International Telecommunication Union

ITU-T

TELECOMMUNICATION
STANDARDIZATION SECTOR
OF ITU

G.996.2
Corrigendum 1
(06/2018)

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

Digital sections and digital line system – Metallic access networks

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

Corrigendum 1

Recommendation ITU-T G.996.2 (2009) – Corrigendum 1

ITU-T

International Telecommunication Union

ITU-T G-SERIES RECOMMENDATIONS

TRANSMISSION SYSTEMS AND MEDIA, DIGITAL SYSTEMS AND NETWORKS

INTERNATIONAL TELEPHONE CONNECTIONS AND CIRCUITS	G.100–G.199
GENERAL CHARACTERISTICS COMMON TO ALL ANALOGUE CARRIER-TRANSMISSION SYSTEMS	G.200–G.299
INDIVIDUAL CHARACTERISTICS OF INTERNATIONAL CARRIER TELEPHONE SYSTEMS ON METALLIC LINES	G.300–G.399
GENERAL CHARACTERISTICS OF INTERNATIONAL CARRIER TELEPHONE SYSTEMS ON RADIO-RELAY OR SATELLITE LINKS AND INTERCONNECTION WITH METALLIC LINES	G.400–G.449
COORDINATION OF RADIOTELEPHONY AND LINE TELEPHONY	G.450–G.499
TRANSMISSION MEDIA AND OPTICAL SYSTEMS CHARACTERISTICS	G.600–G.699
DIGITAL TERMINAL EQUIPMENTS	G.700–G.799
DIGITAL NETWORKS	G.800–G.899
DIGITAL SECTIONS AND DIGITAL LINE SYSTEM	G.900–G.999
General	G.900–G.909
Parameters for optical fibre cable systems	G.910–G.919
Digital sections at hierarchical bit rates based on a bit rate of 2048 kbit/s	G.920–G.929
Digital line transmission systems on cable at non-hierarchical bit rates	G.930–G.939
Digital line systems provided by FDM transmission bearers	G.940–G.949
Digital line systems	G.950–G.959
Digital section and digital transmission systems for customer access to ISDN	G.960–G.969
Optical fibre submarine cable systems	G.970–G.979
Optical line systems for local and access networks	G.980–G.989
Metallic access networks	**G.990–G.999**
MULTIMEDIA QUALITY OF SERVICE AND PERFORMANCE – GENERIC AND USER-RELATED ASPECTS	G.1000–G.1999
TRANSMISSION MEDIA CHARACTERISTICS	G.6000–G.6999
DATA OVER TRANSPORT – GENERIC ASPECTS	G.7000–G.7999
PACKET OVER TRANSPORT ASPECTS	G.8000–G.8999
ACCESS NETWORKS	G.9000–G.9999

For further details, please refer to the list of ITU-T Recommendations.

Recommendation ITU-T G.996.2

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

Corrigendum 1

Summary

Corrigendum 1 to Recommendation ITU-T G.996.2 (2009) fixes a number of inconsistencies.

History

Edition	Recommendation	Approval	Study Group	Unique ID*
1.0	ITU-T G.996.2	2009-05-22	15	11.1002/1000/9666
1.1	ITU-T G.996.2 (2009) Amd. 1	2009-10-09	15	11.1002/1000/9892
1.2	ITU-T G.996.2 (2009) Amd. 2	2012-04-06	15	11.1002/1000/11503
1.3	ITU-T G.996.2 (2009) Amd. 3	2013-03-16	15	11.1002/1000/11892
1.4	ITU-T G.996.2 (2009) Amd. 4	2013-08-29	15	11.1002/1000/11995
1.5	ITU-T G.996.2 (2009) Amd. 5	2017-12-07	15	11.1002/1000/13309
1.6	ITU-T G.996.2 (2009) Cor. 1	2018-06-22	15	11.1002/1000/13532
1.7	ITU-T G.996.2 (2009) Amd. 6	2018-06-22	15	11.1002/1000/13531

* To access the Recommendation, type the URL http://handle.itu.int/ in the address field of your web browser, followed by the Recommendation's unique ID. For example, http://handle.itu.int/11.1002/1000/11830-en.

FOREWORD

The International Telecommunication Union (ITU) is the United Nations specialized agency in the field of telecommunications, information and communication technologies (ICTs). The ITU Telecommunication Standardization Sector (ITU-T) is a permanent organ of ITU. ITU-T is responsible for studying technical, operating and tariff questions and issuing Recommendations on them with a view to standardizing telecommunications on a worldwide basis.

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.

INTELLECTUAL PROPERTY RIGHTS

ITU draws attention to the possibility that the practice or implementation of this Recommendation may involve the use of a claimed Intellectual Property Right. ITU takes no position concerning the evidence, validity or applicability of claimed Intellectual Property Rights, whether asserted by ITU members or others outside of the Recommendation development process.

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/.

Table of Contents

Recommendation ITU-T G.996.2 (2009)

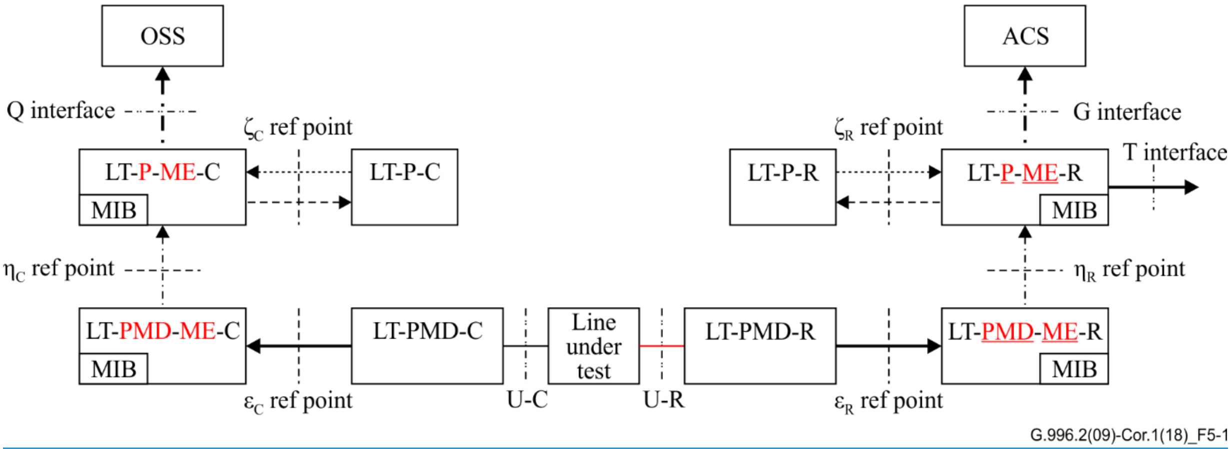
Single-ended line testing for digital subscriber lines (DSL) – Corrigendum 1

Corrigendum 1

1) Clause 5.1, Line test reference model

Revise clause 5.1 as follows:

…



NOTE – Arrows show flow of data elements only; flow of control elements are bidirectional (not shown).

Figure 5-1 – Functional reference model

There are four functional blocks at each end of a line. The following general descriptions of the functionality of each block apply at both ends of the line but the detail of their functionality may be different at each end.

The first functional block is called the LT-PMD (line test – Physical medium dependent). The LT-PMD function performs measurements on the physical medium to which the line test device is connected. The result of a measurement is a quantity represented as a parameter (one or more dimensional, discrete or continuous). From these parameters, measurement parameters are derived, usually through multiple measurements.

The fact that the functional block is connected to the physical medium motivates calling it "PMD". The prefix LT indicates that this functional block is specific to line testing. However, in some instantiations, this may be the same as, or nearly the same as, instantiations of an xTU-PMD functional block.

The second functional block is called the LT-P (LT – Processing). The LT-P function transforms the measurement parameters into derived parameters. These derived parameters directly reflect the characteristics of the loop under test.

The third functional block is denoted LT-P-ME~~-P~~ (LT – P – Management entity~~ – P~~) and has the following functionalities:

a) Data plane:

- to provide an interface point to the OSS, ACS or user for access to both derived and measurement parameters across the Q, G or T interfaces, respectively;

- to access the measurement parameters in the LT-~~ME-~~PMD-ME across the η reference point.

b) Management plane:

- to manage the LT-P-MIB;
- to control the functionality of the LT-P across the ζ reference point;
- to communicate with the far end LT-P-ME~~-P~~ across the U interface to coordinate testing and exchange derived and measurement parameters.

The fourth functional block is denoted LT-~~ME-~~PMD-ME (LT – Management entity – PMD) and has the following functionalities:

a) Data-plane:

- to provide to the LT-P-ME~~-P~~ access to measurement parameters.

b) Management plane:

- to manage the LT-PMD-MIB;
- to control the measurements performed by the LT-PMD across the ε reference point.

The term "LT" in the line test reference model refers to all forms of line test (i.e., SELT, DELT and MELT). In Annexes A and B, which contain SELT requirements, the term "SELT" is used in place of the term "LT". In Annexes C and D, which contain DELT requirements, the term "DELT" is used in place of the term "LT". In Annexes E and F, which contain MELT requirements, the term "MELT" is used in place of the term "LT".

