YD

Communication Industry Standard

of the People's Republic of China

YD/T 777-2006

Replacing YD/T 777-1999

Inversion equipment for telecommunications

通信用逆变设备

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Foreword

This Standard replaces YD/T 777-1999 *Inversion equipment for telecommunications*.

Compared with the YD/T 777-1999, this Standard has the following major changes:

— This Standard is drafted according to the format requirements specified in the GB/T 1.1-2000.

— DELETE the reference to the GB 7260.

— ADD the definition “3.7 Peak factor”.

— REVISE “4.1.3.1” of the original version. ADD “1.5” and “4” to this Standard.

— REVISE “5.2” of the original version. MODIFY the allowable variation range of the input voltage to 40 ~ 57.6V.

— DELETE “5.2.2” of the original version.

— REVISE the contents in the “5.4.2” of the original version. MODIFY the “power factor 0.7” to “power factor 0.8” in Note 2 of the table. DECREASE the AC output current rating.

— REVISE the contents in the “5.4.8” of the original version. STIPULATE the AC output frequency rating as 50Hz. SEE 5.4.7 of this version.

— REVISE “5.4.9” of the original version. CANCEL the restriction of “2MHz”. SEE 5.4.8 of this version.

— REVISE the headline of the “5.4.12” of the original version. MODIFY the “conversion mode” to the “conversion time”. SEE 5.4.11 of this version.

— REVISE the contents in the “5.4.13” of the original version. ADD the input requirements for inrush starting current. SEE 5.4.12 of this version.

— REVISE “5.4.14” of the original version. MODIFY the sentences. SEE 5.4.13 of this version.

— REVISE the contents in the “5.4.15” of the original version. MAKE the grading rules for overload capacity. SEE 5.4.14 of this version.

— DELETE the requirements for temperature rise specified in the “5.4.16”

Inversion equipment for telecommunications

1 Scope

This Standard specifies the technical conditions, test methods, and inspection rules of the DC-AC sine wave inversion equipment for telecommunications (hereinafter referred to as “inversion equipment”), which are required for accommodating the special requirements for communication equipment.

This Standard applies to the sine wave inversion equipment providing power supply for the communication equipment.

2 Normative references

The provisions in the following documents become the provisions of this Standard through reference in this Standard. For dated references, the subsequent amendments (excluding corrections) or revisions do not apply to this Standard. However, parties who reach an agreement based on this Standard are encouraged to study if the latest versions of these documents are applicable. For undated references, the latest versions apply to this Standard.

GB/T 191 *Packaging – Pictorial marking for handling of goods*

GB/T 2423.1-2001 *Environmental testing for electric and electronic products – Part 2: Test methods – Tests A: Cold*

GB/T 2423.2-2001 *Environmental testing for electric and electronic products – Part 2: Test methods – Tests B: Dry heat*

GB/T 2423.9-2001 *Environmental testing for electric and electronic products – Part 2: Test methods – Test Cb: Damp heat, steady state, primarily for equipment*

GB/T 2829-2002 *Sampling procedures and tables for periodic inspection by attributes (Apply to inspection of process stability)*

GB/T 3047.1 *Series of basic dimensions of panels, rack and cabinets for vertical increment of 20mm*

GB/T 3859.2 *Semiconductor convertors – Application guide*

GB/T 3873 *General specifications for products packaging of communication equipment*

3.7 Peak factor

It refers to the ratio OF the peak value of the periodic load current TO its effective value, which is generally used for measuring the inversion equipment's ability of carrying non-linear loads.

3.8 Total harmonic distortion (THD)

It refers to the percentage OF the root mean square value of the distortion content TO that of the fundamental component in the AC quantity.

3.9 Harmonic content

It refers to the value obtained after the fundamental component is subtracted from the AC quantity.

Note: Harmonic content can be expressed as time functions or root mean square values.

4 Product classification

4.1 Product types, specifications and series

4.1.1 Product types

a) Single-phase sine wave inversion equipment;

b) Three-phase sine wave inversion equipment;

c) Redundant single-phase or three-phase sine wave inversion equipment in parallel.

4.1.2 Input voltage rating series

SELECT 48V from the following numerical values as the DC input voltage rating of inversion equipment.

