



AC Power Source Summary

This appendix contains the following information about ac power sources:

- [Types of Electrical Distribution Systems](#) on page A-1 contains diagrams of common electrical-distribution systems that are in use throughout the world and identifies those types that are acceptable for NonStop Himalaya servers.
- [Summary of Worldwide Power Information](#) on page A-4 lists ac power-source information for residential, commercial, and industrial facilities throughout the world.

Types of Electrical Distribution Systems

A wide variety of supply voltages are used worldwide, even within the same country. [Figure A-1](#) and [Figure A-2](#) illustrate twelve types of power-distribution systems (Diagrams 1 through 12) that represent the most common 3-phase, 2-phase, and single-phase configurations used worldwide. The six systems shown in [Figure A-1](#) are the only ones that are acceptable for NonStop Himalaya servers. Those systems shown in [Figure A-2](#) are not acceptable under any circumstances.

Note. These diagrams do not show the contiguous ground connection that is required and is shown in [Figure 2-1](#) on page 2-6.

As noted in [Section 2, Safety Guidelines and Electrical Requirements](#), only a contiguous ground version of the 3-phase wye system shown in Diagram 1 is acceptable for NonStop Himalaya computer equipment that is installed inside a computer room; additional configurations are acceptable in cases where the equipment is not installed in a computer room (see [Electrical Service Requirements](#) on page 2-5).

If the required configuration is not present at the facility's main service entrance, then it must be provided from a separately derived power source (for example, UPS, computer-room power center, stand-alone transformer) that supplies power to the NonStop Himalaya computer equipment.

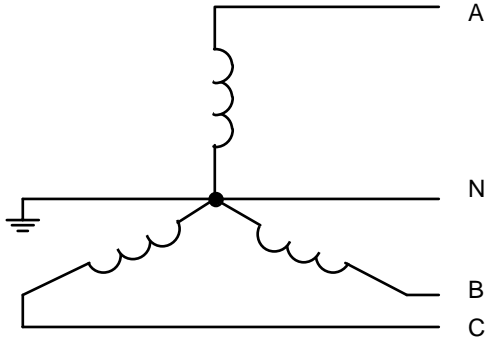
The 3-phase, 4-wire wye configuration with grounded neutral and contiguous ground (Diagram 1 in [Figure A-1](#)) has several properties that improve the performance of electronic equipment. For example, the neutral-to-ground bond at the facility's main service entrance creates a zero-volt reference for equipment and also limits the propagation of common-mode interference voltage throughout the facility. Phase voltages are also balanced with respect to ground. Erratic computer equipment performance usually occurs at sites where non-ground-referenced electrical systems are used or where facility electrical problems degrade the performance of the electrical-distribution system. The use of this type of power-distribution system ensures optimum system performance and reliability.

All power-distribution systems for NonStop Himalaya computer equipment must comply with the grounding and equipment grounding requirements listed in [Section 2, Safety Guidelines and Electrical Requirements](#). In addition, multiple-row NonStop Himalaya systems that are not installed in a dedicated computer room must be installed on raised-floor structures to facilitate cable placement. Compaq recommends that these

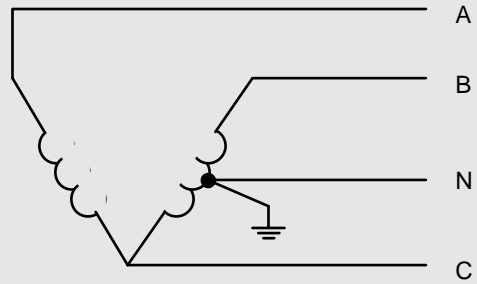
raised-floor structures employ one of the reference grounding options described under [Reference Grounding Options](#) on page 3-7.

