

Technical Requirements for  
High-voltage DC Power Feeding Interfaces of  
ICT equipment

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Nippon Telegraph and Telephone Corporation

## Introduction

This document describes the requirements for the power feeding interface and functions relevant to the information and communication technology (ICT) equipment that operates on high-voltage direct current (DC) used by the Nippon Telegraph and Telephone Corporation (NTT) Group. The requirements described in this document are for maintaining the overall reliability and safety of power feeding systems for information and telecommunications systems. The content of this document may be changed without notice when related standards are revised, new equipment technology is introduced, or equipment requirements are modified.

Inquiries for the content of this document are as follows.

NTT Space Environment and Energy Laboratories

Zero Environmental Impact Research Project

E-mail [power-system-tr@ml.ntt.com](mailto:power-system-tr@ml.ntt.com)

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# 1 Overview

The technical requirements (TR) for high-voltage DC power feeding interfaces present the requirements for the power feeding interface and functions of ICT equipment that operates on high-voltage DC in telecommunications buildings and data centers.

The technical standards cited in this TR conform to ITU-T Recommendation L.1200 [1], TTC Standard JT-L1200 [2] and other such specifications. Conditions not specified in this TR may be required at the time of provisioning according to the purpose and use environment of the equipment.

## 2 References and definition of terms

### 2.1 References

The references of the specifications listed below in this TR makes those specifications a part of this TR. Dated specifications are those that are relevant in this TR; specifications that are more recent than dated or revised versions do not apply. However, it is recommended that users of this TR determine whether the most recent version of the specifications listed below is applicable or appropriate. In the case that there are changes in the references, treatment of the specifications will be revised.

[1] ITU-T L.1200 (2012)

Direct current power feeding interface up to 400 V at the input to telecommunication and ICT equipment

[2] TTC JT-L1200 Ver. 1.2 (2014)

Direct current power feeding interface up to 400 V at the input to telecommunication and ICT equipment

[3] IEC 60445 (2010)

Basic and safety principles for man-machine interface, marking and identification – Identification of equipment terminals, conductor terminations and conductors

[4] IEC 60950-1 (2005)

Information technology equipment – Safety – Part 1: General requirements

- [5] IEC 61000-4-5 (2005)  
Electromagnetic compatibility (EMC) – Part 4-5: Testing and measurement techniques – Surge immunity test Reference
- [6] IEC 61000-4-29 (2000)  
Electromagnetic compatibility (EMC) - Part 4-29: Testing and measurement techniques - Voltage dips, short interruptions and voltage variations on DC input power port immunity tests
- [7] ETSI EN 300 132-3-1 (2011)  
Power supply interface at the input to telecommunications and datacom (ICT) equipment; Part 3: Operated by rectified current source, alternating current source or direct current source up to 400 V; Sub-part 1: Direct current source up to 400 V
- [8] NTT TR 176001 Ver. 1 (2008)  
Technical requirements for the power-supply interface of communications equipment
- [9] NTT TR 550004 Ver. 4 (2009)  
Technical requirements for electromagnetic disturbance emitted from telecommunications equipment
- [10] NTT TR 549001 Ver. 3 (2005)  
Technical requirements for immunity of telecommunications equipment
- [11] NTT TR 189001 Ver. 2 (2012)  
Technical requirements for Resistibility of Telecommunications Equipment to Overvoltage and Overcurrent

## **2.2 Definition of terms**

The terms used in this TR are defined below.

### (1) High-voltage DC

In the field of information and telecommunications, the power feeding voltage in the range from 260 to 400 VDC .

### (2) Telecommunication equipment

Equipment that handles both voice signals and data signals, including switchboards, routers, ethernet switches, and transmitters.

(3) ICT equipment

Telecommunication equipment and equipment for information processing, including servers and storage devices.

(4) Power feeding system

A system that supplies electrical power to ICT equipment, including rectifiers, storage batteries, power distribution frames (equipment that distributes a source of DC power to various units of ICT equipment), power feeding lines, and circuit breakers (fuse, MCCB, etc).