2) 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.

The accuracy values provided in this annex are based on an assumption that the MELT functionality has, or obtains, the value of the input capacitance looking into the xTU-C and subtracts it from the raw results to report the measurement of the external capacitance. The method to obtain the input capacitance of the xTU-C is vendor discretionary and is beyond the scope of this Recommendation. No part of the overall accuracy budget has been allocated to account for a possible change in the input capacitance of the xTU-C.

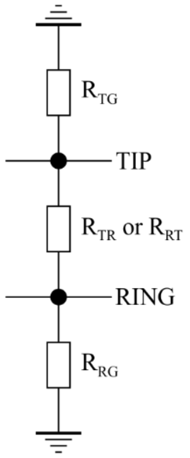
E.1.1 MELT-PMD measurement functions

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. This requirement applies to a test executed on a typical loop without obtaining the optional measurement results (see Table E.12) and does not include an allowance for system or network delays.

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.



G.996.2(09)-Cor.1(18)_FE.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 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

R_{XY} Range	Accuracy
0 Ω – 250 Ω	± 10 Ω
250 Ω – 1 kΩ	± 4 %
1 kΩ – 100 kΩ	± 4 %
100 kΩ – 1 MΩ	± 8 %
1 MΩ – 5 MΩ	± 15 %
5 MΩ – 10 MΩ	± 25 %

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 DC 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 given in Table E.1.1, while the range of valid values and granularity are defined in clause E.2.3.2.

Table E.1.1 – Measurement test voltages (VDC_{TR}, VDC_{RT}, VDC_{TG} and VDC_{RG}) accuracy

Voltage range (V)	Accuracy	Granularity
$-20 \le VDC_{XY} \le 20$	±1 V	100 mV
$-100 < VDC_{XY} < -20$ $20 < VDC_{XY} < 100$	±5%	100 mV

E.1.1.1.3 Test currents for the measurement of 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 given in Table E.1.2, while the range of valid values and granularity are defined in clause E.2.3.3.

Table E.1.2 – Measurement test currents (IDC_{TR}, IDC_{RT}, IDC_{TG} and IDC_{RG}) accuracy

Current range (mA)	Accuracy	Granularity
$-20 \le IDC_{XY} \le 20$	±2 mA	1 µA
$-100 < IDC_{XY} < -20$ $20 < IDC_{XY} < 100$	±10%	1 µA

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

E.1.1.2.1 3-element capacitance

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.

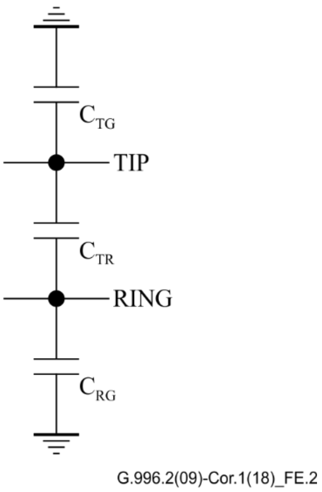


Figure E.2 – Capacitance between tip, ring and GND

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 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}

Capacitance range	Accuracy
0 nF – 60 nF	± 3 nF
60 nF – 1 µF	± 5 %
1 µF – 5 µF	± 10 %

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

Capacitance range	Accuracy
0 nF – 20 nF	± 1 nF
20 nF – 1 µF	± 5 %
1 µF – 5 µF	± 10 %

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

Capacitance range	Accuracy
0 nF – 1 µF	± 50 nF
1 µF – 5 µF	± 10 %

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

Capacitance range	Accuracy
0 nF – 100 nF	± 5 nF
100 nF – 1 µF	± 5 %
1 µF – 5 µF	± 10 %

E.1.1.2.2 Test voltages for the measurement of the 3-element capacitance with a controlled metallic voltage

This parameter reports the AC rms voltages present on the tip and ring wires while executing a 3-element capacitance test with a controlled metallic voltage, as defined in clause E.1.1.2, if performed with a sine wave signal. Three values are reported in relation with the tip-to-ground, ring-to-ground and tip-to-ring branches.

Three values VAC_{XY} shall be reported:

1) $VAC_{TR\text{-}CC}$ – AC voltage between tip and ring

2) $VAC_{TG\text{-}CC}$ – AC voltage between tip and GND

3) $VAC_{RG\text{-}CC}$ – AC voltage between ring and GND.

The accuracy for each element of this parameter is defined in Table E.5.1, while the range of valid values and granularity are defined in clause E.2.3.11.

Table E.5.1 – Measurement test voltages ($VAC_{TR\text{-}CC}$, $VAC_{TG\text{-}CC}$ and $VAC_{RG\text{-}CC}$) accuracy

Voltage range (Vrms)	Accuracy	Granularity
$0 \le VAC_{XY\text{-}CC} \le 10$	±0.5 Vrms	100 mV
$10 < VAC_{XY\text{-}CC} < 100$	±5%	100 mV

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.2.3.5) 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 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 µF. The maximum foreign DC voltages error due to the residual charge at this maximum capacitance is not expected to be higher than 1 V.

Table E.6 – Foreign DC voltages accuracy

Foreign DC voltages V_{XY} range	Accuracy
0 V – 20 V	± 1 V
20 V – 250 V	± 5 %

Table E.7 – Foreign AC voltages accuracy

Foreign AC voltages V_{XY} range	Accuracy
0 V – 20 Vrms	± 1 V rms
20 V – 250 Vrms	± 5 %

Table E.8 – Foreign AC frequency accuracy

Foreign AC frequency V_{XY} range	Accuracy
10 Hz – 60 Hz	± 3 Hz
60 Hz – 90 Hz	± 10 %

E.1.1.4 Measurement of the loop capacitance with a high metallic voltage

E.1.1.4.1 Loop capacitance

The loop capacitance $C_{TR,HV}$ is defined as the measured capacitance between tip and ring, using a high voltage to conduct current through the zener diode located in the far-end signature (see clause E.2.1.5). To this effect, the metallic voltage used by this procedure shall be higher than the maximum far-end signature conduction voltage configuration parameter (see clause E.2.1.5).

The measuring method is vendor discretionary.

The accuracy of this parameter is defined in Table E.9.

The accuracy of this parameter in cases of MELT measurements on loops being connected to SHDSL equipment according to [ITU-T G.991.2] is defined in Table E.10.

The accuracy numbers apply to a measurement performed with only one capacitance component connected to tip and ring.

NOTE – When MELT measurements on loops are 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.9 – Capacitance accuracy $C_{TR, HV}$

Capacitance range	Accuracy
0 nF – 60 nF	± 3 nF
60 nF – 1 µF	± 5 %
1 µF – 5 µF	± 10 %

Table E.10 – Capacitance accuracy $C_{TR, HV}$ for loops connected to SHDSL equipment according to [ITU-T G.991.2]

Capacitance range	Accuracy
0 nF – 1 µF	± 50 nF
1 µF – 5 µF	± 10 %

E.1.1.4.2 Test voltage for the measurement of the loop capacitance with a high metallic voltage

This parameter reports the rms AC voltage present on the tip and ring wires while executing a loop capacitance test with a high metallic voltage, as defined in clause E.1.1.4, if performed with a sine wave signal. One value is reported in relation with the tip-to-ring branch.

One value VAC_{XY} shall be reported:

1) $VAC_{TR\text{-}HC}$ – AC voltage between tip and ring

The accuracy for this parameter is defined in Table E.10.1, while the range of valid values and granularity are defined in clause E.2.3.12.

Table E.10.1 – Measurement test voltage ($VAC_{TR\text{-}HC}$) accuracy

Voltage range (Vrms)	Accuracy	Granularity
$0 \leq VAC_{TR\text{-}HC} \leq 10$	±0.5 Vrms	100 mV
$10 < VAC_{TR\text{-}HC} < 100$	±5%	100 mV

E.1.1.5 Measurement of the loop resistance with a high metallic voltage

E.1.1.5.1 ~~Measurement of the l~~Loop resistance

The loop resistances $R_{TR,HV}$ and $R_{RT,HV}$ are defined as the measured resistance between tip and ring and between ring and tip, respectively, using a high voltage to conduct current through the zener diode located in the far-end signature (see clause E.2.1.5). To this effect, the metallic voltage used by this procedure shall be higher than the maximum far-end signature conduction voltage configuration parameter (see clause E.2.1.5).

In order to identify the loop resistance, a dynamic resistance measurement using at least two voltages levels may be performed. However, the measuring method is at the vendor's discretion.

The accuracy for each element of this parameter is defined in Table E.11.

The accuracy numbers apply to a measurement performed with only one resistance connected between tip and ring.

