

TECHNICAL REQUIREMENTS
FOR POWER-SUPPLY INTERFACE OF COMMUNICATIONS EQUIPMENT

TR No. 176001-1.3. EDITION

June 5th, 2023

Nippon Telegraph and Telephone Corporation

Introduction

This report describes the recommended criteria regarding a power-supply interface for communications equipment in use at NTT Group. The materials described in this report are required from the viewpoint of ensuring the reliability of an entire power-supply system for communications systems. Moreover, they may be subject to change without notice due to revisions of related specifications, introduction of new technologies, and change of requirements in accordance with certain products. Any enquiries concerning the material in this report should be addressed to the contact address described below.

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1 Overview

This “technical requirements” report (hereafter, simply “TR”) presents the necessary technical standards in regards to the interfacial and functional requirements of communications equipment for providing communications services with high reliability.

2. Cited specifications and definition of terms

2.1 Cited specifications

- JIS-C 61000-3-2

Value limit: value limit on higher-harmonics current-generation (device with input current per phase of below 20 A)

2.2 Definition of terms

The terms used in this TR are defined in the table below.

Term	Definition
Communications equipment	Devices (i.e., exchange equipment and transmission equipment) mainly for transmitting voice signals and devices such as routers, servers, and switches for mainly transmitting data.
Datacom equipment	Communications equipment, such as routers, servers, and switches, and devices (such as peripheral devices like DSUs, DSLAMs, and ONUs) for mainly transmitting data.
Large-volume datacom equipment	Devices with power consumption per power-supply unit fitted in datacom equipment in the range of 1.8 to 6.7 kW, including devices whose power consumption temporarily exceeds 1.8 kW when half of the fitted power supply stops.
DC power-source equipment	Devices for supplying DC power to communications equipment.
Power distribution frame	Equipment branch supplying DC power to each piece of communications equipment.

Term	Definition
Built-in power-supply unit of communications equipment	Power sources (mounted in communications equipment) for transforming DC power supplied from DC-power-source equipment to the voltage used in the communications equipment.
Pre-charge circuit	A circuit for stopping the incoming current that charges the input condenser of the power source mounted in the communications device when the power switch of the device is released or when voltage is applied to the input terminal of the device. It is referred to as a "soft start" circuit.
Voltage reduction	Decrease of the absolute value of voltage.
Shutdown	Forcible blocking of the power supply of a part or all of a communications equipment when the voltage of an input terminal of the communications device deviates from the operating-voltage range of that device.
Condenser box	Device for housing the condenser for suppressing voltage fluctuation due to abrupt variation of oscillation or input currents.
Rated capacity of condenser	The value of the rated capacitance of a condenser.
Actual capacity of condenser	Actual value of condenser capacity required by the communications equipment for oscillation suppression.
Built-in capacitance of condenser	The rated capacitance of the condenser mounted in communications equipment. It is necessary to have a higher rated capacitance than the actual capacitance in consideration of the initial-capacitance dispersion ratio, aging degradation, temperature dependence, voltage dependence, etc.
Duplexing of power supply	A configuration whereby the built-in power supply is duplicated in such a way that service remains uninterrupted even if one of the power-supply systems fails.
Operating-voltage range	The voltage range for ensuring that a communications equipment functions properly even if the voltage supplied to the input terminals of that device varies within the aforementioned range.
Operating-current value	Current supplied to input terminals of the aforementioned communications equipment when the packages mounted in it are operating in a steady state and consuming the maximum power. (Incoming current, transitional current, etc. are excluded.)

3 Types of power supply for communications equipment

This TR report presents the technical requirements for communication equipment with either alternating current (AC) or direct current (DC) as input. At NTT Group, we are implementing DC power supplies because they are advantageous compared to AC ones from the viewpoints of reliability, power-supply efficiency, and economic efficiency.

4 Technical requirements regarding communications equipment with DC as input

4.1 Requirements regarding interface for communications equipment

The requirements concerning an interface for communications equipment are stated below.