(5) Power supply unit

A power supply that is built into ICT equipment and converts the DC voltage supplied by the power feeding system to the various voltages used within the equipment

(6) Duplexing of power supply unit

A configuration whereby the built-in power supply unit is duplicated in such a way that service remains uninterrupted even if one of the power feeding system fails.

(7) Operating voltage range

The range for the voltage applied to the input of ICT equipment within which the ICT equipment is guaranteed to operate normally, even if the supplied voltage varies within that range.

(8) Maximum operating current

The current at the rated voltage at the input of ICT equipment and the packages mounted in ICT equipment at the maximum power consumption for the equipment and packages. (Inrush current and other types of overcurrent are not taken into account.)

(9) Rated capacity

The maximum load power at the rated voltage.

(10) Power feeding route

A route that feeds power via one circuit breaker or a pair of circuit breakers mounted in a power distribution frame.

### 3 Basic requirements for ICT equipment

This TR presents the requirements for the input to ICT equipment that has high-voltage DC input. The technical requirements for ICT equipment that has 48 VDC input or AC input are presented in NTT TR176001 (2008).

## 4 Technical requirements for ICT equipment with high-voltage DC input

### 4.1 ICT equipment interface requirements

The interface requirements for ICT equipment that has high-voltage DC input are specified below.

#### (1) Input method

[Specification 1]

The power feeding interfaces of ICT equipment are shown as Interface P. A positive power feeding line, a negative power feeding line, and a safety ground line can be connected to ICT equipment (Fig. 4-1).

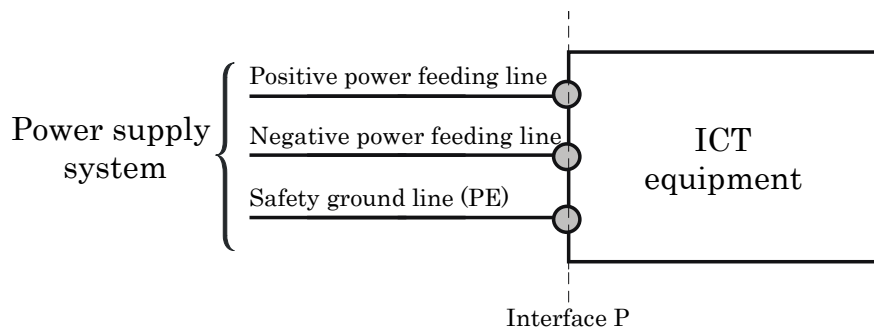


Figure 4-1 ICT equipment power feeding interface

#### (2) Voltage

[Specification 2]

The rated voltage and operating voltage range are specified below.

1. The rated voltage of ICT equipment is 380 V.
2. The operating voltage range of ICT equipment is from 260 V to 400 V. The ICT equipment shall operate

normally when DC voltage within the operating voltage range is supplied to the input terminals of the ICT equipment.

(3) Rated capacity

[Specification 3] The rated capacity of the ICT equipment power supply unit shall be 7.8 kW or less per power feeding route.

(4) Isolation resistor

[Specification 4] Isolation resistors that have resistance of at least 1 MΩ shall be placed between the positive power feeding line and the safety ground line and between the negative power feeding line and the safety ground line.

(5) Abnormal conditions

Tests and criteria for abnormal conditions, such as giving rise to voltages that are outside the operating voltage range (260 V to 400 V), are described here. The abnormal DC voltage ranges are from 0 V to 260 V and from over 400 V to 410 V. Voltages 410 V and over are outside the abnormal DC voltage range.

If the testing apparatus cannot be set to the rated voltage of 380 V during the test, the rated voltage may be set to 350 V or 300 V.

< Compliance criteria on ICT equipment >

Criteria a) The ICT equipment shall continue to operate as intended during and after the test. That is to say, when the ICT equipment is used as intended, there shall be no degradation of performance or loss of function below the performance level agreed between the product manufacturer and purchaser or product specifications producer.

Criteria b) The ICT equipment shall recover to the level of performance agreed between the product manufacturer and purchaser or product specifications producer without intervention by an operator once the cause of temporary degradation of performance or loss of function has been eliminated.