Table E.11 – Loop resistance accuracy

$R_{XY,HV}$ range	Accuracy
0 Ω – 250 Ω	± 10 Ω
250 Ω – 1 kΩ	± 4 %
1 kΩ – 100 kΩ	± 4 %
100 kΩ – 500 kΩ	± 8 %

E.1.1.5.2 Test voltage for the measurement of the loop resistance with a high metallic voltage

This parameter reports the DC voltage present on the tip and ring wires while executing the measurement with a high metallic voltage and which are used to calculate the resistance results. Two values are reported in relation with the 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.

Two voltage values $VDCH_{XY}$ shall be reported:

1) $VDCH_{TR}$ – DC voltage between tip and ring

2) $VDCH_{RT}$ – DC voltage between ring and tip.

The accuracy for each element of this parameter is defined in Table E.11.1, while the range of valid values and granularity are defined in clause E.2.3.8.

Table E.11.1 – Measurement test voltages (*$VDCH_{TR}$* and *$VDCH_{RT}$*) accuracy

Voltage range (V)	Accuracy	Granularity
$-20 \leq VDCH_{XY} \leq 20$	±1 V	100 mV
$-100 < VDCH_{XY} < -20$ $20 < VDCH_{XY} < 100$	±5%	100 mV

Table E.11.2 –*Table intentionally left blank*

Table E.11.3 – *Table intentionally left blank*

E.1.1.6 Measurement of the 3-element complex admittances with a controlled metallic voltage

E.1.1.6.1 3-element complex admittances

When measuring a signature network made of a resistor in series with a capacitor, a simple 3-element capacitance measurement may not produce the correct component values depending on the load network topology. Better visibility is obtained by performing a test that takes the phase of the load impedance into consideration and reports its real and imaginary parts.

Three different types of admittance are defined using the following relationship:

$$Y_{XY} = G_{XY} + j \cdot B_{XY}$$

1) G_{TR}, B_{TR} – Conductance and susceptance between tip and ring

2) G_{TG}, B_{TG} – Conductance and susceptance between tip and GND

3) G_{RG}, B_{RG} – Conductance and susceptance between ring and GND

The measuring method is vendor discretionary.

In the case where the metallic branch element, G_{TR} and B_{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 admittances. 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.

E.1.1.6.2 Test voltages for the measurement of the 3-element complex admittance with a controlled metallic voltage

This parameter reports the AC rms voltages present on the tip and ring wires while executing a 3-element complex admittance test with a controlled metallic voltage, as defined in clause E.1.1.6, if performed with a sine wave signal. Three values are reported in relation with the tip-to-ground, ring-to-ground and tip-to-ring branches.

Three values VAC_{XY} shall be reported:

1) $VAC_{TR\text{-}CA}$ – AC voltage between tip and ring
2) $VAC_{TG\text{-}CA}$ – AC voltage between tip and GND
3) $VAC_{RG\text{-}CA}$ – AC voltage between ring and GND.

The accuracy for each element of this parameter is defined in Table E.11.4, while the range of valid values and granularity are defined in clause E.2.3.13.

Table E.11.4 – Measurement test voltages ($VAC_{TR\text{-}CA}$, $VAC_{TG\text{-}CA}$ and $VAC_{RG\text{-}CA}$) accuracy

Voltage range (Vrms)	Accuracy	Granularity
$0 \leq VAC_{XY\text{-}CA} \leq 10$	±0.5 Vrms	100 mV
$10 < VAC_{XY\text{-}CA} < 100$	±5%	100 mV

E.1.1.7 Measurement of the loop complex admittance with a high metallic voltage

E.1.1.7.1 Loop complex admittance

The loop branch elements $G_{TR,HV}$ and $B_{TR,HV}$ are defined as the measured conductance and susceptance between tip and ring, using a high voltage to conduct current through the zener diode located in the far-end signature (see clause E.2.1.5). To this effect, the metallic voltage used by this procedure shall be higher than the maximum far-end signature conduction voltage configuration parameter (see clause E.2.1.5).

The measurement is performed on the basis of a linear load and does not modify the result to compensate for the cross-over distortion introduced by the zener diode. To this effect, the metallic voltage applied between tip and ring should be set to a value well above the conduction threshold of the zener diode.

The measuring method is vendor discretionary.

NOTE – If the tip-to-ground and ring-to-ground impedances are large in comparison to the tip-to-ring impedance, the testing time can be reduced by only measuring the impedance in the metallic branch instead of executing the 3-element resistance and capacitance measurements.

The accuracy of this parameter is for further study.

~~E.1.1.8 Measurement voltages for the 3-element capacitance test with a controlled metallic voltage~~

~~This parameter reports the AC voltages present on the tip and ring wires while executing a 3-element capacitance test with a controlled metallic voltage as defined in clause E.1.1.2, if performed with a sine wave signal. Three values are reported in relation with the tip-to-ground, ring-to-ground and tip-to-ring branches.~~

~~Three values VAC_{XY} shall be reported:~~

~~1) $VAC_{TR\text{-}CC}$ – AC voltage between tip and ring~~
~~2) $VAC_{TG\text{-}CC}$ – AC voltage between tip and GND~~
~~3) $VAC_{RG\text{-}CC}$ – AC voltage between ring and GND.~~

The accuracy for each element of this parameter is defined in Table E.11.2, while the range of valid values and granularity are defined in clause E.2.3.11.

Table E.11.2 – Measurement test voltages (VAC_{TR-CC}, VAC_{TG-CC} and VAC_{RG-CC}) accuracy

Voltage range (Vrms)	Accuracy	Granularity
$0 \leq VAC_{XY-CC} \leq 10$	±0.5 Vrms	100 mV
$10 < VAC_{XY-CC} < 100$	±5%	100 mV

E.1.1.9 Measurement voltage for the loop capacitance test with a high metallic voltage

This parameter reports the AC voltage present on the tip and ring wires while executing a loop capacitance test with a high metallic voltage as defined in clause E.1.1.4, if performed with a sine wave signal. One value is reported in relation with the tip-to-ring branch.

One value VAC_{XY} shall be reported:

1) VAC_{TR-HC} AC voltage between tip and ring

The accuracy for this parameter is defined in Table E.11.3, while the range of valid values and granularity are defined in clause E.2.3.12.

Table E.11.3 – Measurement test voltage (VAC_{TR-HC}) accuracy

Voltage range (Vrms)	Accuracy	Granularity
$0 \leq VAC_{TR-HC} \leq 10$	±0.5 Vrms	100 mV
$10 < VAC_{TR-HC} < 100$	±5%	100 mV

E.1.1.10 Measurement voltages for the 3-element complex admittance test with a controlled metallic voltage

This parameter reports the AC voltages present on the tip and ring wires while executing a 3-element complex admittance test with a controlled metallic voltage as defined in clause E.1.1.6, if performed with a sine wave signal. Three values are reported in relation with the tip-to-ground, ring-to-ground and tip-to-ring branches.

Three values VAC_{XY} shall be reported:

1) VAC_{TR-CA} AC voltage between tip and ring

2) VAC_{TG-CA} AC voltage between tip and GND

3) VAC_{RG-CA} AC voltage between ring and GND.

The accuracy for each element of this parameter is defined in Table E.11.4, while the range of valid values and granularity are defined in clause E.2.3.13.

Table E.11.4 – Measurement test voltages (VAC_{TR-CA}, VAC_{TG-CA} and VAC_{RG-CA}) accuracy

Voltage range (Vrms)	Accuracy	Granularity
$0 \leq VAC_{XY-CA} \leq 10$	±0.5 Vrms	100 mV
$10 < VAC_{XY-CA} < 100$	±5%	100 mV

E.1.1.~~11~~7.2 Test ~~Measurement~~ voltage for the measurement of the loop complex admittance ~~test~~ with a high metallic voltage

This parameter reports the AC rms voltage present on the tip and ring wires while executing a loop complex admittance test with a high metallic voltage, as defined in clause E.1.1.7, if performed with a sine wave signal. One value is reported in relation with the tip-to-ring branch.

One value VAC_{XY} shall be reported:

1) $VAC_{TR\text{-}HA}$ – AC voltage between tip and ring

The accuracy for this parameter is defined in Table E.11.5, while the range of valid values and granularity are defined in clause E.2.3.14.

Table E.11.5 – Measurement test voltage ($VAC_{TR\text{-}HA}$) accuracy

Voltage range (Vrms)	Accuracy	Granularity
$0 \le VAC_{TR\text{-}HA} \le 10$	±0.5 Vrms	100 mV
$10 < VAC_{TR\text{-}HA} < 100$	±5%	100 mV

E.1.1.~~12~~8 Combined measurement of 4-element resistance and 3-element capacitance

The accuracy numbers defined in clauses E.1.1.1.1 and E.1.1.2 apply to a 4-element DC resistance and a 3-element capacitance measurement performed on a single component. This clause defines the accuracy numbers for a combined measurement performed on a multiple component network as shown in Figure E.3. The network consists of six components located tip-to-ring, tip-to-ground and ring-to-ground, with neither foreign voltages nor a signature network connected to it.