Figure A-1. Common Electrical-Distribution Systems, Acceptable

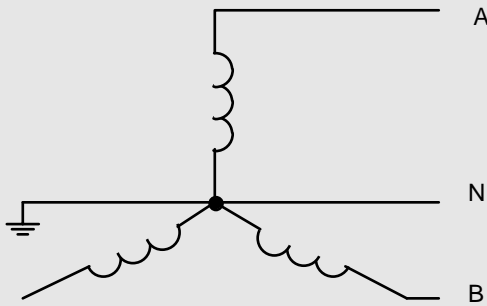
1 3-Phase Wye, 4-Wire; Grounded Neutral and Contiguous Ground



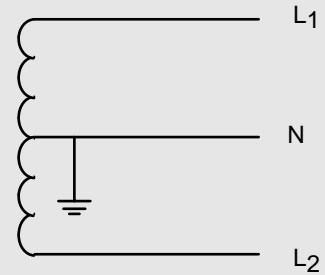
4 3-Phase Open Delta, 4-Wire; Grounded at Midpoint of Phase; Contiguous Ground



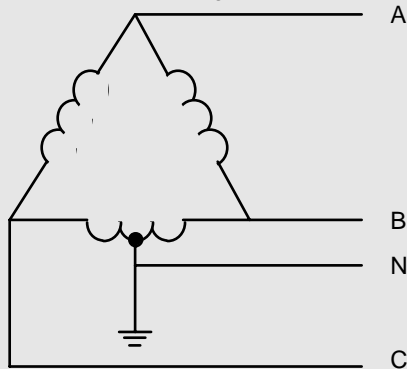
2 2-Phase Wye, 3-Wire; Grounded Neutral and Contiguous Ground (typically called a single-phase supply in North America)



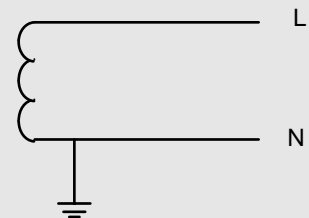
5 Single-Phase, 3-Wire; Grounded Neutral; Grounded at Midpoint of Phase; Contiguous Ground