(1) Rated power consumption and operating-voltage range

- Specification 4-1
- 1) Rated power consumption of the power supply mounted in communications equipment is below 6.7 kW per built-in power-supply unit.
 - 2) The communications equipment in question must operate properly with a DC voltage supplied to its input terminals within the range listed in Table 4-1 below. However, the operating-voltage range of datacom equipment (including large-capacity datacom equipment) should be from -40.5 to -57.0 V. Moreover, communications equipment must not fail even if the DC voltage supplied to its input terminals falls below the range specified for that equipment.

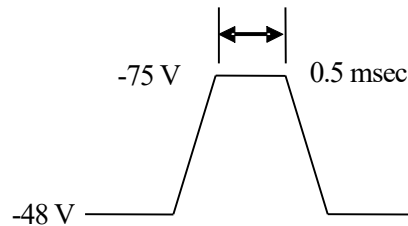
Table 4-1: Operating-voltage range of communications equipment

Operating-voltage range of communications equipment	Range in which communications equipment must not fail
-43 to -53 V	0 to -43 V
-42 to -53 V	0 to -42 V
-40.5 to -57 V	0 to -40.5 V

(2) Transient voltage

Specification 4-2

The communications equipment must not fail even if a voltage with the waveform shown in Figure 4-1 is input into the input terminals of that equipment.



Note: Rise and fall times of transient voltage are not specified.

Figure 4-1: Waveform of transient voltage

(3) Power-supply-system impedance

Specification 4-3

If the impedance requirement of the communications equipment side does not match that of the power-supply side, an oscillation phenomenon occurs. To prevent this, either one of the two requirements listed below must be satisfied.

- For large-capacity datacom equipment:

- 1) The total of the input condenser capacitances of each power-supply unit must be more than $1.5 \mu\text{F}/\text{W}$ under actual capacitance in accordance with the maximum power consumption of each power supply unit. However, the case that an electrolytic condenser ensures a total capacitance of more than $1.3 \mu\text{F}/\text{W}$ under rated capacity is excluded. In addition, condenser capacity on the load side used in the audible spectrum below 20 kHz and the power supplied through that filter are omitted (see Figure 4-2).

*Actual capacitance is the condenser capacity that must ordinarily be guaranteed in consideration of initial capacitance variation, temperature dependence, voltage dependence, aging degradation, and so on.

- 2) The oscillation phenomenon must not occur when equipment is connected to the power-supply-system impedance model shown in Figure 4-3.
- For communications equipment other than large-capacity datacom devices:
 - 1) The total of the input condenser capacitance of each power-supply unit must be more than $0.3 \mu\text{F}/\text{W}$ under rated capacity, in accordance with the maximum power consumption of the power supply unit. In addition, the condenser capacity on the load side used in the audible spectrum below 20 kHz and the power supplied through that filter are omitted (see Figure 4-2).
 - 2) The oscillation phenomenon must not occur when equipment is connected to the power-supply-system impedance model shown in Figure 4-3.