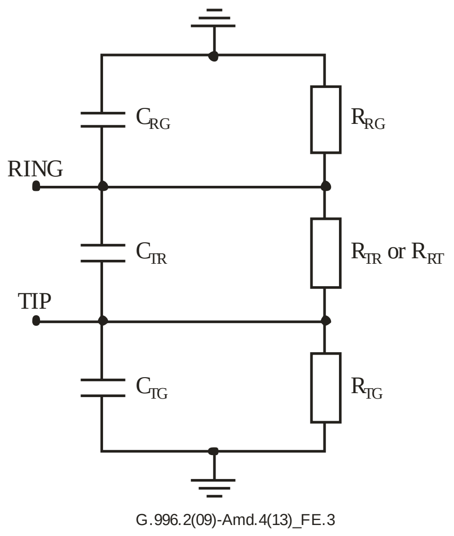


Figure E.3 – Multiple component network

The accuracy numbers included in Tables E.11.8 to E.11.12 are applicable to a combined measurement of 4-element DC resistance and 3-element capacitance when using any combination of external components selected within the range of values defined in Table E.11.6 or in Table E.11.7. Tables E.11.8 to E.11.12, indicating the accuracy of individual components when measured within a multi-component network, shall not be used for components outside of the range covered by Tables E.11.6 and E.11.7.

Table E.11.6 – Range of external components for MELT measurements on ADSLplus or VSDL equipment

Resistance range:	1 MΩ to 6.8 MΩ
C_{TG} and C_{RG} capacitance range:	22 nF to 470 nF
C_{TR} capacitance range:	10 nF to 100 nF

Table E.11.7 – Range of external components for MELT measurements on SHDSL equipment

Resistance range:	1 MΩ to 6.8 MΩ
C_{TG} and C_{RG} capacitance range:	22 nF to 470 nF
C_{TR} capacitance range:	100 nF to 1 μF

Tables E.11.8 to E.11.12 provide the accuracy of individual components when measured within a multi-component network. Those accuracy figures are applicable when all components have values selected within the ranges specified in Table E.11.5 for ADSL2plus or VDSL applications, or specified in Table E.11.6 for SHDSL applications. The accuracies are cumulative when both an absolute and a relative figure are provided. The 7-element parameter set, that is the four DC resistances (R_{TR}, R_{RT}, R_{TG} and R_{RG}) and the three capacitances (C_{TR}, C_{TG} and C_{RG}), shall be measured and reported.

Table E.11.8 – Resistance accuracy R_{TR}, R_{TG}, R_{RG}

Resistance range	Accuracy
1 MΩ-4 MΩ	±15%
4 MΩ-5 MΩ	±20%
5 MΩ-6.8 MΩ	±25%

Table E.11.9 – Capacitance accuracy C_{TR} for MELT measurements on ADSLplus or VSDL equipment

Capacitance range	Accuracy
10 nF-60 nF	±7 nF
60 nF-100 nF	±(4 nF + 5%)

Table E.11.10 – Capacitance accuracy C_{TG}, C_{RG} for MELT measurements on ADSLplus or VSDL equipment

Capacitance range	Accuracy
22 nF-60 nF	±6 nF
60 nF-300 nF	±(3 nF + 5%)
300 nF-470 nF	±6%

Table E.11.11 – Capacitance accuracy C_{TR} for MELT measurements on SHDSL equipment

Capacitance range	Accuracy
100 nF-700 nF	±55 nF
700 nF-1 μF	±(20 nF + 5%)

Table E.11.12 – Capacitance accuracy C_{TG}, C_{RG} for MELT measurements on SHDSL equipment

Capacitance range	Accuracy
22 nF-250 nF	±25 nF
250 nF-470 nF	±(15 nF + 4%)

E.1.2 MELT-PMD non-measurement functions

E.1.2.1 Pair identification tone generation

This function shall be used to generate a tone in the frequency range defined in clause E.2.1.4 at a signal level of at least 120 mVrms but not higher than 330 mVrms on 600 ohms between tip and ring of the MELT-PMD unit. The actual level is vendor discretionary. This function does not report any measurement result to the ~~MELT-ME-PMD~~MELT-PMD-ME. In order to identify the individual wires (tip or ring), a DC voltage of 10 V ±2 V shall be superimposed on the pair identification tone between tip and ring such that the tip wire is positive with respect to the ring wire.

NOTE – The generated tone may be listened to or detected by a field technician.

E.2 MELT-PMD management entity

E.2.1 MELT-PMD management entity configuration parameters

E.2.1.1 Measurement class

This parameter defines the list of measurements to be executed. It shall support a single measurement or a set of MELT measurements in a consecutive manner. The measurements of interest are selected via a flag register, or equivalent.

The following measurement tests can be enabled:

1) Measurement of the 4-element DC resistance with a controlled metallic voltage

2) Measurement of the 3-element capacitance with a controlled metallic voltage

3) Measurement of foreign DC voltage

4) Measurement of foreign AC voltage

5) Measurement of the loop capacitance with a high metallic voltage

6) Measurement of the loop resistance with a high metallic voltage

7) Measurement of the 3-element complex admittances with a controlled metallic voltage

8) Measurement of the loop complex admittance with a high metallic voltage

As pair identification tone is a non-measurement-function of long duration, it is not part of measurement class. Its activation shall be an alternative to the measurement activation.

E.2.1.2 Peak metallic voltage between tip and ring

This parameter defines the peak metallic voltage which must not be exceeded in any active measurement applying a metallic voltage between tip and ring in order not to conduct current in a non-linear termination located at the far-end during the measurement. The range of valid values is from 0 to 100150 V with a granularity of 1 V. In the case of a test performed with a sinewave signal, it applies to the peak of the sinewave, not to its rms value.

E.2.1.3 Test Signal frequency for active AC measurementstests

This parameter controls the frequency used during the 3-element capacitance test, if performed with a sinewave signal, and during the 3-element complex admittance test. This parameter shall be represented in linear format with values from 10 to 1000 Hz with a granularity of 1 Hz.

The supported set of frequencies is at the vendor's discretion with an option to operate in automatic mode for which the testing routine will select the frequency on its own.

E.2.1.4 Pair identification tone frequency

This parameter sets up the frequency of the pair identification tone as defined in clause E.1.2.1. The range of frequencies is from 300 to 3400 Hz in granularity of 1 Hz.

The supported set of frequencies is at the vendor's discretion.

E.2.1.5 Pair identification tone timeout

For further study.

E.2.1.56 Maximum far-end signature conduction voltage

This parameter specifies the maximum conduction voltage level of an expected far-end signature. It defines the minimum metallic voltage required for all measurements with a high metallic voltage between tip and ring in order to conduct current in a far-end signature during the measurement. The range of valid values is from 0 to 50 V with a granularity of 0.1 V.

E.2.1.76 Minimum far-end signature conduction voltage

This parameter specifies the minimum conduction voltage level of an expected far-end signature. It defines the maximum metallic voltage allowed for all measurements with a controlled metallic voltage between tip and ring in order not to conduct current in a far-end signature during the measurement. The range of valid values is from 0 to 50 V with a granularity of 0.1 V. In the case of a measurement performed with a sinewave signal, it applies to the peak of the sinewave, not to its rms value.

E.2.2 MELT-PMD management entity reporting parameters

E.2.2.1 Measurement Test frequency for active AC measurementstests

This parameter is the measurement test frequency for a 3-element capacitance measurement, if performed with a sinewave signal, or a for 3-element complex admittance measurement. The range of valid values is from 10 to 1000 Hz with a granularity of 1 Hz.

E.2.2.2 Input impedance for foreign voltage measurements

This parameter reports the nominal input impedance of the measuring instrument during foreign voltage tests. The range of valid values is from 0 to 10 MΩ with a granularity of 1 Ω.

E.2.2.3 Peak ~~Ttest~~ source voltage for the measurement of the loop complex admittance with a high metallic voltage

This parameter ~~is~~reports the peak voltage~~amplitude~~ of the differential~~ sinewave~~ signal generator used ~~by~~to execute the measurement of the loop complex admittance with a high metallic voltage~~ metallic test~~ (see clause E.1.1.7). The range of valid values is from 0 to ~~100~~150 V and it shall be represented in linear format with a granularity of 0.1 V.

E.2.3 MELT-PMD management entity measurement parameters

E.2.3.1 4-element DC resistance with controlled metallic voltage

The 4-element DC resistances R_{TR}, R_{RT}, R_{TG} and R_{RG}, shall be represented in linear format. The range of valid values is from 0 to 10 MΩ with a granularity of 1 Ω.

NOTE – The linear format is chosen for simplicity reason and does not imply any future accuracy requirements.

E.2.3.2 DC test voltages for the measurement of the 4-element DC resistance with a controlled metallic voltage

The DC test voltages for the measurement of the 4-element DC resistance VDC_{TR}, VDC_{RT}, VDC_{TG} and VDC_{RG}, shall be represented in linear format. The range of valid values is from –~~100~~150 V to +~~100~~150 V with a granularity of 0.1 V.

NOTE – The linear format is chosen for simplicity reason and does not imply any future accuracy requirements.