Note: After the user puts forward the requirement and negotiates with the manufacturer, the products beyond the above numerical values can also be produced.

4.1.3 Output power rating series (in unit of kVA)

4.1.3.1 Single-phase sine wave inversion equipment or single-phase sine wave inverter unit

0.5, 1, 1.5, 2, 3, 4, 5 and 10.

Note: After the user puts forward the requirement and negotiates with the manufacturer, the products

from the heat sources.

5.1.2 Special operating conditions

If it is necessary to use the inverter under the conditions which are different from the normal operating conditions specified in the Section 5.1.1, the user shall put forward when placing orders, and shall make an agreement with the manufacturer. For instance:

a) The inversion equipment used in abnormal mechanical stress, such as vehicular communication;

b) The inversion equipment operating in tropical climates with high humidity and high temperature;

c) The inversion equipment used in the environments where the atmospheric pressure exceeds the range of 86kPa ~ 106kPa;

d) Marine inversion equipment, or the inversion equipment operating in maritime climates.

5.2 Input conditions of DC power supplies

The DC input voltage is 48V. The allowable variation range is 40V~ 57.6V.

Note: After the user puts forward the requirement and negotiates with the manufacturer, the inversion equipment beyond the above numerical values can also be produced.

5.3 Input conditions of AC power supplies

The inversion equipment can be provided with bypass power supply devices. The AC power supplies providing power supply for the bypass devices shall conform to the following requirements:

a) The allowable variation range of AC voltage shall be 85% to 110% of the rated value;

b) The frequency rating and the allowable deviation of AC voltage shall be respectively 50Hz and ± 5%;

c) The unbalance degree of three-phase AC voltage shall not be greater than 10%;

d) The phase deviation of three-phase AC voltage shall not be greater than 5° electrical degree.

Note: After the user puts forward the requirement and negotiates with the manufacturer, the products beyond the above numerical values can also be produced.

Table 2 Conduction Disturbance Limits of AC Output Voltage

Frequency range (MHz)	Limits dB (μV)	
	Quasi-peak	Mean value
0.15~0.5	79	66
0.5~30	73	60

5.4.5 Unbalance degree of three-phase output voltage

During the nominal voltage input, and under the load conditions specified in the specific product standards, the unbalance degree of three-phase output voltage shall not be greater than 5%.

5.4.6 Phase deviation of three-phase output voltage

During the nominal voltage input, and under the load conditions specified in the specific product standards, the phase deviation of three-phase output voltage shall not be greater than 5° electrical degree.

5.4.7 Output frequency ratings and stabilizing accuracy

The AC output frequency rating is 50Hz. When the input voltage and load current (resistive load) are within the allowable variation range, the stabilizing accuracy of the output frequency shall not be greater than ± 2%.

5.4.8 Reflected wide band noise current at the input

When the input voltage, output voltage, and output current (resistive load) operate at rated values, the wide band noise component in the DC current (root mean square value) shall be less than 10% of the DC current.

5.4.9 Reflected relative psophometrically weighted noise current at the input

When the input voltage, output voltage, and output current (resistive load) operate at rated values, the reflected relative psophometrically weighted noise current at the input shall not be greater than 1%.

5.4.10 Rated output efficiency

During the input of nominal voltage and rated load current (resistive load), the efficiency of the complete equipment shall be greater than 80%.

Note: For the equipment with the input voltage of 24V and 48V as well as the output power of less than 1kVA, the efficiency shall not be less than 75%.

5.4.11 Conversion time

greater than 3% under pure resistive load.

5.4.17 Parallel performance

5.4.17.1 Electrical performance indexes of the parallel system

The electrical performance indexes of the parallel system shall be the same with those of the non-parallel inversion equipment. Furthermore, the reliability and stability of the system cannot be reduced due to the parallel connection. If there are any special requirements, PUT them forward when placing orders.

5.4.17.2 Maximum number in parallel

The number of the inverter units in parallel shall be determined according to the load size and the load's requirements for the power supply continuity. The maximum number in parallel shall be prescribed by the specific technical conditions for products. The current unbalance shall not be greater than ± 10% of the rated value.

