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Amendment 2

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SERIES G: TRANSMISSION SYSTEMS AND MEDIA,
DIGITAL SYSTEMS AND NETWORKS

Digital sections and digital line system – Access networks

Single-ended line testing for digital subscriber lines
(DSL)

Amendment 2

Recommendation ITU-T G.996.2 (2009) –
Amendment 2



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Recommendation ITU-T G.996.2

Single-ended line testing for digital subscriber lines (DSL)

Amendment 2

Summary

Amendment 2 to Recommendation ITU-T G.996.2 (2009) provides updates to Annexes E and F, defining revised new measurement parameters for a MELT-PMD and a MELT-P.

History

Edition	Recommendation	Approval	Study Group
1.0	ITU-T G.996.2	2009-05-22	15
1.1	ITU-T G.996.2 (2009) Amd. 1	2009-10-09	15
1.2	ITU-T G.996.2 (2009) Amd. 2	2012-04-06	15

FOREWORD

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The World Telecommunication Standardization Assembly (WTSA), which meets every four years, establishes the topics for study by the ITU-T study groups which, in turn, produce Recommendations on these topics.

The approval of ITU-T Recommendations is covered by the procedure laid down in WTSA Resolution 1.

In some areas of information technology which fall within ITU-T's purview, the necessary standards are prepared on a collaborative basis with ISO and IEC.

NOTE

In this Recommendation, the expression "Administration" is used for conciseness to indicate both a telecommunication administration and a recognized operating agency.

Compliance with this Recommendation is voluntary. However, the Recommendation may contain certain mandatory provisions (to ensure, e.g., interoperability or applicability) and compliance with the Recommendation is achieved when all of these mandatory provisions are met. The words "shall" or some other obligatory language such as "must" and the negative equivalents are used to express requirements. The use of such words does not suggest that compliance with the Recommendation is required of any party.

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As of the date of approval of this Recommendation, ITU had received notice of intellectual property, protected by patents, which may be required to implement this Recommendation. However, implementers are cautioned that this may not represent the latest information and are therefore strongly urged to consult the TSB patent database at <http://www.itu.int/ITU-T/ipr/>.

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Recommendation ITU-T G.996.2

Single-ended line testing for digital subscriber lines (DSL)

1) References

Add the following reference to clause 2:

[ITU-T G.991.2] Recommendation ITU-T G.991.2 (2003), Single-pair high-speed digital subscriber line (SHDSL) transceivers.

2) Updates to Annex E – Specific requirements for a MELT-PMD

Update Annex E as follows:

Annex E

Specific requirements for a MELT-PMD

(This annex forms an integral part of this Recommendation.)

E.1 MELT-PMD functions

MELT-PMD functions are applicable at the η_C reference point only.

Various implementations of the MELT-PMD feature are possible, including the use of a common functional block shared among multiple lines and capable of executing the procedures described herein on the basis of one line at a time.

It is assumed that the MELT-PMD measurements are performed when there is no transmission in the frequency band up to 4 kHz on the loop under test. The method of ensuring this is beyond the scope of this Recommendation.

E.1.1 MELT-PMD measurement functions

The maximum allowed time for single or combined measurement (see clause E.2.1.1), excluding the processing time in the MELT-P, shall not exceed 20 seconds for a test sequence made of foreign DC and AC voltage, 4-element resistance with a controlled metallic voltage, and 3-element capacitance with a controlled metallic voltage.

E.1.1.1 Measurement of the 4-element DC resistance with a controlled metallic voltage

E.1.1.1.1 4-element DC resistance

This parameter defines a measurement, or a series of measurements, to measure the relevant resistance values from an equivalent DC resistance network located between tip, ring, and GND as shown in Figure E.1.

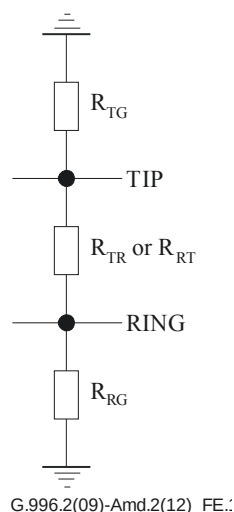


Figure E.1 – DC resistance between tip, ring, and GND

Four resistance values R_{XY} shall be reported:

- 1) R_{TR} – DC resistance between tip and ring
- 2) R_{RT} – DC resistance between ring and tip
- 3) R_{TG} – DC resistance between tip and GND
- 4) R_{RG} – DC resistance between ring and GND.