3 3-Phase Delta, 4-Wire; Grounded at Midpoint of Phase; Contiguous Ground



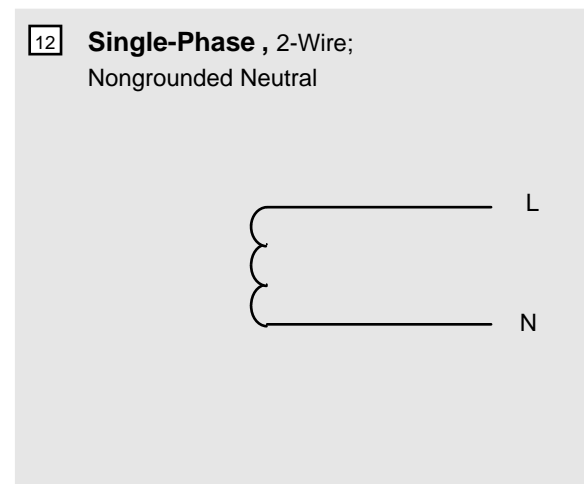
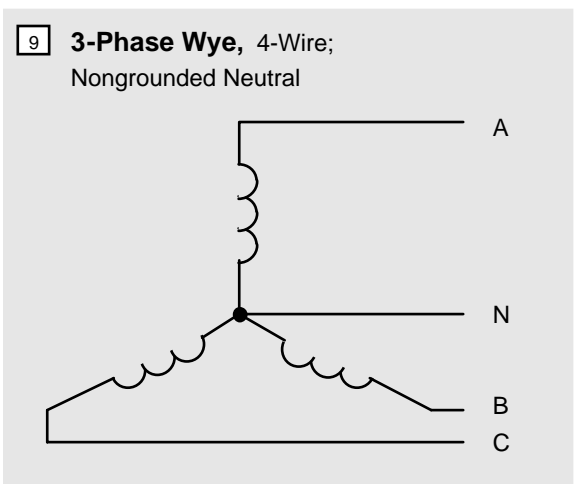
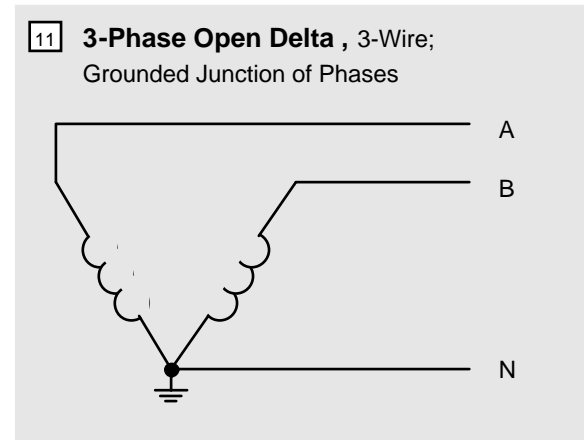
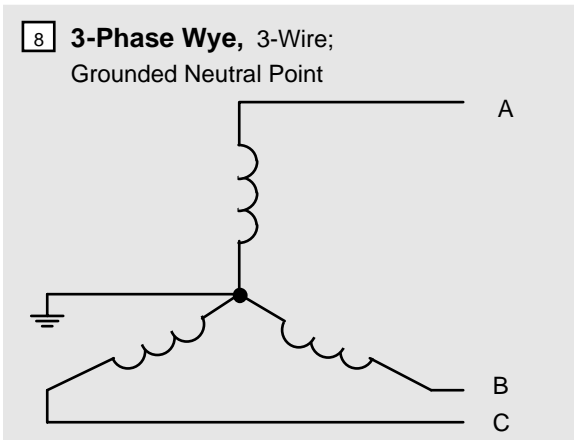
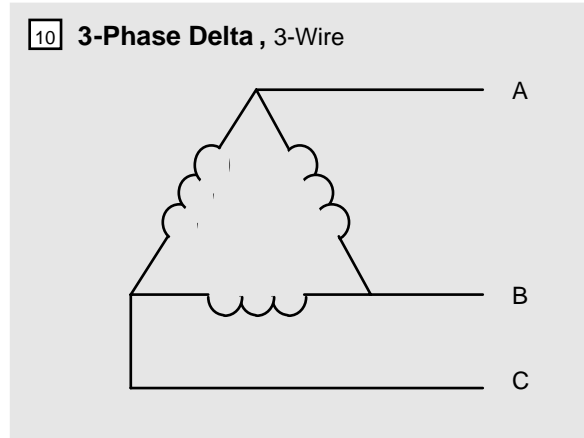
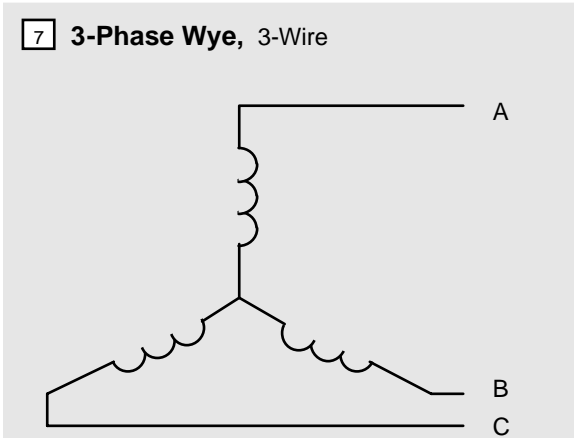
6 Single-Phase, 2-Wire; Grounded Neutral and Contiguous Ground



Note: Shaded configurations are not acceptable for computer-room power.

CDT 002CDD

Figure A-2. Common Electrical-Distribution Systems, Not Acceptable



CDT 003CDD

Summary of Worldwide Power Information

[Table A-1](#) lists ac power information for residential, commercial, and industrial facilities throughout the world, in alphabetic order by country. In the table, numbers in parentheses identify the electrical-distribution system in [Figure A-1](#) or [Figure A-2](#) that is used. Lowercase letters in parentheses identify one of the following notes:

- a. The supply to each residence is normally single-phase, using one phase line and neutral from electrical-distribution systems shown in Diagrams 1 and 3 from [Figure A-1](#).
- b. Frequencies below 50 Hz and dc supplies are only in limited areas. The supplies given indicate the range of possibilities that might exist.
- c. Information on higher voltage supplies to factories is not available.
- d. More than one area of the country has been listed to illustrate the differences that exist. These might not be the only supplies available in that country.
- e. Frequency is 50 Hz in eastern Japan and 60 Hz in western Japan. The dividing line is a north/south line through Shizuoka on Honshu Island.
- f. Some remote areas are supplied from a single-wire earthed return (SWER) system.
- g. Only a few towns have this supply.
- h. Refers to isolated mining districts.
- i. This information is not available at this time.
- j. The neutral wire of the secondary distribution system is grounded.