5.4.18 Monitoring performance

5.4.18.1 Intelligent inversion equipment

The inversion equipment requiring the intelligent monitoring function shall be equipped with monitoring devices, so as to realize the management, measurement and control of the inversion equipment, and to accept the monitoring of the superior monitoring and management department. The intelligent inversion equipment shall have the following major functions:

Telemetry: output voltage and current, input voltage and current, etc. (optional);

Tele-signalling: equipment operating mode, and fault alarm;

Remote control: startup/shutdown.

5.4.18.2 Non-intelligent inversion equipment

The non-intelligent inversion equipment shall be equipped with analog signals and on-off state signals.

5.5 Security and protection

5.5.1 Insulation resistance and dielectric strength

5.5.1.1 Insulation resistance

When the ambient temperature is 20°C ± 5°C, and the relative humidity is 90%, the main circuit's insulation resistance of the input and output circuits to the

with clear signs.

b) The resistance among the surface of the inversion equipment, all the accessible moving metal parts, and the ground nuts shall not be greater than 0.1Ω.

5.5.2.4 Surge protection

During or after the experiment, the immunity of the electrical fast transient at the DC input port of the inversion equipment shall conform to the requirements specified in the Table 9 of the YD/T 983-1998.

5.6 Equipment body and structure quality

5.6.1 Relevant components and parts of the rack assembly

Each of them shall conform to the respective technical requirements.

5.6.2 Paint plating

It shall be solid and smooth without any detachment, corrosions and cracks.

5.6.3 Rack panel

It shall be smooth. The requirements for characters and symbols shall be clear, tidy, attractive and correct.

5.6.4 Labels, marks and signs

They shall be intact and clear.

5.7 Reliability index

The *MTBF* of the inversion equipment shall be ≥ 100,000h.

6 Test methods

6.1 Tests for AC output voltage ratings and stabilizing accuracy

USE resistive loads when testing the test items of the inversion equipment in the manufacturing plant.

DETERMINE the DC output voltage according to the provisions specified in the Section 5.2 of this Standard, and the load current within the range of 0% to 100% of the rated value. The stabilizing accuracy of the output voltage shall conform to the provisions specified in the Section 5.4.1 of this Standard. CALCULATE according to the Formula (1):

$$\delta_u = \frac{u - u_0}{u_0} \times 100\% \quad (1)$$

Where:

δu – Stabilizing accuracy;

u – Maximum or minimum of the measured voltage, V;

u_0 – AC voltage rating, V.

6.2 Dynamic characteristic test of AC output voltage

USE a digital storage oscilloscope to measure the AC output voltage according to the provisions specified in the Section 5.4.3 of this Standard. CALCULATE according to the Formula (1). The dynamic accuracy and recovery time of the output voltage shall conform to the provisions specified in the Section 5.4.3 of this Standard.

6.3 Test for the conduction disturbance limits of AC output voltage

CONDUCT the test according to the provisions specified in the Section 5.5.1 of the YD/T 983-1998. The results shall conform to the provisions specified in the Section 5.4.4 of this Standard.

6.4 Balanced load test

APPLY balanced load to the three-phase inversion equipment. MEASURE the unbalance of the output voltage. The result shall conform to the provisions specified in the Section 5.4.5 of this Standard.

MEASURE the phase angle deviation, or USE the measured line voltage value and phase voltage value for calculation. The result shall conform to the provisions specified in the Section 5.4.6 of this Standard.

6.5 Unbalanced load test

APPLY appropriate unbalanced load to the three-phase inversion equipment. MEASURE the unbalance of the output voltage. The result shall conform to the provisions specified in the Section 5.4.5 of this Standard.

MEASURE the phase angle deviation, or USE the measured line voltage value and phase voltage value for calculation. The result shall conform to the provisions specified in the Section 5.4.6 of this Standard.

6.6 Stabilizing accuracy test of output frequency

$$\delta_{Ip} = \frac{I_p}{I_{DC}} \times 100\% \quad \cdots\cdots (4)$$

I_p – Input psophometrically weighted noise current, A.

