversion loss (LCL)*

The LCL of a one- or two-port network is a measure (a ratio expressed in dB) of the degree of unwanted transverse signal produced at the terminals of the network due to the presence of a longitudinal signal on the connecting leads. It is measured as shown in Figure 1/O.9. This technique is applicable to either the input or output terminals, e.g., transpose terminals a and b with d and e respectively. (See § 4.1.3 of Recommendation G.117 [1].)

Figure 1/O.9, p.

2.2 *Transverse conversion loss (TCL)*

The TCL of a one- or two-port network is a measure (a ratio expressed in dB) of the degree of unwanted longitudinal signal produced at the input (or output) of a network due to the presence of a transverse signal at the same port. TCL is measured as shown in Figure 2/O.9 (see § 4.1.2 of Recommendation G.117 [1]).

2.3 *Longitudinal conversion transfer loss (LCTL)*

The LCTL is a measure (a ratio expressed in dB) of an unwanted transverse signal produced at the output of a two-port network due to the presence of a longitudinal signal on the connecting leads of the input port. It is measured as shown in Figure 3/O.9 (see § 4.2.3 of Recommendation G.117 [1]).

If the item under test exhibits gain or loss between ports a/b and d/e, this must be taken into account when specifying LCTL. In addition to the general requirements of § 3, the measurement range of the test equipment must also take into account the gain or loss of the item under test. In addition, if the item under test performs a signal conversion (e.g., in FDM or TDM multiplexers) then the signal measured at $V_{T\backslash d2}$may not be at the same frequency as that of the energizing signal designated $V_{L\backslash d1}$. The signal at $V_{T\backslash d2}$may even appear in coded form as a digital signal. Further study is required to define these signals and their relationships.

Figure 2/O.9 and Note, p.

Figure 3/O.9 and note, p.

2.4 *Transverse conversion transfer loss (TCTL)*

Transverse conversion transfer loss is a measure (a ratio expressed in dB) of an unwanted longitudinal signal produced at the output of a two-port circuit due to the presence of a transverse signal at the input port. It is measured as shown in Figure 4/O.9. If a signal conversion is performed by the item under test (e.g., in FDM or TDM multiplexers) then the signal measured at $V_{L\d2}$ may not be at the same frequency as that of the energizing signal designated $V_{T\d1}$. The energizing signal may even be applied in coded form as a digital signal. Further study is required to define these signals and their relationships (see § 4.2.2 of Recommendation G.117 [1]).

Figure 4/O.9, p.

2.5 *Input longitudinal interference loss (ILIL)*

The measurement of this parameter is applicable to receiving devices (e.g., amplifiers, level meters, etc.). ILIL is a measure (a ratio expressed in dB) of the sensitivity of a receiving device to longitudinal disturbances. It is measured as shown in Figure 5a/O.9 and 5b/O.9. In principle, it is similar to the longitudinal conversion loss (LCL) measurement. However, since the measurement is performed internally (using a built-in indicating device) or at the output of the item under test, not only the impedance balance at port a/b, but also the effect of common-mode rejection is measured. (See § 4.4.1 of Recommendation G.117 [1].)

Measurements in accordance with Figure 5b/O.9 are also applicable to devices which perform a signal conversion (e.g. VF/CF side of channel translating equipment, A/D side of PCM multiplex equipment, etc. See § 2, item f of Recommendation G.117 [1]). In this case the measurement at the

output of the device under test requires an appropriate analyzer, namely a selective level meter for measurements at channel translators or a digital analyzer (see Recommendation O.133) for measurements at PCM-multiplexers. In the equation in Figure 5b/O.9 it is assumed that V_0 is measured at a 0-dBr point. The quantity X_1 is the relative level at port a/b.

Figure 5/O.9, p.

2.6 *Common-mode rejection (CMR)*

Common-mode rejection is another measurement (a ratio expressed in dB) that is appropriate for receiving devices and is measured as shown in Figure 6/O.9. Note that in this arrangement the input terminals are short-circuited and then energized (see § 5.1 of Recommendation G.117 [1]).

Figure 6/O.9, p.

2.7 *Output signal balance (OSB)*

This measurement (a ratio expressed in dB) is applicable to signal outputs. OSB is a measure of unwanted longitudinal signals at the output of a device. It is measured as shown in Figure 7/O.9 (see § 4.3.1 of Recommendation G.117 [1]).

Figure 7/O.9, p.

