Verizon NEBS™ Compliance: Vendor Power and Grounding Questionnaire

Verizon Technical Purchasing Requirements

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*** New, Add, Delete, Change, Reissue**

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1.0 PURPOSE

The purpose of this document is to mandate the collection of data related to power fusing and operation; frame, chassis, logic and power grounding; and power connector types and uses. This information is required by Verizon engineering and installation personnel to safely create provision and maintain network-serving equipment in central offices, data centers and remote terminals. Vendor responses to the topics included herein will be used to properly protect systems from over-current (via fuses and circuit breakers) and to correctly size batteries, cable sizing, and rectifier plant.

2.0 SCOPE

This TPR applies to all network equipment supplied by OEMs and system integrators. This TPR applies to products owned or leased by Verizon, including but not limited to, equipment installed in central offices, data centers, outside plant, cell sites, mobile switching centers, and network equipment centers. This TPR does not apply to customer premises equipment powered by AC mains.

3.0 REFERENCES

IP72202	Verizon Network Equipment Installation Standards
VZ 292-100-000	Verizon Material Standard and Engineering Guidelines for DC Distribution Systems

4.0 ACRONYMS

AC	Alternating Current
AWG	American Wire Gauge
BPGB	Building Principle Ground Bar
CBN	Common Bonding Network
CO	Central Office
DC	Direct Current
FGB	Floor Ground Bar
NEC	National Electric Code
MGB	Master Ground Bar
OC	Over Current

OEM	Original Equipment Manufacturer
SPG	Single Point Ground
TPR	Technical Purchasing Requirements

5.0 DEFINITIONS

Duplex – this is the predominate method used by digital switch vendors. The Central Office provides separate "A" and "B" power buses that power the "A" and "B" sides of the switching equipment. The Key point of the Duplex powering scheme is the equipment functionality is duplicated on both sides of the power bus and the loss of one power bus (A or B) will result in restricted traffic (throughput) only but no loss of any function.

Simplex – the equipment is powered by either the "A" or "B" power bus but not both. The equipment has only one type of each device or function and if the bus looses power or a piece of equipment fails, the system fails.

OR'd – the equipment has dual power converters. One power converter is powered by the Central Office "A" power bus and the other power converter is powered by the Central Office "B" power bus. The outputs of both power converters are connected through OR'ing diodes to a common bus that powers the equipment. During normal operation current is drawn equally from both power converters, i.e. load sharing. However, during a fault condition (for example, if the "A" power bus or "A" power converter fails), the current will **double** in the operating power converter ("B" power converter) and diode. The equipment will not lose functionality. The key point of the OR'd system is an OR'ing Diode Network connecting the output side of the power converters to the common bus. **Without the Diode Network**, the equipment is parallel fused**. The NEC expressly prohibits parallel fusing**.

Logic OR'd – the Central Office has "A" and "B" power buses feeding the equipment. The equipment uses a "logic circuit" to select which power bus to use (a "best source" evaluation) then electrically couples that "best source" to a common power converter that powers the equipment. The equipment will draw substantially all the power from the selected power source, either "A" or "B" but not both. Note that there is no load sharing and all (or substantially all) the current will be drawn from either the Central Office "A" or "B" power bus. Due to the reliability of Central Office power, the logic circuit probably will not switch to the non-selected power bus until there is a circuit or power failure.

Note: The power bus (A or B or C etc.) must originate at the Main Power Board. It cannot be derived from a combination of the A power bus and/or the B power bus.

Equipment Frame

The metal rack or frame is the mounting point for the equipment. The equipment chassis is required to match the configuration of the equipment frame.

A. Single Point Ground (SPG) / (insulating material is used)
   The equipment frame is not contacting the floor or the overhead structure. There is only one common electrical connection point with the remainder of the building or equipment. That point is either the Floor Ground Bar (FGB) or the Building Principal Ground Bar (BPGB). In the SPG

configuration, there will be No AC or DC current on the frame ground lead except in a Fault condition.

B. Common Bonded Network (CBN) / (insulating material **is not** used)
The equipment frame is mounted directly to the floor and to the overhead structure. There has been no design as to the value of resistance of an individual contact point. All contacts are defined as incidental.