E.2.3.3 Test currents for the 4-element DC resistance with a controlled metallic voltage

The DC test currents for the measurement of the 4-element DC resistance IDC_{TR}, IDC_{RT}, IDC_{TG} and IDC_{RG}, shall be represented in linear format. The range of valid values is from –1 A to +1 A with a granularity of 1 µA.

NOTE – The linear format is chosen for simplicity reason and does not imply any future accuracy requirements.

E.2.3.4 3-element capacitance with controlled metallic voltage

The 3-element capacitances C_{TR}, C_{TG} and C_{RG}, shall be represented in linear format. The range of valid values is from 0 to 5 µF with a granularity of 0.1 nF.

NOTE – The linear format is chosen for simplicity reason and does not imply any future accuracy requirements.

E.2.3.5 Foreign voltage

The range of valid values for the foreign DC voltages $V_{TR,DC}$, $V_{TG,DC}$ and $V_{RG,DC}$ is from –350 to 350 V. The range of valid values for the foreign AC voltages $V_{TR,AC}$, $V_{TG,AC}$ and $V_{RG,AC}$ is from 0 to 250 Vrms. The foreign AC and DC voltages shall be represented in linear format with a granularity of 100 mV. The range of valid values for the foreign AC voltage frequencies $F_{TR,AC}$, $F_{TG,AC}$ and $F_{RG,AC}$ is from 10 to 90 Hz with a granularity of 0.1 Hz.

NOTE – The voltage actually present on the tip and ring leads may be limited by the presence of protection components.

The reported DC voltage polarity is defined with respect to ground for the $V_{TG,DC}$ and $V_{RG,DC}$ measurements and returns a positive result for the $V_{TR,DC}$ measurement if the tip wire is more positive than the ring wire.

E.2.3.6 Loop capacitance with high metallic voltage

The loop capacitance $C_{TR,HV}$ shall be represented in linear format. The range of valid values is from 0 to 5 µF with a granularity of 0.1 nF. The $C_{TR,HV}$ value of the loop capacitance with high metallic voltage test is the total capacitance measured. The C_{TR} value obtained from the 3-element capacitance with controlled metallic voltage test is not subtracted from the results.

NOTE – The linear format is chosen for simplicity reason and does not imply any future accuracy requirements.

E.2.3.7 Loop resistance with high metallic voltage

The loop resistances $R_{TR,HV}$ and $R_{RT,HV}$ shall be represented in linear format. The range of valid values is from 0 to 10 MΩ with a granularity of 1 Ω. The $R_{TR,HV}$ and $R_{RT,HV}$ values of the loop resistance with high metallic voltage test are the total resistances measured. The R_{TR} and R_{RT} values obtained from the 3-element resistance with controlled metallic voltage test are not subtracted from the results.

NOTE – The linear format is chosen for simplicity reason and does not imply any future accuracy requirements.

E.2.3.8 Test voltage for the measurement of the loop resistance with a high metallic voltage

The DC test voltages for the measurement of the loop resistance with a high metallic voltage $VDCH_{TR}$ and $VDCH_{RT}$ shall be represented in linear format. The range of valid values is from –~~100~~150 V to +~~100~~150 V with a granularity of 0.1 V.

NOTE – The linear format is chosen for simplicity reason and does not imply any future accuracy requirements.

E.2.3.9 3-element complex admittance with controlled metallic voltage

The range of valid values for the 3-element complex conductances and susceptances G_{TR}, B_{TR}, G_{TG}, B_{TG}, G_{RG} and B_{RG} is from 0.1 µSiemens to 0.1 Siemens. The values shall be represented in linear format with a granularity of 0.1 µSiemens.

NOTE – The linear format is chosen for simplicity reason and does not imply any future accuracy requirements.

E.2.3.10 Loop complex admittance with high metallic voltage

The range of valid values for the 3-element complex conductance and susceptance $G_{TR,HV}$, and $B_{TR,HV}$ is from 0.1 µSiemens to 0.1 Siemens. The values shall be represented in linear format with a granularity of 0.1 µSiemens. The $G_{TR,HV}$ and $B_{TR,HV}$ values of the loop complex admittance with high metallic voltage test are the total conductance and susceptance measured. The G_{TR} and B_{TR} values obtained from the 3-element complex admittance with controlled metallic voltage test are not subtracted from the results.

NOTE – The linear format is chosen for simplicity reason and does not imply any future accuracy requirements.

E.2.3.11 ~~Measurement~~Test voltages for the measurement of the 3-element capacitance ~~test~~ with a controlled metallic voltage

The range of valid values for the AC voltages $VAC_{TR\text{-}CC}$, $VAC_{TG\text{-}CC}$, and $VAC_{RG\text{-}CC}$ for the 3-element capacitance test with a controlled metallic voltage is from 0 V rms to ~~100~~150 V rms. The values shall be represented in linear format with a granularity of 0.1 V.

NOTE 1 – The linear format is chosen for simplicity reason and does not imply any future accuracy requirements.

NOTE 2 – The voltage is reported as rms in general. This does not necessarily imply usage of a sinewave.

E.2.3.12 Test ~~Measurement~~ voltage for the measurement of the loop capacitance ~~test~~ with a high metallic voltage

The range of valid values for the AC voltage $VAC_{TR\text{-}HC}$ for the loop capacitance test with a high metallic voltage is from 0 Vrms to ~~100~~150 Vrms. The values shall be represented in linear format with a granularity of 0.1 V.

NOTE 1 – The linear format is chosen for simplicity reason and does not imply any future accuracy requirements.

NOTE 2 – The voltage is reported as rms in general. This does not necessarily imply usage of a sinewave.

E.2.3.13 Test ~~Measurement~~ voltages for the measurement of the 3-element complex admittance ~~test~~ with a controlled metallic voltage

The range of valid values for the AC voltages $VAC_{TR\text{-}CA}$, $VAC_{TG\text{-}CA}$, and $VAC_{RG\text{-}CA}$ for the 3-element complex admittance test with a controlled metallic voltage is from 0 Vrms to ~~100~~150 Vrms. The values shall be represented in linear format with a granularity of 0.1 V.

NOTE 1 – The linear format is chosen for simplicity reason and does not imply any future accuracy requirements.

NOTE 2 – The voltage is reported as rms in general. This does not necessarily imply usage of a sinewave.

E.2.3.14 Test ~~Measurement~~ voltage for the measurement of the loop complex admittance ~~test~~ with a high metallic voltage

The range of valid values for the AC voltage $VAC_{TR\text{-}HA}$ for the loop complex admittance test with a high metallic voltage is from 0 V rms to ~~100~~150 V rms. The values shall be represented in linear format with a granularity of 0.1 V.

NOTE 1 – The linear format is chosen for simplicity reason and does not imply any future accuracy requirements.

NOTE 2 – The voltage is reported as rms in general. This does not necessarily imply usage of a sinewave.

E.2.4 MELT-PMD management entity parameter partitioning

This clause defines the parameters which correspond to the η_C reference point.

The parameters at the η_C reference point are described by Table E.12, indicating the status of the parameter as:

– R are read only.

– W are write only.

– R/W are read and write.

– (M) are mandatory.

– (O) are optional.

R and W are defined as:

– W: parameter written by the ~~MELT-ME-P~~MELT-P-ME-C to the ~~MELT-ME-PMD~~MELT-PMD-ME-C.

– R: parameter provided by the ~~MELT-ME-PMD~~MELT-PMD-ME-C to be read by the ~~MELT-ME-P~~MELT-P-ME-C.