The signal source *G* shown in Figure 7/O.9 can be internal or external to the device under test. OSB measurements are also applicable to devices which perform a signal conversion (e.g. CF/VF side of channel translating equipment. D/A side of PCM multiplex equipment, etc. See § 2, item f of Recommendation G.117 [1]). In this case an appropriate external signal source, namely a signal generator for measurements at channel translators or a digital signal generator (see Recommendation O.133) for measurements at PCM-multiplexers is required.

3 Requirements for the measuring arrangements

3.1 *Inherent balance*

The measuring arrangements shown in Figures 1/O.9 through 7/O.9 include two independent impedances and a centre-tapped inductor arranged as indicated to yield the equivalence of two matched impedances of the value $Z/2$. The coil should be iron-cored with an accurate centre-tapped connection, both the tightly coupled half windings being as symmetrical as possible. The circuits shown in Figure 8/O.9 are electrically equivalent and any one can be used to perform the measurements described in this Recommendation. It should be noted that in the case of option *c)* of Figure 8/O.9, the connection of point c to earth must be made via an impedance which is virtually zero. For very low frequencies, the arrangements *a)* and *b)* of Figure 8/O.9 may be unsuitable and it may be more convenient to use arrangement *c)* of Figure 8/O.9, with a small (e.g., 1 ohm) resistor being inserted in the longitudinal arm, so that a measure of longitudinal current can be obtained to derive the equivalent voltage across $Z/4$.

The inherent balance of any measuring arrangements must be determined and found to be sufficiently good before a measurement is made. This may be done by replacing the equipment being tested with a second test bridge. The inherent longitudinal conversion loss of the measuring arrangements should be 20 dB greater than the limit set for the item under test. This balance should also be obtained when the connections at a and b are reversed. This permits an accuracy in the order of ± 1 dB. An example of a practical test bridge is given in Recommendation G.117, Figure 21/G.117 [1].

Figure 8/O.9, p.

3.2 *Impedances* $Z_{L\backslash dL\backslash d2}$ [garbled text] Z_1 and Z_2 are the impedances connected in parallel to the input and/or output port respectively of the item under test. Z_1 and Z_2 are generally within ± 25% of the nominal impedance of the port to which they are connected. If measurements are made via high-impedance input ports, an additional impedance Z_1 should be connected between points a and b. The longitudinal impedances $Z_{L\backslash d1}$ and $Z_{L\backslash d2}$ are nominally equal to $Z_1/4$ or $Z_2/4$ respectively. Different values, however, may be used. This may be necessary to more properly simulate operating conditions of the item under test. In such cases the value of $Z_{L\backslash d1}$ and/or $Z_{L\backslash d2}$ shall be specified by the Recommendation convering the item under test.

3.3 *Measuring and generating the test signals*

The voltages V_L and V_T are measured with high-impedance voltmeters, and in such a way that the balance is not disturbed. The actual values of the internal impedance and e.m.f. of the generator G are irrelevant if $V_{L\d1}$ is measured. The design of the item under test may impose a limit on the permissible magnitude of the longitudinal excitation.

When the equipment being tested as shown in Figure 1/O.9 is a signal generating device, $V_{T\d1}$ must be measured selectively if it is required to measure the longitudinal conversion loss while the signal generator is active. Selective measurements are also preferable when high losses are to be measured.

3.4 *Other considerations*

It may be necessary in some measurements to make provisions for supplying a d.c. line holding current or a d.c. line current termination. In these cases the Recommendation covering the requirements for the item under test shall also specify the requirements for such d.c. line current treatment.

References

[1] CCITT Recommendation *Transmission aspects of unbalance about earth* Vol. III, Rec. G.117.

[2] CCITT Recommendation *Transmission characteristics of an international analogue exchange* Vol. VI, Rec. Q.45.

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SECTION 2

MAINTENANCE ACCESS

Recommendation O.11

MAINTENANCE ACCESS LINES

(Geneva, 1972; amended at Malaga-Torremolinos, 1984, and at Melbourne, 1988)

1 General

1.1 *Introduction*

In order to more effectively carry out manual and automatic maintenance of international circuits in an automatic telephone network, the following international maintenance access lines are recommended:

a) a balanced quiet termination which initially returns a —10 dBm0 test tone;

b) a maintenance test position or console access line with multiple access codes for both voice communications and/or circuit testing;

c) a test line to terminate the echo suppressor testing system (ESTS) (see Recommendation O.25) responder;

d) a loopback test line (analogue or digital);

e) a test line to terminate the echo canceller test responder.

f) a test line to terminate the signalling system functional testing and transmission measuring responder (type a) for use with ATME No. 2 (Recommendation O.22);

g) a test line which returns a busy flash signal for use with ATME No. 2 (also referred to as type c responding equipment, see Recommendation O.22).