Table A-1. Summary of Worldwide Power Information (page 1 of 13)

Country	Frequency (Hz) and Tolerance (%)	Residential Voltage	Commercial Voltage	Industrial Voltage	Voltage Tolerance (%)
Afghanistan, D. R. of	50	380/220 (1) 220 (6)	380/220 (1)	380/220 (1, c)	(i)
Albania	50	220 (6, a)	380/220 (1)	380/220 (1)	(i)
Algeria	50 ±1.5	220/127 (2) 220 (6, a)	380/220 (1) 220/127 (1) 380/220 (1)	10 kV 6.6 kV 5.5 kV	±5 and ±10
Angola (j)	50	220 (6, a)	380/220 (1)	380/220 (1)	(i)
Anguilla	50	230 (6, a)	400/230 (1)	400/230 (1, c)	(i)
Antigua	60	230 (6, a)	400/230 (1)	400/230 (1, c)	(i)
Argentina	50 ±1.0	225 (6, a) 220 (6, a)	390/225 (1) 380/220 (1) 220 (6) 380/220 (1)	13.2 kV 6.88 kV 390/225 (1)	±10

Table A-1. Summary of Worldwide Power Information (page 2 of 13)

Country	Frequency (Hz) and Tolerance (%)	Residential Voltage	Commercial Voltage	Industrial Voltage	Voltage Tolerance (%)
Australia (j) (Excluding Western)	50 ±0.1	415/240 (1, 2) 240 (6)	415/240 (1) 440/250 (1) 440 (f) 415/240 (1) 440/250 (1)	22 kV 11 kV 6.6 kV	±6
Western	50	440/250 (1)	(i)	(i)	±6
Austria	50 ±0.1	380/220 (1, 7) 220 (6)	380/220 (1, 7) 220 (6) 5 kV 380/220 (1)	20 kV 10 kV	±5
Azores (Portugal)	50	220 (6) 120 (6)	380/220 (1)	380/220 (1)	
Bahamas	60	240/120 (3) 120 (6)	240/120 (3) 120 (6)	415/240 (1, c) 208/120 (1)	(i)
Bahrain Fir	50 & 60	400/230 (1) 230 (6) 110 (6)	400/230 (1) 380/220 (1) 230 (6) 220/110 (5)	11 kV 400/230 (1) 380/220 (1)	±6
Bangladesh	50 ±4	400/230 (1) 230 (6)	11 kV 400/230 (1)	11 kV 400/230 (1)	±5
Barbados	50 ±0.4	230/115 (3, 5) 200/115 (1, 2)	230/115 (3, 5) 200/115 (1, 2)	11 kV 3.3 kV 230/115 (3) 200/115 (1)	±6
Belgium	50 ±3	380/220 (1) 220/127 (1) 220 (10)	380/220 (1) 220/127 (1) 220 (10) 220/127 (1) 220 (10)	15 kV 6 kV 380/220 (1)	±5 (day) ±10 (night)
Belize	60 ±0.1	220/110 (5)	220/110 (5)	440/220 (5, c)	(i)
Benin	50 ±1	380/220 (1) 220 (6)	380/220 (1) 220 (6)	5 kV 380/220 (1)	±10
Bermuda	60 ±0.1	240/120 (5) 208/120 (1)	240/120 (5) 208/120 (1)	4.16/2.4 kV 208/120 (1) 240/120 (5)	±5
Bolivia	50 ±1	230/115 (4)	230/115 (4)	230/115 (4, c)	±5
Bosnia & Herzegovina	50	380/220 (1) 220 (6)	380/220 (1) 220 (6)	10 kV 6.6 kV 380/220 (1)	(i)
Botswana	50	220 (6, a)	380/220 (1)	380/220 (1, c)	(i)
Brazil (j)	60	220 (6, a) 127 (6, a)	380/220 (1) 220/127 (1)	13.8 kV 11.2 kV 380/220 (1) 220/127 (1)	(i)
Brunei	50	240 (6)	415/240 (1)	22 kV 415/240 (1)	±5

Table A-1. Summary of Worldwide Power Information (page 3 of 13)