Table E.12 – Partitioning of ~~MELT-ME-PMD~~MELT-PMD-ME parameters

Category/element	Defined in clause	η_C – reference point
MELT-PMD configuration parameters		
Measurement class (MELT-MCLASS)	E.2.1.1	R/W (O)
Peak metallic voltage between tip and ring (MELT-PV)	E.2.1.2	R/W (M)
Signal frequency for active AC tests (MELT-AC-F)	E.2.1.3	R/W (O)
Pair identification tone frequency (MELT-PIT-F)	E.2.1.4	R/W (M)
Maximum far-end signature conduction voltage (MELT-MAXFE-SCV)	E.2.1.5	R/W (M)
Minimum far-end signature conduction voltage (MELT-MINFE-SCV)	E.2.1.6	R/W (M)
MELT-PMD reporting parameters		
~~Measurement~~ Test frequency for active AC ~~tests~~measurements (MELT-~~M~~TFREQ)	E.2.2.1	R (O)
Input impedance for foreign voltage measurements (MELT-IMP-V)	E.2.2.2	R (O)
Peak source~~Measurement~~ voltage for the measurement of the loop complex admittance with a high metallic voltage ~~test~~ (MELT-HCA-V)	E.2.2.3	R (O)
MELT-PMD measurement parameters		
4-element DC resistance with controlled metallic voltage R_{TR} (MELT-CDCR-TR)	E.2.3.1	R (M)
4-element DC resistance with controlled metallic voltage R_{RT} (MELT-CDCR-RT)	E.2.3.1	R (M)
4-element DC resistance with controlled metallic voltage R_{TG} (MELT-CDCR-TG)	E.2.3.1	R (M)
4-element DC resistance with controlled metallic voltage R_{RG} (MELT-CDCR-RG)	E.2.3.1	R (M)
DC test voltage for the measurement of the 4-element DC resistance with a controlled metallic voltage VDC_{TR} (MELT-CDCV-TR)	E.2.3.2	R(O)
DC test voltage for the measurement of the 4-element DC resistance with a controlled metallic voltage VDC_{RT} (MELT-CDCV-RT)	E.2.3.2	R(O)
DC test voltage for the measurement of the 4-element DC resistance with a controlled metallic voltage VDC_{TG} (MELT-CDCV-TG)	E.2.3.2	R(O)
DC test voltage for the measurement of the 4-element DC resistance with a controlled metallic voltage VDC_{RG} (MELT-CDCV-RG)	E.2.3.2	R(O)
Test current for the measurement of the 4-element DC resistance with a controlled metallic voltage IDC_{TR} (MELT-CDCI-TR)	E.2.3.3	R(O)
Test current for the measurement of the 4-element DC resistance with a controlled metallic voltage IDC_{RT} (MELT-CDCI-RT)	E.2.3.3	R(O)
Test current for the measurement of the 4-element DC resistance with a controlled metallic voltage IDC_{TG} (MELT-CDCI-TG)	E.2.3.3	R(O)
Test current for the measurement of the 4-element DC resistance with a controlled metallic voltage IDC_{RG} (MELT-CDCI-RG)	E.2.3.3	R(O)
3-element capacitance with controlled metallic voltage C_{TR} (MELT-CC-TR)	E.2.3.4	R (M)
3-element capacitance with controlled metallic voltage C_{TG} (MELT-CC-TG)	E.2.3.4	R (M)
3-element capacitance with controlled metallic voltage C_{RG} (MELT-CC-RG)	E.2.3.4	R (M)
Foreign DC voltage $V_{TR,DC}$ (MELT-FVDC-TR)	E.2.3.5	R (M)
Foreign DC voltage $V_{TG,DC}$ (MELT-FVDC-TG)	E.2.3.5	R (M)
Foreign DC voltage $V_{RG,DC}$ (MELT-FVDC-RG)	E.2.3.5	R (M)

Table E.12 – Partitioning of ~~MELT-ME-PMD~~MELT-PMD-ME parameters

Category/element	Defined in clause	η_C – reference point
Foreign AC voltage $V_{TR,AC}$ (MELT-FVAC-TR)	E.2.3.5	R (M)
Foreign AC voltage $V_{TG,AC}$ (MELT-FVAC-TG)	E.2.3.5	R (M)
Foreign AC voltage $V_{RG,AC}$ (MELT-FVAC-RG)	E.2.3.5	R (M)
Foreign AC voltage frequency $F_{TR,AC}$ (MELT-FVACF-TR)	E.2.3.5	R (M)
Foreign AC voltage frequency $F_{TG,AC}$ (MELT-FVACF-TG)	E.2.3.5	R (M)
Foreign AC voltage frequency $F_{RG,AC}$ (MELT-FVACF-RG)	E.2.3.5	R (M)
Loop capacitance with high metallic voltage $C_{TR,HV}$ (MELT-HC-TR)	E.2.3.6	R (M)
Loop resistance with high metallic voltage $R_{TR,HV}$ (MELT-HDCR-TR)	E.2.3.7	R (M)
Loop resistance with high metallic voltage $R_{RT,HV}$ (MELT-HDCR-RT)	E.2.3.7	R (M)
Test voltage for the measurement of the loop resistance with a high metallic voltage $VDCH_{TR}$ (MELT-HDCV-TR)	E.2.3.8	R (O)
Test voltage for the measurement of the loop resistance with a high metallic voltage $VDCH_{RT}$ (MELT-HDCV-RT)	E.2.3.8	R (O)
3-element complex admittance with controlled metallic voltage real part G_{TR} (MELT-CAG-TR)	E.2.3.9	R (O)
3-element complex admittance with controlled metallic voltage imaginary part B_{TR} (MELT-CAB-TR)	E.2.3.9	R (O)
3-element complex admittance with controlled metallic voltage real part G_{TG} (MELT-CAG-TG)	E.2.3.9	R (O)
3-element complex admittance with controlled metallic voltage imaginary part B_{TG} (MELT-CAB-TG)	E.2.3.9	R (O)
3-element complex admittance with controlled metallic voltage real part G_{RG} (MELT-CAG-RG)	E.2.3.9	R (O)
3-element complex admittance with controlled metallic voltage imaginary part B_{RG} (MELT-CAB-RG)	E.2.3.9	R (O)
Loop complex admittance with high metallic voltage real part $G_{TR,HV}$ (MELT-HAG-TR)	E.2.3.10	R (O)
Loop complex admittance with high metallic voltage imaginary part $B_{TR,HV}$ (MELT-HAB-TR)	E.2.3.10	R (O)
Test voltage for the measurement of the 3-element capacitance with a controlled metallic voltage~~Measurement voltage~~ VAC_{TR-CC} (MELT-ACV-CC-TR)	E.2.3.11	R (O)
Test voltage for the measurement of the 3-element capacitance with a controlled metallic voltage~~Measurement voltage~~ VAC_{TG-CC} (MELT-ACV-CC-TG)	E.2.3.11	R (O)
Test voltage for the measurement of the 3-element capacitance with a controlled metallic voltage~~Measurement voltage~~ VAC_{RG-CC} (MELT-ACV-CC-RG)	E.2.3.11	R (O)
Test voltage for the measurement of the loop capacitance with a high metallic voltage~~Measurement voltage~~ VAC_{TR-HC} (MELT-ACV-HC-TR)	E.2.3.12	R (O)
Test voltage for the measurement of the 3-element complex admittance with a controlled metallic voltage~~Measurement voltage~~ VAC_{TR-CA} (MELT-ACV-CA-TR)	E.2.3.13	R (O)
Test voltage for the measurement of the 3-element complex admittance with a controlled metallic voltage~~Measurement voltage~~ VAC_{TG-CA} (MELT-ACV-CA-TG)	E.2.3.13	R (O)

Table E.12 – Partitioning of ~~MELT-ME-PMD~~MELT-PMD-ME parameters

Category/element	Defined in clause	η_C – reference point
Test voltage for the measurement of the 3-element complex admittance with a controlled metallic voltage~~Measurement voltage~~ $VAC_{RG\text{-}CA}$ (MELT-ACV-CA-RG)	E.2.3.13	R (O)
Test voltage for the measurement of the loop complex admittance with a high metallic voltage~~Measurement voltage~~ $VAC_{TR\text{-}HA}$ (MELT-ACV-HA-TR)	E.2.3.14	R (O)

E.3 Test management

For further study.

3) Annex F, Specific requirements for a MELT-P

Update Annex F as follows:

Annex F

Specific requirements for a MELT-P

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

F.1 MELT-P functions

MELT-P functions are applicable at the Q-interface only.

F.1.1 MELT-P derived parameters

F.1.1.1 Identification of an open wire failure

In case of an open wire failure, this parameter provides information about the type of failure and the estimated distance from the central office.

F.1.1.1.1 Open wire failure type

This sub-parameter is a five state indication of the type of open wire failure defined as follows:

1) No open wire failure detected
2) Tip and ring wires open in equal distance
3) Tip wire open
4) Ring wire open
5) Undefined.

NOTE – An error-free loop will be classified as failure state 2) in case that the remote end of the loop was left open during the measurement, or the connected CPE equipment could not be detected (too low parallel CPE system capacitance).

F.1.1.1.2 Distance to the open wire failure

This parameter represents a best-effort estimate of the distance of the detected open wire failure from the measurement point, i.e., from the central office or of the total loop length if no failure is detected. *A priori* knowledge of the loop characteristics is required for reliable estimation of the distance (see clause F.2.1.2). The range of valid values is from 0 to 10-000 m with a granularity of 1 m.

The accuracy is for further study.

When the presence of the CPE equipment has been detected, the system capacitance at the CPE side (see clause F.2.1.7) shall be subtracted from the C_{TR} capacitance to calculate and report the cable length. If this value is not available, the calculation shall be based solely on the C_{TG} and C_{RG} capacitances.

F.1.1.2 Identification of a short circuit failure

In case of a short circuit failure, this parameter provides information about the type of failure.

F.1.1.2.1 Short circuit failure type

This parameter is a six-state indication of the type of short circuit failure defined as follows:

1) No short circuit detected
2) Tip and ring wires shorted to GND
3) Tip wire shorted to GND
4) Ring wire shorted to GND
5) Tip and ring wires shorted to each other
6) Undefined.

F.1.1.3 Leakage identification

This parameter indicates a leakage to GND failure, classified into the following states:

– No leakage detected
– Tip and ring wire leaking to GND
– Tip wire leaking to GND
– Ring wire leaking to GND.

F.1.1.4 Resistive fault identification

This parameter indicates a resistive fault to GND failure, classified into the following states:

– No resistive fault detected
– Resistive fault tip and ring to GND
– Resistive fault tip to GND
– Resistive fault ring to GND.