6.9 Rated output efficiency test

According to the provisions specified in the Section 5.4.10 of this Standard, MEASURE the DC input voltage U_{DC}, DC input current I_{DC}, AC output voltage $U_{O\sim}$, and AC output current $I_{o\sim}$. CALCULATE according to the Formula (5). The calculation result shall conform to the provisions specified in the Section 5.4.10 of this Standard.

$$\eta = \frac{U_{o\sim} \times I_{O\sim}}{U_{DC} \times I_{DC}} \times 100\% \quad \cdots\cdots (5)$$

Note: It is also allowable to use a power meter to directly measure the AC active power, and to substitute the AC active power into the Formula (5) for calculation.

6.10 Conversion time test

Under the circumstance that the AC input voltage meets the requirements specified in the c) and d) of the Section 5.3 of this Standard, USE an electronic storage oscilloscope to measure the output voltage in the conversion process. The result shall conform to the provisions specified in the Sections 5.4.11.1 and 5.4.11.2 of this Standard.

6.11 Startup characteristic test

Under the rated conditions, USE a storage oscilloscope matching with the current sampling device to respectively measure the current in the steady operating mode of the input impulse current peak. The results shall conform to the provisions specified in the Section 5.4.12 of this Standard.

Note: The Level μs impulse current generated by the EMI circuit shall not be taken into consideration.

6.12 Noise test

When the inversion equipment inputs nominal voltage and rated load current, USE an A sound level meter to measure the noise at 1m in front of the equipment and at 1/2 of the equipment height. The measured value shall conform to the provisions specified in the Section 5.4.13 of this Standard.

6.13 Overload capacity test

The duration when the inversion equipment outputs 120% and 150% of the rated current shall conform to the provisions specified in the Section 5.4.14 of

6.17 Monitoring performance test

6.17.1 Intelligent equipment

USE a computer to conduct remote measurement to the output voltage, output current, output frequency, and DC input voltage of the equipment. Furthermore, CONDUCT remote signaling to the operating status and fault status of the equipment. The test results shall conform to the provisions specified in the Section 5.4.18 of this Standard.

6.17.2 Non-intelligent equipment

a) During the normal operating mode of the inversion equipment, USE a voltmeter or milli-ammeter to measure the corresponding analog signals sent by the equipment on the telemetry terminal;

b) During the normal operating mode and artificial fault simulation of the inversion equipment, USE a multimeter to measure the corresponding on-off state signals on the tele-signalling terminal.

6.18 Insulation resistance and dielectric strength tests

6.18.1 Test conditions and measuring instruments

The insulation test of the inversion equipment can be conducted under the normal operating conditions specified in the Section 5.1.1 of this Standard.

For single-phase inversion equipment, USE a 500V mega-ohm meter to measure the insulation resistance. For three-phase inversion equipment, USE a 1,000V mega-ohm meter instead. The transformers used in the dielectric strength test shall not be less than 1kVA.

6.18.2 Measurement and test orders

After the measured insulation resistance is qualified, CONDUCT the dielectric strength test.

6.18.3 Preparations before the insulation resistance measurement and dielectric strength test

Before the insulation resistance measurement of the complete equipment and the dielectric strength test, ELIMINATE all the elements that cannot bear high voltage from the circuits. The test results shall conform to the provisions specified in the Section 5.5.1.2 of this Standard.

6.19 Protection performance test

6.19.1 Tests for the overcurrent protection and output short-circuit protection

When adjusting the output current of the inversion equipment up to overcurrent, and performing short-circuit simulation, the inversion equipment shall be able to shut down and to give an alarm. After troubleshooting, the inversion equipment shall be able to function properly.

6.19.2 Tests for the output overvoltage and undervoltage protection, and over-temperature protection

When adjusting the output voltage of the inversion equipment up to the overvoltage and undervoltage values, the inversion equipment shall be able to shut down and to give an alarm. After troubleshooting, the inversion equipment shall be able to function properly.

INPUT nominal voltage to the inversion equipment, until the internal temperature comes up to the over-temperature protection point. The inversion equipment shall be able to give an alarm. After the internal temperature decreases to safe temperature, the inversion equipment shall be able to function properly.