R_{TR} is measured with a voltage applied between tip and ring such that tip is positive with respect to ring. A reversed voltage is applied between the tip and ring leads for the measurement of R_{RT} .

In the case where the metallic branch elements, R_{TR} or R_{RT} , may be in parallel with a signature network containing a non-linear element such as a zener diode, it will be required to limit the metallic test voltage such as to remain below the conduction threshold when measuring the cable leakage resistances. To this effect, the metallic voltage used by this procedure shall be lower than the minimum far-end signature conduction voltage configuration parameter (see clause E.2.1.6).

~~The accuracy of this parameter is for further study.~~

The accuracy numbers apply to a measurement performed with only one resistance component at a time connected to one of tip and ring, ring and tip, tip and GND, or ring and GND.

The accuracy for each element of this parameter is defined in Table E.1.

Table E.1 – 4-element DC resistor accuracy

<u>R_{XY} Range</u>	<u>Accuracy</u>
<u>0 Ω – 250 Ω</u>	<u>$\pm 10 \Omega$</u>
<u>250 Ω – 1 kΩ</u>	<u>$\pm 4 \%$</u>
<u>1 kΩ – 100 kΩ</u>	<u>$\pm 4 \%$</u>
<u>100 kΩ – 1 MΩ</u>	<u>$\pm 8 \%$</u>
<u>1 MΩ – 5 MΩ</u>	<u>$\pm 15 \%$</u>
<u>5 MΩ – 10 MΩ</u>	<u>$\pm 25 \%$</u>

E.1.1.1.2 Test voltages for the measurement of the 4-element DC resistance with a controlled metallic voltage

This parameter reports the voltages present on the tip and ring wires while executing the measurement with a controlled metallic voltage and which are used to calculate the resistance results. Four values are reported in relation with the tip-to-ground, ring-to-ground, tip-to-ring, and ring-to-tip branches. If a branch is measured by comparing the load current at two different source voltages, the voltage delta is reported instead of each individual voltage.

NOTE – The voltage values can be based on a calculation, using the source voltage, the load current and the output impedance, or can be a direct measurement.

Four voltage values VDC_{XY} shall be reported:

- 1) VDC_{TR} – DC voltage between tip and ring
- 2) VDC_{RT} – DC voltage between ring and tip
- 3) VDC_{TG} – DC voltage between tip and GND
- 4) VDC_{RG} – DC voltage between ring and GND.

The accuracy for each element of this parameter is for further study.

E.1.1.1.3 Test currents for the 4-element DC resistance with a controlled metallic voltage

This parameter reports the DC currents measured during the test execution. Those currents are useful to identify the possible presence of a foreign voltage source. To this effect, the current contribution resulting from the application of the test voltage to the measured external resistance shall be removed from the reported currents.

Four current values IDC_{XY} shall be reported:

- 1) IDC_{TR} – DC current between tip and ring
- 2) IDC_{RT} – DC current between ring and tip
- 3) IDC_{TG} – DC current between tip and GND
- 4) IDC_{RG} – DC current between ring and GND.

The accuracy for each element of this parameter is for further study.

NOTE – Removing the current contribution resulting from the application of the test voltage only leaves the current due to a foreign potential, if any is present. To this effect, the IDC_{TR} and IDC_{RT} results are equivalent to the results that would be obtained when connecting a current meter between tip and ring. Similarly, the IDC_{TG} and IDC_{RG} results are equivalent to the results that would be obtained when connecting two current meters, one between tip and ground and one between ring and ground.

E.1.1.2 Measurement of the 3-element capacitance with a controlled metallic voltage

This parameter defines a measurement, or a series of measurements, to measure the capacitance of the cable plus line equipment, if present, from an equivalent AC network located between tip, ring, and GND as shown in Figure E.2.

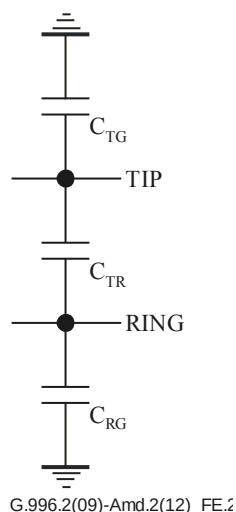


Figure E.2 – Capacitance between tip, ring, and GND

The capacitance C_{XY} is defined as the measured capacitance between nodes X and Y . The measuring method for C_{XY} is vendor discretionary.