Country	Frequency (Hz) and Tolerance (%)	Residential Voltage	Commercial Voltage	Industrial Voltage	Voltage Tolerance (%)
Bulgaria	50 \pm 0.1	380/220 (1) 220 (6)	380/220 (1) 220 (6)	20 kV 15 kV 380/220 (1)	\pm 5
Burma	50	230 (6, a)	400/230 (1) 230 (6)	11 kV 6.6 kV 400/230 (1)	(i)
Burundi	50	220 (6)	380/220 (1)	380/220 (1)	
Cambodia	50	208/120 (1) 120 (6)	380/220 (1) 208/120 (1)	380/220 (1, c) 208/120 (1)	(i)
Cameroon (FR)	50 \pm 2	220 (6, a)	380/220 (1)	15 kV 380/220 (1)	\pm 5
Canada	60 \pm 0.02	240/120 (5)	600/347 (1) 480 (10) 240 (10) 240/120 (5) 208/120 (1) 240 (10)	12.5/7.2 kV 600/347 (1) 208/120 (1) 600 (10) 480 (10)	\pm 4
Cayman Islands	60 \pm 0.1	240/120 (5)	240/120 (5, 3)	480/240 (3) 480/227 (1) 240/120 (3) 208/120 (1)	\pm 10
Central Africa	50	220 (6, a)	220 (6, a)	380/220 (1, c)	(i)
Chad	50	220 (6, a)	220 (6, a)	380/220 (1, c)	(i)
Chile	50	220 (6, a)	380/220 (1, a)	380/220 (1, c)	(i)
China, P. R. of	50	220 (6, a)	80/220 (1)	380/220 (1, c)	\pm 7
Colombia	60 \pm 1	240/120 (5) 120 (6)	240/120 (3) 120 (6)	13.2 kV 240/120 (3)	\pm 10
Commonwealth of Independent States (and other former Soviet republics)	50	380/220 (1) 220 (6) 220/127 (1) 127 (6)	380/220 (1) 220 (6)	380/220 (1, c)	(i)
Congo, Dem. Rep. of	50	220 (6, a)	380/220 (1)	380/220 (1, c)	(i)
Congo, Rep. of	50	220 (6)	380/220 (1)	380/220 (1)	
Costa Rica	60	120 (6, a)	240/120 (5) 120 (6, a)	13.8 kV 240/120 (3, c)	(i)
Croatia	50	380/220 (1) 220 (6)	380/220 (1) 220 (6)	10 kV 6.6 kV 380/220 (1)	(i)
Cyprus	50 \pm 2.5	240 (6, a)	240 (6, a)	11 kV 415/240 (1)	\pm 6
Czech Republic	50 \pm 0.1	380/220 (1) 220 (6)	380/220 (1) 220 (6)	22 kV 15 kV 6 kV 3 kV 380/220 (1)	\pm 10

Table A-1. Summary of Worldwide Power Information (page 4 of 13)

Country	Frequency (Hz) and Tolerance (%)	Residential Voltage	Commercial Voltage	Industrial Voltage	Voltage Tolerance (%)
Dahomey	50 ±0.1	380/220 (1) 220 (6)	380/220 (1) 220 (6)	15 kV 380/220 (1)	±10 ±10
Denmark	50 ±0.4	380/220 (1) 220 (6)	380/220 (1) 220 (6)	30 kV 10 kV 380/220 (1)	±10
Dominica	50	230 (6, a)	400/230 (1)	400/230 (1, c)	(i)
Dominican Republic	60	110 (6, a)	220/110 (5, a) 110 (6)	220/110 (3, c)	(i)
Ecuador	60	127 (6, a) 120 (6, a) 110 (6)	240/120 (5) 208/120 (1) 220/127 (1) 220/110 (5)	240/120 (5) 208/120 (1) 220/127 (1) 220/110 (5)	±5
Egypt, Arab Republic of	50 ±1	380/220 (1) 220 (6)	380/220 (1) 220 (6)	11 kV 6.6 kV 380/220 (1)	±10
El Salvador (j)	60 ±1	240/120 (5)	240/120 (5, 3)	14.4 kV 2.4 kV 240/210 (3)	±5
Equatorial Guinea	50	220 (6)	220 (6)		
Ethiopia	50	220 (6, a)	380/220 (1)	380/220 (1, c)	(i)
Falkland Islands (UK)	50 ±3	230 (6, a)	415/230 (1)	415/230 (1, c)	±2.5
Fiji Islands	50 ±1	415/240 (1) 240 (6)	415/240 (1) 240 (6)	11 kV 415/240 (1)	(i)
Finland	50 ±0.1	220 (6, 1)	380/220 (1)	660/380 (1) 500 (7) 380/220 (1, 9)	±10
France	50 ±1	380/220 (1) 220 (6) 220/127 (2) 127 (6)	380/220 (1) 380/220 (9) 380 (7)	20 kV 15 kV 380 (7) 380/220 (1, 9)	±10
Gabon	50	220 (6)	380/220 (1)	380/220 (1)	
Gambia	50	230 (1, a)	230 (1, a)	400/230 (1, c)	5 (1)
Germany					
West (j)	50 ±0.3	380/220 (1) 220 (6)	380/220 (1) 220 (6)	20 kV 10 kV	±10
East	50 ±0.3	380/220 (1) 220 (6) 220/127 (1) 127 (6)	380/220 (1) 220 (6)	10 kV 6 kV 660/380 (1) 380/220 (1)	±5
Ghana	50 ±5	250 (6, a)	250 (6, a)	440/250 (1, c)	±10
Gibraltar	50 ±1	415/240 (1)	415/240 (1)	415/240 (1, c)	±6
Greece	50 ±1	220 (6, a)	6.6 kV 380/220 (1)	22 kV 20 kV 15 kV 6.6 kV 380/220 (1)	±5