6.19.3 Ground protection test

a) The equipment under test shall be totally disconnected with the input circuits, output circuits, monitoring equipment, and all the external circuits;

b) USE digital micro-ohmmeter, Kelvin bridge, and other micro resistance measuring instruments. According to the wiring methods of the micro resistance measuring instruments for measurement (two-wire or four-wire), CONNECT the main terminal of the measuring line with the main protective grounding terminal; successively CONNECT the other end of the measuring line with the door (panel) that can move forward and backward, and the handle, knob, key lock, and other accessible metal parts on the outer surface of the door (panel);

c) Successively and directly READ the connection resistance values between the main protective grounding terminal and each measuring point from the micro resistance measuring instrument, which shall conform to the requirements specified in the Section 5.5.2.3 of this Standard.

6.19.4 Surge test

CONDUCT the surge test according to the provisions specified in the Section 7.4.5 of the YD/T 983-1998. The surge test shall also conform to the provisions specified in the Section 5.5.2.4 of this Standard.

7 Inspection rules

7.1 Inspection classification

The product inspection is divided into exit-factory inspection and type inspection.

7.1.1 Exit-factory inspection

Each piece of inversion equipment needs to be conducted with exit-factory inspection when leaving the factory. Even if there is only one performance index failing to conform to the requirements, the inversion equipment shall be deemed as non-conforming product, and shall be repaired and retested. If failing to pass the retesting, no certificate will be issued. After passing the inspection, FILL in the inspection records, and SEND them to the party issuing the certificate before leaving the factory.

7.1.2 Type inspection

The products manufactured in batches shall be conducted with the inspection once every two years.

7.1.2.1 Inspection range

The inversion equipment shall be conducted with the type inspection under one of the following circumstances:

a) Authentication of the trial manufacture to finalize the design conducted to the new or old products manufactured after the plant transfer;

b) There are major changes in structure, materials and process after official production, which might affect the product performance;

c) REPRODUCE after stopping manufacturing products for a long time.

7.1.2.2 Sampling method

CONDUCT the type inspection according to the single sampling scheme with the discrimination level I. The product quality shall be expressed as RQL (RQL = 120), and shall be determined according to the quantity of non-conforming products. The sample size n = 2.

7.2 Test items

SEE Table 3 for the test items of the type inspection and exit-factory inspection of inversion equipment.

8 Marks, packaging, transportation and storage

8.1 Marks

8.1.1 Product marks

The nameplates shall be installed on the appropriate positions of the inversion equipment. The nameplate type and dimensions shall conform to the provisions specified in the relevant national and industry standards.

8.1.2 Packaging marks

The outer packaging of the inversion equipment shall have receiving and delivering marks as well as pictorial marking for handling of goods. IMPLEMENT according to the relevant provisions specified in the GB/T 191.

8.2 Packaging

8.2.1 Accompanying technical files:

The technical files provided along with the products include:

a) product certificate;

b) product instructions for use and installation; and

c) list for the product's supplied accessories and spare parts.

8.2.2 Product packaging

The product packaging shall conform to the provisions specified in the GB/T 3873.

8.3 Transportation

There shall be no violent vibration, impact and inverted placement during the transportation of inversion equipment.

8.4 Storage

The storage of inversion equipment shall be conducted according to the relevant provisions specified in the Section 5.1.1.2 of this Standard and the GB/T 3873.

parameters. Do NOT adjust the test loads.

The connection between reference non-linear load and inversion equipment:

a) For the single-phase inverter whose rated value is below 33kVA, the apparent power *S* of the reference non-linear load in use equals to the rated apparent power of the inversion equipment.

b) For the single-phase inverter whose rated value is above 33kVA, USE the reference non-linear load with the apparent power of 33kVA. ADD linear loads afterwards, so as to come up to the rated apparent power and rated active power of the inversion equipment.

c) For the three-phase inversion equipment with the rated value of below 100kVA, which is designed for three-phase loads, CONNECT three same single-phase reference non-linear loads among the phases or wires of the inversion equipment.

d) For the three-phase inversion equipment with the rated value of above 100kVA, USE 100kVA reference non-linear loads according to c). ADD linear loads afterwards, so as to come up to the rated apparent power and rated active power of the inversion equipment.

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