These test lines should be provided as modular units to that each Administration may choose the number of each type it wishes to install at a given centre.

The test lines listed in a) to e) above will not provide reliable test results for a circuit which is routed through a circuit multiplication system (CMS) employing interpolation techniques [this includes the case where a circuit is routed over time division multiple access/digital speech interpolation (TDMA/DSI) satellite channels] and therefore should not be used in this instance unless a permanent trunk-channel association in both directions of transmission can be made for the duration of the test sequence. The reason for this is that without such a trunk-channel association, circuit continuity may not be maintained within the CMS in the absence of a signal and during very low signal level conditions.

1.2 *Quiet termination test line*

The quiet termination test line is a dialable test line that initially returns a nominal 1020 Hz —10 dBm0 tone for 13 to 15 seconds. After the initial tone period, the test line should present a balanced 600-ohm termination to simulate the nominal exchange impedance. This quiet termination should remain connected until the calling party disconnects. This dialable test line is intended to allow one-man manual 1-way loss, 1-way noise (or noise with tone) measurements and impulsive noise checks on any circuit from the distant switching centre.

1.3 *Test and/or communications access line*

The test and/or communications access line is a dialable access line intended to be located at the circuit maintenance test position or test console location associated with the international switching centres. These access lines are expected to be used for voice communications between the circuit maintenance personnel at the appropriate maintenance elements and as a test access point to make a variety of manual transmission tests. These access lines are potential facilities as a fault report point (circuit) or fault report point (network) and/or testing point (transmission).

Separate access codes will be allocated for each of the access line types described below. This is to ensure that if an Administration wishes to separate the various maintenance functions (i.e. transmission testing, switching testing and fault reports) it can do so. These allocations should not, however, stop those Administrations that wish to combine one or more of the functions, using a single access code.

1.3.1 *Transmission access test lines*

The transmission access test line is a dialable test line intended to be located at the circuit maintenance test position or test console location associated with the international switching centres. These test lines are expected to be used as a test access point to make a variety of manual transmission tests. They may also be used for voice communication purposes associated with the circuit testing.

The proposed dialling plan for these test lines enables a particular test position or console to be selected when the distant switching centre is equipped for this type of dialling access. If the normal test position number (access code) is busy, it is expected that the call should route to an idle test position number via a hunting group. Generally, the allocation of access codes should allow the digits 21 (see § 2.4.2) to cause the incoming test line call to route to the test position or maintenance console normally assigned to the particular circuit group over which the incoming call originated. Then the use of digits 22 to 29 (non CCITT No. 6 signalling) would allow the maintenance personnel to make a test line call to a specific test position or maintenance console at the distant location. This will allow both flexibility in assigning the test positions and consoles, and may also relieve the need for all test positions or consoles to be equipped with the same test equipment.

1.3.2 *Other test and/or communication lines*

A requirement exists for the provision of lines for manual switching and signalling tests and for the provision of facilities for a fault report point (circuit) or a fault report point (network). Codes will be allocated to these lines when the requirements are fully defined.

1.4 *Echo suppressor test line*

The echo suppressor test line is a dialable 4-wire test line intended to terminate the echo suppressor testing system (ESTS) (see Recommendation O.25) responder on an international switching centre. This test line will allow the maintenance personnel at the distant switching centre using the ESTS director equipment to make one-man semi-automatic echo suppressor tests on the circuits between the two centres.

For further information about the choice of the test reference frequency refer to Recommendation O.6.

1.5 *Loopback test line*

1.5.1 *Analogue loopback test line*

The loopback test line is a dialable 4-wire test line that initially returns a nominal 1020 Hz —10 dBm0 tone for 13 to 15 seconds. After the initial tone period, the test line should present a balanced 600 ohm termination to the ‘‘RETURN’’ direction for the next 13 to 15 seconds. The ‘‘GO’’ direction should also be terminated in a 600-ohm balanced termination during both these first two intervals.

After the second interval, the 600-ohm terminations should be disconnected. Finally, the ‘‘GO’’ and the ‘‘RETURN’’ directions should be connected (looped around) in the test responder at the correct level until released by the calling station.