[Specification 5] The ICT equipment shall satisfy the operation criteria specified in Table 4-1 for the voltage variation test. The test shall be conducted in accordance with IEC 61000-4-29.



**Table 4-1. Test levels, duration and compliance criteria for voltage variation (see ITU-T L.1200 [1])**

| Voltage  | Duration | Compliance criteria on ICT equipment | Comments   |
|--|----------|--------------------------------------|--|
| From the rated voltage to 260 V, back to the rated voltage | 1 min    | Criteria a)                          | Test of minimum operating voltage within the normal DC voltage range.      |
| From the rated voltage to 400 V, back to the rated voltage | 1 min    | Criteria a)                          | Test of maximum operating voltage within the normal DC voltage range.      |
| From the rated voltage to 410 V, back to the rated voltage | 1 s      | Criteria b)                          | Test of voltage increase variation entering the abnormal DC voltage range. |
| From the rated voltage to 420 V, back to the rated voltage | 10 ms    | Criteria b)                          | Test of voltage increase variation outside the abnormal DC voltage range.  |

[Specification 6] The ICT equipment shall satisfy the operation criteria specified in Table 4-2 for the voltage dips test. The test shall be conducted in accordance with IEC 61000-4-29.

**Table 4-2. Test levels, duration and compliance criteria for voltage dips (see ITU-T L.1200 [1])**

| Voltage  | Duration | Compliance criteria on ICT equipment | Comments  |
|--|----------|--------------------------------------|---|
| From the rated voltage to 260 V, back to the rated voltage | 10 ms    | Criteria a)                          | Test of minimum operating voltage within the normal DC voltage range. |

[Specification 7] The ICT equipment shall satisfy the operation criteria specified in Table 4-3 for the short interruptions test. The test shall be conducted in accordance with IEC 61000-4-29.

**Table 4-3. Test levels, duration and compliance criteria for short interruptions (see ITU-T L.1200 [1])**

| Voltage  | Supply circuit                | Duration | Compliance criteria on ICT equipment | Comments   |
|--|-------------------------------|----------|--------------------------------------|--|
| From the rated voltage to 0 V, back to the rated voltage | Low impedance (short circuit) | 10 ms    | Criteria a)                          | Test of hold-up time during fault clearing due to a short-circuit in the system.           |
| From the rated voltage to 0 V, back to the rated voltage | High impedance (open circuit) | 1 s      | Criteria b)                          | Test of automatic recovery after an extended (>1 s) interruption of the operating voltage. |

Note: With reference to clauses 6.1.1 and 6.1.2 of IEC61000-4-29, the definition of low impedance is a generator output impedance < 0.5Ω and high impedance > 100 kΩ.

[Specification 8] The ICT equipment shall satisfy the operation criteria under the test conditions specified in Table 4-4. The test shall be conducted in accordance with IEC 61000-4-5 and NTT TR 189001 Ver. 2.

**Table 4-4. Test levels, wave shape and compliance criteria for voltage surges/transients (see ITU-TL1200 [1])**

| Test voltage | Supply network | Wave shape                       | Compliance criteria on ICT equipment | Comments  |
|--------------|----------------|----------------------------------|--------------------------------------|---|
| 500 V        | Line to line   | 1.2/50 $\mu$ s<br>(8/20 $\mu$ s) | Criteria a)                          | Test of voltage increase variation outside the abnormal voltage range (e.g., due to fuse blow, switching). Test voltage polarity shall be the same as for normal power feeding. |
| 500 V        | Line to ground | 1.2/50 $\mu$ s<br>(8/20 $\mu$ s) | Criteria a)                          | Test of voltage increase variation outside the abnormal voltage range (e.g., due to fuse blow, switching). Test voltage polarity shall be the same as for normal power feeding. |
| 2 kV         | Line to line   | 1.2/50 $\mu$ s<br>(8/20 $\mu$ s) | Criteria b)                          | Test of system recovery after a line-to-line short-circuit condition. Test voltage polarity shall be the same as for normal power feeding.                                      |
| 2 kV         | Line to ground | 1.2/50 $\mu$ s<br>(8/20 $\mu$ s) | Criteria b)                          | Test of system recovery after a line-to-ground (line-to-PE) short-circuit condition. Test voltage polarity shall be the same as for normal power feeding.                       |

Note: In some sensitive equipment, momentary and temporary interruption of the service may occur as a result of such transients. The duration of service interruption (equipment is not functioning as intended) due to the recovery of software shall be taken into account. More detailed information about the service interruption shall be provided by the manufacturer on the request of the operator.