F.1.1.5 Foreign voltage classification

F.1.1.5.1 Foreign voltage type

The foreign voltage impairment in the loop under test is classified into the following states:

– No foreign voltage detected
– 16 2/3 Hz AC voltage
– 25 Hz AC voltage
– 50 Hz AC voltage
– 60 Hz AC voltage
– POTS equipment (–48 V DC)
– ISDN equipment (–96 V DC)
– Undefined foreign voltage detected.

This classification shall be done separately for both, the tip and the ring wire.

F.1.1.5.2 Foreign voltage level class

This parameter provides a general classification of the foreign voltage into the following classes:

– hazardous potential (e.g., power contact);

– foreign electromotive force;

– other.

F.1.1.6 Far-end signature topology identification

F.1.1.6.1 Far-end signature topology type

This parameter specifies the topology types of the detected far-end signature. The valid signature topology types are defined in Figure F.1.

NOTE 1 – The far-end signature capacitance C_{SIG} can be estimated from the capacitance measurement at low voltage C_{TR} (see clause E.1.1.2) and the capacitance measurement at high voltage $C_{TR,HV}$ (see clause E.1.1.4), using a vendor-discretionary algorithm.

NOTE 2 – The passive termination resistance (R_{PT}) can be estimated from two consecutive measurements of resistance (R_{TR} and R_{RT}, see clause E.1.1.1) using a vendor-discretionary algorithm.

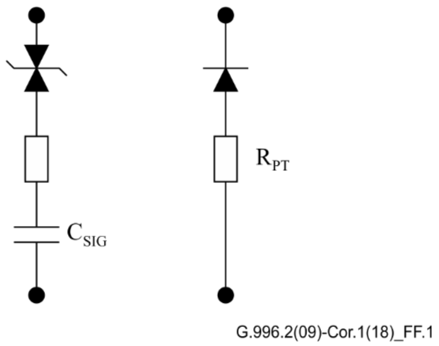


Figure F.1 – Valid signature topology types (resp. ZRC (left) and DR (right))

Valid response values are:

– no signature detected;

– unknown signature;

– signature type DR detected;

– signature type ZRC detected

F.2 MELT-P management entity

F.2.1 MELT-P management entity configuration parameters

F.2.1.1 Loop resistance classification threshold

This parameter defines the limits for classification of the resistances to GND of the loop under test. The following limit values need to be defined:

– maximum resistance for a short-circuit to GND;

– minimum resistance for a leakage to GND;

– maximum resistance for a leakage to GND.

A resistance to ground measured as being:

– Below the maximum resistance for a short circuit shall be interpreted as a short circuit to GND.

– Above the maximum resistance for a short circuit and below the minimum resistance for a leakage shall be interpreted as a resistance fault to GND.

– Above the minimum resistance for a leakage and below the maximum resistance for a leakage shall be interpreted as a leakage to GND.

– Above the maximum resistance for a leakage shall be interpreted as a high impedance to GND.

F.2.1.2 Loop parameters per unit length

The *a priori* knowledge of some characteristic parameters per unit length of the loop under test is necessary to derive length or distance information from the MELT-PMD measurements. This parameter combines the set of required loop parameters:

1) Cable characteristic capacitance per unit length between tip and ring. The range of valid values is from 0 to 100 nF/km with a granularity of 0.1 nF/km.

2) Cable characteristic capacitance per unit length between tip and GND and ring and GND. The range of valid values is from 0 to 100 nF/km with a granularity of 0.1 nF/km.

3) Cable loop DC resistance per unit length (sum of both wires). The range of valid values is from 50 to 400 Ω/km with a granularity of 1 Ω/km.

F.2.1.3 Hazardous DC voltage level

This parameter defines the level above which DC voltage shall be identified as hazardous. The hazardous voltage level shall be configurable between 0 and 200 V with a granularity of 1 V.

F.2.1.4 Hazardous AC voltage level

This parameter defines the level above which AC voltage shall be identified as hazardous. The hazardous voltage level shall be configurable between 0 and 200 Vrms with a granularity of 1 Vrms.

F.2.1.5 Foreign EMF DC voltage level

This parameter defines the level above which a DC voltage shall be identified as a foreign EMF. The foreign EMF voltage level shall be configurable between 0 and 50 V with a granularity of 1 V.

F.2.1.6 Foreign EMF AC voltage level

This parameter defines the level above which an AC voltage shall be identified as a foreign EMF. The foreign EMF voltage level shall be configurable between 0 and 50 Vrms with a granularity of 1 Vrms.

F.2.1.7 System capacitance at the CPE side

This parameter is the expected value of the system capacitance at the CPE side as it appears in parallel between tip and ring in a corresponding MELT measurement. *A priori* knowledge of this capacitance improves accuracy of the results and offers additional degrees for interpretation.

The range of valid values is from 0 to 2 µF with a granularity of 0.1 nF.

F.2.2 MELT-P management entity derived parameters

F.2.2.1 Identification of an open wire failure

F.2.2.1.1 Open wire failure type

The parameter in the ~~MELT-ME-P~~MELT-P-ME shall have the same format as specified for the MELT-P. See clause F.1.1.1.1.

F.2.2.1.2 Distance to the open wire failure

The parameter in the MELT-ME-PMELT-P-ME shall have the same format as specified for the MELT-P. See clause F.1.1.1.2.

F.2.2.2 Identification of a short circuit failure

F.2.2.2.1 Short circuit failure type

The parameter in the MELT-ME-PMELT-P-ME shall have the same format as specified for the MELT-P. See clause F.1.1.2.1.

F.2.2.3 Leakage identification

The parameter in the MELT-ME-PMELT-P-ME shall have the same format as specified for the MELT-P. See clause F.1.1.3.

F.2.2.4 Resistive fault identification

The parameter in the MELT-ME-PMELT-P-ME shall have the same format as specified for the MELT-P. See clause F.1.1.4.

F.2.2.5 Foreign voltage classification

F.2.2.5.1 Foreign voltage type

The parameter in the MELT-ME-PMELT-P-ME shall have the same format as specified for the MELT-P. See clause F.1.1.5.1.

F.2.2.5.2 Foreign voltage level class

The parameter in the MELT-ME-PMELT-P-ME shall have the same format as specified for the MELT-P. See clause F.1.1.5.2.

F.2.2.6 Far-end signature topology identification

F.2.2.6.1 Far-end signature topology type

The parameter in the MELT-ME-PMELT-P-ME shall have the same format as specified for the MELT-P. See clause F.1.1.6.1.

F.2.3 MELT-P network management elementmanagement entity parameter partitioning

This clause defines the network management elements which correspond to the Q-interface.

The parameters at the Q-interface are described by Table F.1 indicating the status of the parameter as:

– R are read only.
– W are write only.
– R/W are read and write.
– (M) are mandatory.
– (O) are optional.

Table F.1 – Partitioning of ~~MELT-ME-P~~MELT-P-ME parameters

Category/element	Defined in clause	Q – interface
MELT-PMD configuration parameters		
Measurement class (MELT-MCLASS)	E.2.1.1	R/W (O)
Peak metallic voltage between tip and ring (MELT-PV)	E.2.1.2	R/W (M)
Signal frequency for active AC tests (MELT-AC-F)	E.2.1.3	R/W (O)
Pair identification tone frequency (MELT-PIT-F)	E.2.1.4	R/W (M)
Maximum far-end signature conduction voltage (MELT-MAXFE-SCV)	E.2.1.5	R/W (M)
Minimum far-end signature conduction voltage (MELT-MINFE-SCV)	E.2.1.6	R/W (M)
MELT-PMD reporting parameters		
~~Measurement~~ Test frequency for active AC ~~tests~~ measurements (MELT-~~M~~TFREQ)	E.2.2.1	R (O)
Input impedance for foreign voltage measurements (MELT-IMP-V)	E.2.2.2	R (O)
Peak~~Measurement~~ source voltage for the measurement of the loop complex admittance with a high metallic voltage ~~test~~ (MELT-HCA-V)	E.2.2.3	R (O)
MELT-PMD measurement parameters		
4-element DC resistance with controlled metallic voltage R_{TR} (MELT-CDCR-TR)	E.2.3.1	R (M)
4-element DC resistance with controlled metallic voltage R_{RT} (MELT-CDCR-RT)	E.2.3.1	R (M)
4-element DC resistance with controlled metallic voltage R_{TG} (MELT-CDCR-TG)	E.2.3.1	R (M)
4-element DC resistance with controlled metallic voltage R_{RG} (MELT-CDCR-RG)	E.2.3.1	R (M)
DC test voltage for the measurement of the 4-element DC resistance with a controlled metallic voltage VDC_{TR} (MELT-CDCV-TR)	E.2.3.2	R(O)
DC test voltage for the measurement of the 4-element DC resistance with a controlled metallic voltage VDC_{RT} (MELT-CDCV-RT)	E.2.3.2	R(O)
DC test voltage for the measurement of the 4-element DC resistance with a controlled metallic voltage VDC_{TG} (MELT-CDCV-TG)	E.2.3.2	R(O)
DC test voltage for the measurement of the 4-element DC resistance with a controlled metallic voltage VDC_{RG} (MELT-CDCV-RG)	E.2.3.2	R(O)
Test current for the measurement of the 4-element DC resistance with a controlled metallic voltage IDC_{TR} (MELT-CDCI-TR)	E.2.3.3	R(O)
Test current for the measurement of the 4-element DC resistance with a controlled metallic voltage IDC_{RT} (MELT-CDCI-RT)	E.2.3.3	R(O)
Test current for the measurement of the 4-element DC resistance with a controlled metallic voltage IDC_{TG} (MELT-CDCI-TG)	E.2.3.3	R(O)
Test current for the measurement of the 4-element DC resistance with a controlled metallic voltage IDC_{RG} (MELT-CDCI-RG)	E.2.3.3	R(O)
3-element capacitance with controlled metallic voltage C_{TR} (MELT-CC-TR)	E.2.3.4	R (M)
3-element capacitance with controlled metallic voltage C_{TG} (MELT-CC-TG)	E.2.3.4	R (M)
3-element capacitance with controlled metallic voltage C_{RG} (MELT-CC-RG)	E.2.3.4	R (M)
Foreign DC voltage $V_{TR,DC}$ (MELT-FVDC-TR)	E.2.3.5	R (M)
Foreign DC voltage $V_{TG,DC}$ (MELT-FVDC-TG)	E.2.3.5	R (M)