The intent of this test facility is to provide a one-man manual means of performing fast transmission tests (level and noise) in both directions. It will also allow seizure and rapid testing by an automatic device at the calling station.

1.5.2 *Digital loopback test line*

The digital loopback test line provides a dialable 4-wire test line capability intended both for use in measuring the error performance of international digital circuits and as a quick method of verifying the continuity of wholly digital, non-PCM encoded and mixed analogue/digital circuits. It consists of circuitry that accepts and loops back on a digital basis the signal from a circuit. The test signal may be any arbitrary digital test pattern or analogue test signal.

Once the tester has accessed the test line at a remote location, the tester may transmit the desired analogue test signals or digital test patterns. The tester may examine the returning signal for the received power (or continuity) of the analogue test signals or the error performance (or continuity) of the digital test patterns.

The proposed dialling plan for this test line enables a particular line to be selected when the distant switching centre is equipped for this type of dialling access. If the normal test line number (access code) is busy, it is expected that the call should route to a busy indication.

1.6 *Echo canceller test line*

The echo canceller test line is a dialable 4-wire test line intended to terminate the echo canceller test responder.

This test facility will allow maintenance personnel at the originating switching centre to make tests of the echo canceller(s) on the circuit under test. Whether the test will be made on both echo cancellers or just the echo canceller at the responder end of the circuit under test will depend on the type of directing equipment being used.

1.7 *ATME No. 2 test lines*

The ATME No. 2 test lines are dialable 4-wire test lines intended to terminate the ATME No. 2 responders (see Recommendation O.22). The responding equipment is available in two forms:

a) a signalling system functional testing and transmission measuring device (type *a*);

b) a signalling system function testing device (type *b)* .

The ATME No. 2 equipment, consisting of directing equipment at the outgoing end and responding equipment at the incoming end, is intended to make automatic transmission measurements and signalling system functional tests on all categories of international circuits terminating in exchange with 4-wire switching.

1.8 *Busy flash signal test line*

The busy flash test line is a dialable 4-wire test line intended for use with the ATME No. 2 directing equipment (see Recommendation O.22). This test line, which is also referred to as type *c* responding equipment in Recommendation O.22, is required in cases when the signalling system used on

the circuits to be tested provides a busy flash signal. This test line functionality may be provided within the exchange equipment or by separate responding equipment.

2 Method of access

2.1 In general, access arrangements should conform to the Recommendation M.565 [1].

2.2 Access to the test lines at the incoming international exchange will be gained via the normal exchange switching equipment on a 4-wire basis on all incoming and both-way circuits.

2.3 The wiring loss build-out arrangements for the test lines should conform to the Recommendation M.565.

2.4 *Address information*

2.4.1 *Address information sequence*

The following address information will be used to gain access to the maintenance access lines at the incoming international exchange:

i) *CCITT Signalling System No. 4*

a) terminal seizing signal,

b) code 13,

c) code 12,

d) digit 0,

e) two digits associated with the particular international test line type to be accessed (see § 2.4.2 below),

f) code 15.

ii) *CCITT Signalling System No. 5*

a) KP1,

b) digit 7 (non-allocated language digit),

c) code 12,

d) digit 0,

e) two digits associated with the particular international test line type to be accessed (see § 2.4.2 below),

f) ST.

iii) *CCITT Signalling System No. 6*

The initial address message format for access to testing devices is given in Recommendations Q.258 [2] and Q.259 [3]. The X digit allocation should be as follows:

a) 1 (ATME No. 2 responding equipment type *a* for signalling tests and transmission measurements),

b) 2 (ATME No. 2 responding equipment type *b* for signalling tests only),

c) 3 (quiet termination test line),

d) 4 (echo suppressor test line),

e) 5 (loopback test line),

f) 6, 7 and 8 (transmission access test line). (See Note),

g) 9 (echo canceller test line),

h) 10 (digital loopback test line).

Note — The allocation of the X digit is under the responsibility of Study Group XI. In Signalling System No. 6, the bits of the access codes (bit pattern) sent on the line need not be identical with the actual access code number used by the maintenance staff. As Signalling System No. 6 will mainly be used together with SPC exchanges, it will be possible to translate any access code into an appropriate bit pattern.

iv) *CCITT Signalling System No. 7*

The initial address message format for access to testing devices is given in Recommendation Q.722 [4]. The two digits associated with the particular international test line to be accessed are given in § 2.4.2.

v) *CCITT Signalling System R1*

a) KP,

b) digits to be agreed upon between the Administrations concerned,

c) ST.

vi) *CCITT Signalling System R2*

a) test call indicator,

b) code I-13,

c) two digits associated with the particular international test line type to be accessed (see § 2.4.2 below),

d) code I-15 (on request).