[Specification 9] The ICT equipment shall operate as intended after voltage in the abnormal DC voltage range from 0 V up to 260 V or from over 400 V up to 410 V is supplied to the input of the ICT equipment and the voltage has been restored to within the operating voltage range. The intended operation is the level of conductance agreed between the product manufacturer and purchaser or product specifications producer.

(6) Inrush current  
[Specification 10]

The ICT equipment inrush current pulse shall be limited in magnitude and in time duration to prevent unintended tripping of the circuit breaker. The test shall be conducted in accordance with ETSI EN 300-132-3-1.

(7) EMC  
[Specification 11]

The performance shall comply with NTT TR 550004 Ver. 4, “Technical requirements for electromagnetic disturbance emitted from telecommunications equipment”.

## **4.2 Functional requirements for ICT equipment**

The requirements for the ICT equipment functions are specified below.

- [Specification 12] For high service reliability, the ICT equipment shall be equipped a duplex power supply unit.
- [Specification 13] The operation of ICT equipment that has a two-system input configuration shall not be affected in the case in which a difference in potential arises between the two systems.
- [Specification 14] The ICT equipment shall have current-breaking functions, such as a fuse, or protective functions, such as ICT equipment stopping function, against overcurrent due to an internal short circuit or other such abnormal operation.
- [Specification 15] The ICT equipment shall be designed to reduce the risk of electrical shock at places where the equipment is disconnected from the main power supply due to the discharge stored in capacitors inside the ICT equipment. The test shall be conducted in accordance with IEC60950-1.
- [Specification 16] The input of the ICT equipment power supply unit shall be constructed so that there is no risk of electrical shock.

## **4.3 Labeling of maximum operating current and maximum power for ICT equipment**

The labeling of ICT equipment for the maximum operating current and maximum power is specified below.

- [Specification 17] The ICT equipment shall be labeled with the maximum operating current or the maximum power value.
- [Specification 18] Each of the packages mounted in the ICT equipment shall be labeled with the maximum operating current or the maximum power value.

# Appendix

This appendix presents reference information that is not a part of this TR.

According to the purpose or use environment of the equipment, it may become necessary at the time of provisioning to add information presented in this appendix other than the specifications described in Section 4. In that case, the fact that the information presented in this appendix applies as requirements is stated in the specification sheet and the content of this appendix can then be treated as a part of the specifications of this TR.

## 1. Configuration of ICT equipment

[Appendix 1]           The ICT equipment shall have a duplex power supply unit. Even in the case that one of the duplex power supply units of the ICT equipment fails, services shall not be interrupted

## 2. ICT equipment behavior when input voltage deviates from normal range

[Appendix 2]           The ICT equipment shall stop operation in the case in which the power feeding voltage drops below the normal range. The stopping of operation shall satisfy the specifications listed below.

- 1) The ICT equipment shall stop operation promptly when the input voltage is less than 260 V.
- 2) The ICT equipment shall stop operation when the input voltage is in the range from 220 V up to 260 V.

## 3. Inrush current

[Appendix 3]           The total capacitance of capacitors connected before the precharge circuit of the ICT equipment input power supply unit shall be 13  $\mu$ F or less per power supply unit.

## 4. EMC

[Appendix 4]           The performance shall comply with NTT TR 549001 Ver. 3, “Technical requirements for immunity of telecommunications equipment”.

[Appendix 5]           The performance shall comply with NTT TR 189001 Ver. 2, “Technical requirements for Resistibility of Telecommunications Equipment to Overvoltage and Overcurrent”.