Table F.1 – Partitioning of MELT-ME-PMELT-P-ME parameters

Category/element	Defined in clause	Q – interface
Foreign DC voltage $V_{RG,DC}$ (MELT-FVDC-RG)	E.2.3.5	R (M)
Foreign AC voltage $V_{TR,AC}$ (MELT-FVAC-TR)	E.2.3.5	R (M)
Foreign AC voltage $V_{TG,AC}$ (MELT-FVAC-TG)	E.2.3.5	R (M)
Foreign AC voltage $V_{RG,AC}$ (MELT-FVAC-RG)	E.2.3.5	R (M)
Foreign AC voltage frequency $F_{TR,AC}$ (MELT-FVACF-TR)	E.2.3.5	R (M)
Foreign AC voltage frequency $F_{TG,AC}$ (MELT-FVACF-TG)	E.2.3.5	R (M)
Foreign AC voltage frequency $F_{RG,AC}$ (MELT-FVACF-RG)	E.2.3.5	R (M)
Loop capacitance with high metallic voltage $C_{TR,HV}$ (MELT-HC-TR)	E.2.3.6	R (M)
Loop resistance with high metallic voltage $R_{TR,HV}$ (MELT-HDCR-TR)	E.2.3.7	R (M)
Loop resistance with high metallic voltage $R_{RT,HV}$ (MELT-HDCR-RT)	E.2.3.7	R (M)
Test voltage for the measurement of the loop resistance with a high metallic voltage $VDCH_{TR}$ (MELT-HDCV-TR)	E.2.3.8	R (O)
Test voltage for the measurement of the loop resistance with a high metallic voltage $VDCH_{RT}$ (MELT-HDCV-RT)	E.2.3.8	R (O)
3-element complex admittance with controlled metallic voltage real part G_{TR} (MELT-CAG-TR)	E.2.3.9	R (O)
3-element complex admittance with controlled metallic voltage imaginary part B_{TR} (MELT-CAB-TR)	E.2.3.9	R (O)
3-element complex admittance with controlled metallic voltage real part G_{TG} (MELT-CAG-TG)	E.2.3.9	R (O)
3-element complex admittance with controlled metallic voltage imaginary part B_{TG} (MELT-CAB-TG)	E.2.3.9	R (O)
3-element complex admittance with controlled metallic voltage real part G_{RG} (MELT-CAG-RG)	E.2.3.9	R (O)
3-element complex admittance with controlled metallic voltage imaginary part B_{RG} (MELT-CAB-RG)	E.2.3.9	R (O)
Loop complex admittance with high metallic voltage real part $G_{TR,HV}$ (MELT-HAG-TR)	E.2.3.10	R (O)
Loop complex admittance with high metallic voltage imaginary part $B_{TR,HV}$ (MELT-HAB-TR)	E.2.3.10	R (O)
Test voltage for the measurement o the 3-element capacitance with a controlled metallic voltageMeasurement voltage $VAC_{TR\text{-}CC}$ (MELT-ACV-CC-TR)	E.2.3.11	R (O)
Test voltage for the measurement o the 3-element capacitance with a controlled metallic voltageMeasurement voltage $VAC_{TG\text{-}CC}$ (MELT-ACV-CC-TG)	E.2.3.11	R (O)
Test voltage for the measurement o the 3-element capacitance with a controlled metallic voltage Measurement voltage $VAC_{RG\text{-}CC}$ (MELT-ACV-CC-RG)	E.2.3.11	R (O)
Test voltage for the measurement of the loop capacitance with a high metallic voltageMeasurement voltage $VAC_{TR\text{-}HC}$ (MELT-ACV-HC-TR)	E.2.3.12	R (O)
Test voltage for the measurement of the 3-element complex admittance with a controlled metallic voltageMeasurement voltage $VAC_{TR\text{-}CA}$ (MELT-ACV-CA-TR)	E.2.3.13	R (O)
Test voltage for the measurement of the 3-element complex admittance with a controlled metallic voltageMeasurement voltage $VAC_{TG\text{-}CA}$ (MELT-ACV-CA-TG)	E.2.3.13	R (O)

Table F.1 – Partitioning of ~~MELT-ME-P~~MELT-P-ME parameters

Category/element	Defined in clause	Q – interface
Test voltage for the measurement of the 3-element complex admittance with a controlled metallic voltage~~Measurement voltage~~ $VAC_{RG\text{-}CA}$ (MELT-ACV-CA-RG)	E.2.3.13	R (O)
Test voltage for the measurement of the loop complex admittance with a high metallic voltage~~Measurement voltage~~ $VAC_{TR\text{-}HA}$ (MELT-ACV-HA-TR)	E.2.3.14	R (O)
MELT-P configuration parameters		
Loop resistance classification threshold (MELT-LRC-TH)	F.2.1.1	R/W (M)
Loop parameters per unit length (MELT-LOOP-PARAMS)	F.2.1.2	R/W (M)
Hazardous DC voltage level (MELT-HDCV-L)	F.2.1.3	R/W (M)
Hazardous AC voltage level (MELT-HACV-L)	F.2.1.4	R/W (M)
Foreign EMF DC voltage level (MELT-FDCV-L)	F.2.1.5	R/W (M)
Foreign EMF AC voltage level (MELT-FACV-L)	F.2.1.6	R/W (M)
System capacitance at the CPE side (MELT-SYSC-CPE)	F.2.1.7	R/W (O)
MELT-P derived parameters		
Identification of an open wire failure (MELT-O-WIRE-type) – Open wire failure type	F.2.2.1.1	R (M)
Identification of an open wire failure (MELT-O-WIRE-DIST) – Distance to the open wire failure	F.2.2.1.2	R (O)
Identification of a short circuit failure type (MELT-S-CCT-type)	F.2.2.2.1	R (M)
Leakage identification (MELT-LEAK-ID)	F.2.2.3	R (M)
Resistive fault identification (MELT-RFAULT-ID)	F.2.2.4	R/W(M)
Foreign voltage type classification (MELT-FV-TYPE)	F.2.2.5.1	R (M)
Foreign voltage level classification (MELT-FV-LEVEL)	F.2.2.5.2	R (M)
Far-end signature topology type identification (MELT-FES-ID)	F.2.2.6.1	R (M)

F.3 Test management

For further study.

SERIES OF ITU-T RECOMMENDATIONS

Series A	Organization of the work of ITU-T
Series D	Tariff and accounting principles and international telecommunication/ICT economic and policy issues
Series E	Overall network operation, telephone service, service operation and human factors
Series F	Non-telephone telecommunication services
Series G	**Transmission systems and media, digital systems and networks**
Series H	Audiovisual and multimedia systems
Series I	Integrated services digital network
Series J	Cable networks and transmission of television, sound programme and other multimedia signals
Series K	Protection against interference
Series L	Environment and ICTs, climate change, e-waste, energy efficiency; construction, installation and protection of cables and other elements of outside plant
Series M	Telecommunication management, including TMN and network maintenance
Series N	Maintenance: international sound programme and television transmission circuits
Series O	Specifications of measuring equipment
Series P	Telephone transmission quality, telephone installations, local line networks
Series Q	Switching and signalling, and associated measurements and tests
Series R	Telegraph transmission
Series S	Telegraph services terminal equipment
Series T	Terminals for telematic services
Series U	Telegraph switching
Series V	Data communication over the telephone network
Series X	Data networks, open system communications and security
Series Y	Global information infrastructure, Internet protocol aspects, next-generation networks, Internet of Things and smart cities
Series Z	Languages and general software aspects for telecommunication systems

Printed in Switzerland
Geneva, 2018