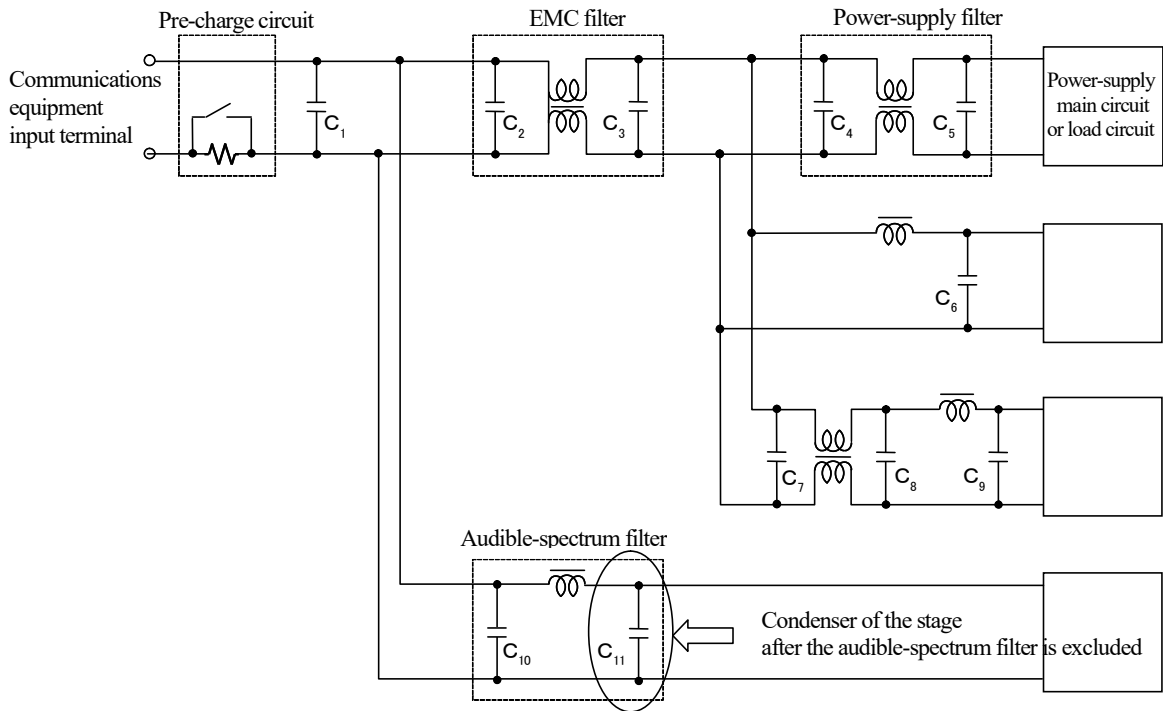
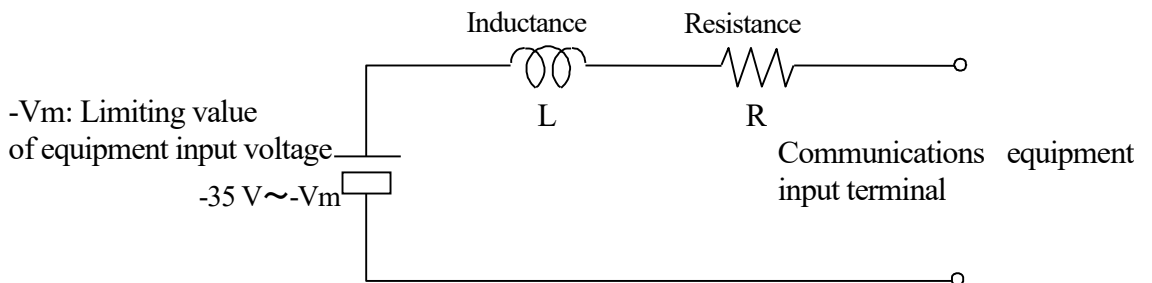


Figure 4-2: Example of input condenser of communications equipment



Power consumption	$0 \text{ W} < P \leq 720 \text{ W}$	$720 \text{ W} < P \leq 1440 \text{ W}$	$1440 \text{ W} < P \leq 1800 \text{ W}$	$1.8 \text{ kW} < P \leq 3.8 \text{ kW}$	$3.8 \text{ kW} < P \leq 6.7 \text{ kW}$
Rated value					
R	31 mΩ	16 mΩ	11 mΩ	11 mΩ	5.7 mΩ
L	19 μH	9.6 μH	6.4 μH	17 μH	9.0 μH

Figure 4-3: Power-supply-system impedance of communications equipment

(4) Incoming current

Specification 4-4

Excess incoming current for charging the input condenser of the built-in power supply of the communications equipment occurs when the power supply of the device is turned on or when voltage is applied to the input terminal of the device flows. The supply voltage varies as a result of this incoming current, and operation of other devices might be stopped. To prevent this stoppage, either one of the following two requirements must be satisfied.