Table A-1. Summary of Worldwide Power Information (page 5 of 13)

Country	Frequency (Hz) and Tolerance (%)	Residential Voltage	Commercial Voltage	Industrial Voltage	Voltage Tolerance (%)
Greenland (Denmark)	50	380/220 (1) 220 (6)	380/220 (1)	380/220 (1)	(i)
Grenada	50	230 (6, a)	400/230 (1)	400/230 (1, c)	(i)
Guadeloupe (France)	50 & 60	220 (6, a)	380/220 (1)	20 kV 380/220 (1)	(i)
Guam (U.S.) (Mariana Islands)	60 ±1 -0.08	240/120 (5) 208/120 (1) 240 (6) 120 (6)	240/120 (5) 208/120 (1) 480/277 (1) 480 (10) 208/120 (1)	13.8 kV 4.0 kV 240/120 (4)	±8 - 10
Guatemala	60 ±1.7	240/120 (5)	240/120 (5)	13.8 kV 240/120 (3)	±10
Guiana (France)	50 & 60	220/110 (5)	220/110 (5)	220 (10)	
Guinea	50	380/220 (1) 220 (6)	380/220 (1)	380/220 (1)	(i)
Guinea-Bissau	50	380/220 (1) 220 (6)	380/220 (1)	380/220 (1)	(i)
Haiti	60	230 (6, a) 220 (6, a) 115 (6)	380/220 (1) 230/115 (5) 220 (6)	380/220 (1) 230/115 (3)	(i)
Honduras	60	110 (6)	220/110 (5) 110 (6)	220/110 (5, c)	(i)
Hong Kong (and Kowloon)	50 ±2	200 (6, 1) 346/200 (1)	11 kV 346/200 (1) 380/220 (1) 200 (6)	11 kV 346/200 (1) 380/220 (1, c)	±6
Hungary	50 ±2	380/220 (1) 220 (6)	380/220 (1) 220 (6)	20 kV 10 kV 380/220 (1)	±5 -10
Iceland	50 ±0.1	380/220 (1) 220 (6)	380/220 (1) 220 (6)	380/220 (1, c)	(i)
India (d)					
Bombay	50 ±1	440/250 (1) 230 (6)	440/250 (1) 230 (6)	11 kV 440/250 (1)	±4
New Delhi	50 ±3	400/230 (1) 230 (6)	400/230 (1) 230 (6)	11 kV 400/230 (1)	±6
Ramakrishna-puram (b)	50 ±3 25 d.c.	400/230 (1) 230 (6) 460/230	400/230 (1) 230 (6) 460/230	22 kV & 11 kV (i) (i)	±6
Indonesia	50 ±1 -2	220/127 (1)	380/220 (1) 220/127 (1)	22 kV 380/220 (1, c)	±5
Iran	50 ±5	220 (6, a)	380/220 (1)	20 kV 11 kV 400/231 (1) 380/220 (1)	±15