2.4.2 *Test line codes for CCITT Signalling Systems No. 4, 5, 7 and R2*

i) ATME No. 2 responding equipment type a | 1

ii) ATME No. 2 responding equipment type b | 2

iii) Busy flash signal | 3

iv) quiet termination | 4

v) echo suppressor | 5

vi) analogue loopback | 6

vii) digital loopback | 8

viii) multiple address capability for transmission access test line 21-29

ix) echo canceller test line | 7

3 Specifications for the test line apparatus

The following specifications apply to all test line types unless otherwise noted and apply over the range of climatic conditions specified in Recommendation O.3.

3.1 *Tone source characteristics (quiet termination and loopback test lines)*

a) The nominal tone source frequency should fall within 1004 to 1020 Hz. The tone source frequency including tone source stability and aging should remain within 1002 to 1025 Hz.

b) Purity of output: ratio of total output to unwanted signal at least 50 dB.

c) Long-term level stability: ± | .03 dB.

3.2 *Transmitted level and timing intervals (quiet termination and loopback test lines)*

a) The test tone level to be transmitted should be —10 dBm0 ± | .1 dB.

b) Tone interval for quiet termination test line: 14 s ± 1.0 s. Tone and quiet termination intervals for the loopback test line: 14 s ± | .0 s.

3.3 *Impedance*

a) 600 ohms, balanced.

b) For all cases, longitudinal conversion loss (see Figure 1/O.9): at least 46 dB between 300 and 3400 | z increasing below 300 Hz to at least 60 dB at 50 Hz.

3.4 *Return loss*

At least 46 dB at 1020 Hz, and at least 30 dB between 300 and 3400 Hz.

3.5 *Frequency response*

a) ± | dB from 300 to 3000 Hz (quiet termination, echo suppressor, echo canceller and loopback test lines).

b) ± | .5 dB from 300 to 3000 Hz (transmission access test line).

3.6 *Loopback test line level adjustment*

The loopback test line equipment shall provide the proper buildout (loss or gain) in the loopback measurement path to adjust its level to within ± | .1 dB of the required nominal value. The required nominal value should be determined using Recommendation M.560 [5] and the reference level points at which the loopback test line is employed.

3.7 *Digital loopback test*

The digital loopback test line provides a dialable, 4-wire test line capability; this type of test line accepts and loops back received octets from a digital circuit. The octets when looped back, are retransmitted so that the positions of the bits within the octet are preserved; that is, the most significant bit of the retransmitted octet corresponds to the most significant bit of the received octet, and so forth.

The loopbacks may be integrated into the switching network of the digital switching machine, or may be provided in a stand-alone mode, having an external 4-wire 64 kbit/s appearance on the switching machine, similar to existing test lines.

4 Signalling system test line test sequence

4.1 *Circuit seizure*

When an outgoing circuit is to be seized and connected at the distant end to one of the international test lines, the appropriate address information is transmitted in accordance with the specification for the signalling system in use (see § 2.4).

4.2 *Test line answer*

When access is gained to the test line equipment, the answer signal (answer, no charge if Signalling System No. 6) will be transmitted. If the test line is occupied, a busy indication should be returned to the originating end in accordance with the normal signalling for the circuit and for the address concerned.

4.3 *Test line not equipped*

When a test line call is received at a switching centre not equipped to handle that type of test call, the called switching centre should respond with the standard ‘‘unallocated number’’ signal where available for the signalling system employed.

References

[1] CCITT Recommendation *Access points for international telephone circuits* , Vol. IV, Rec. M.565.

[2] CCITT Recommendation *Telephone signals* , Vol. VI, Rec. Q.258.

[3] CCITT Recommendation *Signalling-system-control signals* , Vol. VI. Rec. Q.259.

[4] CCITT Recommendation *General function of telephone messages and signals* , Vol. VI, Rec. Q.722.

[5] CCITT Recommendation *International telephone circuits — principles, definitions and relative transmission levels* , Vol. IV, Rec. M.560.

Blanc