- 1) The communications equipment in question must be fitted with a pre-charge circuit for stopping the occurrence of an excessive incoming current. In addition, the total condenser capacity of the EMI filter connected before the pre-charge circuit must be less than 25 μF per built-in power-supply unit.
- 2) The numerical value of the voltage on the input terminal of the power-distribution frame must be greater than 43.75 V when the power supply is connected, or when the power is turned on. However, this requirement excludes the specified divergence time within 12 μs due to the effect of the EMI filter. The communications equipment circuit is shown in Figure 4-4. The condition are as follows. (a)it is unclear whether a pre-charging circuit is equipped or not, (b)the condenser capacity of the EMI filter is unknown or exceeds 25 μF , and (c)the communications equipment is connected to the circuit.

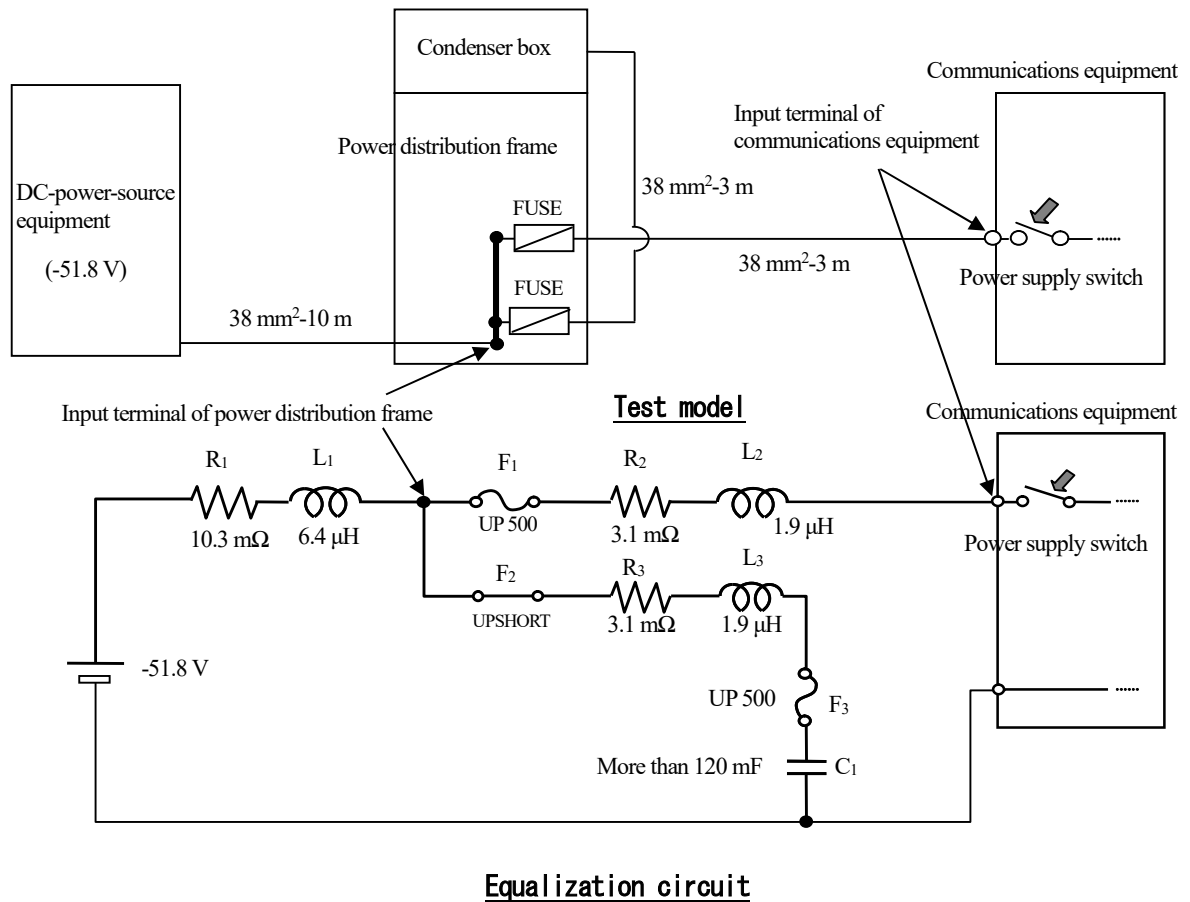


Figure 4-4: Test circuit for incoming-current characteristics of communications equipment

4.2 Functional requirements for communications equipment

The requirements concerning the functions of the communications equipment are stated below.

(1) Functions of communications equipment

Specification 4-5 The communications equipment should have a duplex power-supply unit. Even in the case that one of the duplex built-in power-supply units of the communications equipment fails, services must not be interrupted.

Specification 4-6 The communications equipment must have a function for cutting off over-current by a fuse etc. or a safeguarding function for stopping operation of the device for internal short-circuits etc.

(2) Response of communications equipment during input-voltage deviations

- Specification 4-7 The communications equipment must be equipped with a function for detecting when the input voltage of the device deviates from the operating-voltage range and go into a device-safeguard operational mode, such as shutdown.
- Specification 4-8 If the input voltage of the communications equipment drops below the operating-voltage range specified in Specification 4-1, the device must shutdown when the absolute value of voltage reaches -35 V.
- Specification 4-9 The communications equipment must be able to re-start normally when recovering after a shutdown due to the operating-voltage-range deviation of the input voltage of the equipment.

4.3 Operational requirements for communications equipment

The requirements concerning the configuration and operation of communications equipment are described as follows.