Three capacitance values C_{XY} shall be reported:

- 1) C_{TR} – Capacitance between tip and ring
- 2) C_{TG} – Capacitance between tip and GND
- 3) C_{RG} – Capacitance between ring and GND.

In the case where the metallic branch element, C_{TR} , may be in parallel with a signature network containing a non-linear element such as a zener diode, it will be required to limit the metallic test voltage such as to remain below the conduction threshold when measuring the cable capacitances. To this effect, the metallic voltage used by this procedure shall be lower than the minimum far-end signature conduction voltage configuration parameter (see clause E.2.1.6).

~~The accuracy of this parameter is for further study.~~

The accuracy of each element of this parameter is defined in Tables E.2 and E.3.

The accuracy of each element of this parameter in cases of MELT measurements on SHDSL equipment according to [ITU-T G.991.2] is defined in Tables E.4 and E.5.

The accuracy numbers apply to a measurement performed with only one capacitance component at a time connected to one of tip and ring, tip and GND, or ring and GND.

NOTE – In cases of MELT measurements on loops connected to SHDSL equipment according to [ITU-T G.991.2], the accuracy requirements have to be relaxed. This accounts for the typically high input capacitance of SHDSL equipment ports.

Table E.2 – Capacitance accuracy C_{TR}

<u>Capacitance range</u>	<u>Accuracy</u>
<u>0 nF - 60 nF</u>	<u>± 3 nF</u>
<u>60 nF - 1 μF</u>	<u>± 5 %</u>
<u>1 μF - 5 μF</u>	<u>± 10 %</u>

Table E.3 – Capacitance accuracy C_{TG} , C_{RG}

<u>Capacitance range</u>	<u>Accuracy</u>
<u>0 nF - 20 nF</u>	<u>± 1 nF</u>
<u>20 nF - 1 μF</u>	<u>± 5 %</u>
<u>1 μF - 5 μF</u>	<u>± 10 %</u>

Table E.4 – Capacitance accuracy C_{TR} for MELT-measurements on SHDSL equipment according to [ITU-T G.991.2]

<u>Capacitance range</u>	<u>Accuracy</u>
<u>0 nF - 1 μF</u>	<u>± 50 nF</u>
<u>1 μF - 5 μF</u>	<u>± 10 %</u>

Table E.5 – Capacitance accuracy C_{TG} , C_{RG} for MELT-measurements on SHDSL equipment according to [ITU-T G.991.2]

<u>Capacitance range</u>	<u>Accuracy</u>
<u>0 nF - 100 nF</u>	<u>± 5 nF</u>
<u>100 nF - 1 μF</u>	<u>± 5 %</u>
<u>1 μF - 5 μF</u>	<u>± 10 %</u>

E.1.1.3 Measurement of foreign voltages

Foreign voltages may occur differentially between tip and ring, in common mode between tip/ring and GND, or be single-ended, between tip and GND or between ring and GND. Therefore, three types of V_{XY} measurements are defined:

- 1) V_{TR} – Foreign voltage between tip and ring
- 2) V_{TG} – Foreign voltage between tip and GND
- 3) V_{RG} – Foreign voltage between ring and GND.

The measurement parameter foreign voltage (see clause E.2.3.53) shall be reported for each of the three types, including the following information:

- Foreign DC voltage level ($V_{XY,DC}$)
- Foreign AC rms voltage level ($V_{XY,AC}$)
- Foreign AC voltage frequency ($f_{XY,AC}$) estimated on the basis that the foreign AC voltage is sine-shaped with a constant frequency.

When measuring the foreign voltages, the input impedance of the measuring instrument can affect the measurement and should be reported in addition to the results.

~~The accuracy of this parameter is for further study.~~

The accuracies for each of these parameters are defined in Tables E.6 to E.8.

The accuracy requirements apply when only one foreign voltage source at a time is connected to one of tip and ring, ring and tip, tip and GND, or ring and GND.

The frequency accuracy numbers only apply to foreign AC voltages V_{XY} higher than 5 Vrms.

NOTE – Typically the maximum capacitance connected between tip and ring does not exceed 5 μ F. The maximum foreign DC voltages error due to the residual charge at this maximum capacitance is not expected not be higher than 1 V.