Logic

The –48 V return is referenced to the Central Office ground plane at the main ground point, either the Master Ground Bar (MGB) or Building Principal Ground Bar (BPGB). The –48 Volt return represents the "best" voltage reference point with regard to noise and electrical transients and is the preferred ground point.

A. Referenced to Power Return (-48 Volt return)
The logic (5 volt, 12 volt, etc., DC circuitry) return is referenced to ground by making a connection to the – 48V return terminal on the equipment.

B. Referenced to Chassis
The logic (5 volt, 12 volt, etc., DC circuitry) return is referenced to ground by making a connection to the chassis of the equipment.

Power Ground (- 48 Volt return)

A. Integrated Power (common with chassis)
The – 48 Volt return (power ground) is intentionally connected to the equipment chassis.

B. Isolated Power (not common with chassis)
The – 48 Volt return (power ground) is not internally connected to the equipment chassis.

6.0 GENERAL REQUIREMENTS

6.1 Format for the Vendor Response

1. Is your equipment powered through an "A" and "B" fuses?
Yes: Equipment is either Duplex, OR'd, or Logic OR'd powered (go on to Question 2)
No: Equipment is Simplex power (Skip Question 2, 3 & 4)

2. If an upstream (i.e. external) fuse feeding "A" blows does the current double in / transfer to fuse "B"?
Yes: Equipment is OR'd or Logic OR'd or Parallel Fused (go on to Question 3)

No: Equipment is Duplex powered (Skip Questions 3 & 4)
N/A: Answer to Question 1 was "No"

3. If the upstream (i.e., external) fuse that powers the "A" side blows, can you read voltage (–48 nominal) on the equipment side (downstream) of the blown fuse?
   Yes: Equipment has Parallel Fusing (NEC Violation-skip question 4).
   No: Equipment is either OR'd or Logic OR'd powered (got to question 4).
   N/A: Answer to Question 1 was "No" or answer to Question 2 was B or N/A

4. In a normal (no fault) condition is current through fuse "A" and through fuse "B" substantially equal?
   Yes: Equipment is OR'd powered
   No: Equipment is Logic OR'd powered
   N/A: Answer to Question 1 was "No", or answer to Question 2 was "No" or N/A, or answer to question 3 was either "Yes" or N/A.

Question	Response (Yes, No, or N/A)
1: Is your equipment fed by an "A" and "B" fuses?	
2: If fuse "A" blows, does the current double in / transfer to in fuse "B"?	
3: If fuse "A" blows, can you read voltage (–48 nominal) on the equipment side (downstream) of the blown fuse?	
4: In normal (no fault) condition is current through fuse "A" and through fuse "B" substantially equal?	

Format for the Vendor Response

6.2 Operational DC Voltage

What are the maximum, minimum, and nominal operational DC voltages and associated DC current for the subject equipment? Consider the equipment to be fully loaded with a full compliment of cards, etc. For equipment with a variety of cards, assume the equipment is fully loaded with cards having the largest current draw. For the purposes of this questionnaire, the voltage and currents requested are per external power bus feeds as measured at the external input to the equipment. If the "A" side draws 35 amps and the "B" side draws 42 amps then record "35" and "42" in the appropriate columns.

The maximum voltage is the highest level voltage the equipment can tolerate without damage. This question is to ensure the equipment will operate within the conventional battery float/equalize voltage ranges.

The Minimum Voltage is the voltage at which the equipment internal power converters shut down and no longer draw current from the external power bus; the current is the maximum current drawn just prior to the converters going off-line.
Note: When inputting the values for current, consider the A & B power bus and subject equipment to be in a "No Fault" state: the equipment is operating normally and no supply fuses are blown.

For Logic OR'd equipment, assume the "A" power bus is the active bus. Enter the current drawn by both "A" and "B" sides when "A" is active. If the readings are different when "B" power bus is active, enter the readings with the largest current draw. Specify the logic circuit hysteresis voltage. The switching time from the active bus to the inactive bus is the time required for the logic circuit to determine that the inactive bus is the "best source" then switch from either "A" to "B" or from "B" to "A". Enter switching time in engineering units (i.e., ms or μs).