- Specification 4-10 Operation of a communications equipment configured with a dual-input system must be unaffected even when a difference occurs between the voltages supplied to both systems.

4.4 Regarding notation of operating-current values of communications equipment

In the case that the operating-current value of the communications equipment cannot be ascertained, superfluous setting up of power-supply and air-conditioning equipment as well as the reduction of operational efficiency are brought on. Consequently, aiming at proper allocation of correct capital expenditure on equipment and implementation of energy saving, this section stipulates the calculated requirements for operating-current values of communications devices as follows.

(1) Quotation of operating current on power-supply voltage

- Specification 4-11 Operating currents are specified in the case that the power supply voltages in table 4-2 are applied to the input terminals of the communications equipment.

Table 4-2: Voltage condition for operating current

Operating-voltage range of communications equipment	Power-supply voltage of communications equipment
-43 to -53 V	-43,-48,-51 V
-42 to -53 V	-42,-48,-51 V
-40.5 to -57 V	-40.5,-48,-51,-53 V

(2) Quotation of operating current per package

Specification 4-12 Operating-current values for each of the various packages mounted in the communications equipment and the voltage values on their input terminals are specified here.

5. Technical requirements concerning communications equipment with AC input

The requirements regarding the case that AC is input into the device are stated below.

5.1 Requirements regarding interfaces with communications equipment

The requirements regarding interfaces with communications equipment are stated below.

Specification 5-1 Measures for suppressing harmonic components in the communications device are specified according to “JIS C 61000-3-2.”

5.2 Functional requirements for communications equipment

The functional requirements for the communications device in question are stated as follows.

Specification 5-2 The communications equipment must have a function for blocking over-current by MCCB, fuses, etc. or a safeguard function for stopping operation of the device for internal short circuits etc.

5.3 Operational requirements for communications equipment

The requirements regarding the configuration and operation of the communications device are stated as follows.

Specification 5-3 Operation of a communications equipment with a dual-input system must be unaffected even when differences between phase, voltage, frequency, etc. of the two systems occur.