	"A" Feed Volts	"A" Feed Amps	"B" Feed Volts	"B" Feed Amps
Maximum operating voltage				
48 volts nominal	48.0		48.0	
42.0 volts	42.0		42.0	
Minimum Voltage (power converters shut down)				

Format for the Vendor Response

Logic OR'd Power Only

	"A" to "B"	"B" to "A"
Switching time from active bus to inactive bus		
Logic circuit hysteresis (volts)		

Format for the Vendor Response

6.3 Grounding

There are three components that are a factor in how a piece of equipment is installed and protected in a central office environment. By using the following definitions and referencing them to your equipment, Verizon can properly install and maintain them to their peak of reliability.

I. Equipment Frame: Single Point Ground or Common Bonded Network?

II. Logic: Referenced to Chassis or Referenced to Power Return?

III. Power Ground: Integrated Power or Isolated Power?

Question	Response
Equipment Frame	
Logic	
Power Ground	

Format for the Vendor Response

6.4 Connector Types

6.4.1 Threaded Pressure Mechanical Connectors

For each external power input designed for threaded pressure mechanical connectors, define the maximum current drawn and the required torque to connect the external power cable to the equipment. Verizon standard IP 72202 and Verizon practice VZ 292-100-000 place limitations on the type of power connectors used in central offices. Specifically, threaded pressure mechanical connectors are limited to wire sizes less than #14 AWG.

External power input information	Number of external power inputs	Maximum fully loaded current at -48 volts	Mechanical connector torque (in/lbs)	Manufacturer recommended wire size (# AWG)
-48 volt supply				
-48 volts return				

Format for the Vendor Response

6.4.2 Compression Connectors

For each external power source that terminates on the equipment that is designed for compression connectors, define the minimum and maximum cable lug for the equipment. Note that each external power and power return cable compression lug connection requires a two-hole lug and requires a physical barrier between each lug landing location. Lugs shall not touch and the inspection window shall be visible after installation. Lugs shall be standard off the shelf (no special order) American sizes (i.e., not metric) with standard NEMA spacing such as a ¼" bolt with 5/8" centers, a 3/8" bolt with 1" center, and a 1/2" bolt with 1-3/4" centers. Use NEC table 310-16 at 75°C when calculating cable currents and required cable lugs. Note that due to Verizon defined maximum allowable voltage drops between a power source and the equipment, the lug landings should be sized to allow the lug size determined by maximum current draw plus the next two larger sized lugs. For example, if the maximum current draw requires a #10 AWG cable and lug, the lug landing should be sized to accept up to a #6 AWG lug.

External power input and lug information	**Number of external power inputs**	**Two-hole (Yes/No)**	**Minimum lug size**	**Maximum lug size**
-48 volt supply				
-48 volts return				

Format for the Vendor Response

6.5 Over Current Protection

The following questions are used to determine maximum cable size and to verify fuse and circuit breaker coordination in accordance with Verizon Practice 292-100-000.

For each external power input to the equipment, identify the type and current rating of any over current (OC) protective device embedded as part of the equipment chassis. Note that Telecom DC power distribution fuses are the only fuses authorized by Verizon. Enter N/A if there is no embedded over current protective device.

The fuse rating is the current at which the fuse will open. The circuit breaker rating is the current rating on the front of the breaker, usually on the switch arm. The circuit breaker trip setting is the current at which the breaker will trip. The trip setting of a breaker is 125% of the circuit breaker rating. For example, a 60-amp breaker (as labeled on the front of the breaker) will trip at 75 amps.

OC Protective Device	**Type of Fuse**	**Fuse Rating**	**Breaker Rating**	**Breaker Trip setting**
Fuse				
Breaker				

Format for the Vendor Response

Fuse type examples include GMT, TPN, TPL, TPH, TPC, and TPW.

7.0 REPORTING REQUIREMENTS

Complete all tables herein and provide a copy along with the NEBS test report submission to Verizon's NEBS & Quality Assurance organization.