Table A-1. Summary of Worldwide Power Information (page 6 of 13)

Country	Frequency (Hz) and Tolerance (%)	Residential Voltage	Commercial Voltage	Industrial Voltage	Voltage Tolerance (%)
Iraq	50	220 (6, a)	80/220 (1)	11 kV 6.6 kV 3 kV 380/220 (1)	±5
Ireland, Northern (j)	50 ±0.4	230 (6, a) 220 (6, a)	400/230 (1) 380/220 (1)	400/230 (1, c) 380/220 (1)	±6
Ireland, Republic of	50	220 (6, a) 380/220 (1)	380/220 (1)	10 kV	(i)
Israel	50 ±0.2	400/230 (1) 230 (6)	400/230 (1) 230 (6)	22 kV 12.6 kV 6.3 kV 400/230 (1)	±6
Italy	50 ±0.4	380/220 (1) 220/127 (2) 220 (6)	380/220 (1) 220/127 (2)	20 kV 15 kV 10 kV 380/220 (1) 220 (8)	±5 (urban) ±10 (rural)
Ivory Coast	50	220 (6, a)	380/220 (1)	380/220 (1, c)	(i)
Jamaica	50 ±1	220/110 (3, 5)	220/110 (3, 5)	4/2.3 kV 220/110 (3)	±6
Japan (d) East	50 ±0.2 (e)	200/100 (5) 100 (6)	200/100 (4, 5)	6.6 kV 200/100 (4) 200 (3, 11)	±10
West	60 ±0.1 (e)	210/105 (5) 200/100 (5) 100 (6)	210/105 (4, 5) 200/100 (5) 100 (6)	22 kV 6.6 kV 210/105 (4) 200/100 (4)	±10
Jordan	50	380/220 (1) 220 (6)	380/220 (1)	380/220 (1, c)	(i)
Kenya	50	240 (6, a)	415/240 (1)	415/240 (1, c)	(i)
Korea, D.P.R. of (North) (j)	60	220 (6)	380/220 (1)	380/220 (1)	±6.8 -13.6
Korea, Rep. of (South)	60	100 (6)	200/100 (5)	22 kV 6.6 kV	±5
Kuwait	50	240 (6, a)	415/240 (1)	415/240 (1, c)	(i)
Laos	50 ±8	380/220 (1)	380/220 (1)	380/220 (1, c)	±6
Lebanon	50	220 (6, a) 110 (6, a)	380/220 (1) 220 (6) 190/110 (1) 110 (6)	380/220 (1, c) 190/110 (1)	(i)
Lesotho	50	220 (6, a)	380/220 (1)	380/220 (1, c)	(i)
Liberia	60 ±3.3	240/120 (5)	240/120 (5)	12.5/7.2 kV 416/240 (7) 240/120 (5) 208/120 (9)	±1.7

Table A-1. Summary of Worldwide Power Information (page 7 of 13)

Country	Frequency (Hz) and Tolerance (%)	Residential Voltage	Commercial Voltage	Industrial Voltage	Voltage Tolerance (%)
Libya, S.P.A.J.	50	230 (6, a) 127 (6, a)	400/230 (1) 220/127 (1) 230 (6) 127 (6)	400/230 (1, c) 220/127 (1)	(i)
Luxembourg	50 ±0.5	380/220 (1) 220/127 (1) 208/120 (1)	380/220 (1) 220/127 (1) 208/120 (1)	20 kV 15 kV 5 kV	±5 and ±10
Macao (Portugal)	50	380/220 (1) 230/115 (5)	380/220 (1) 220/127 (1)	380/220 (1) 220/127 (1)	(i) (i)
Malagasy Republic (Madagascar)	50 ±2	220 (6, 1) 127 (6, a)	380/220 (1) 220/127 (1)	5 kV 380/220 (1) 220/127 (1)	±3
Malawi	50	230 (6, a)	400/230 (1)	400/230 (1, c)	(i)
Malaysia	50 ±1.0	240 (6, a)	415/240 (1)	22 kV 415/240 (1, c)	±5
Mali	50	220 (6, a) 127 (6, a)	380/220 (1) 220/127 (1) 220 (6) 127 (6)	380/220 (1, c) 220/127 (1)	(i)
Malta	50 ±1	240 (6, a)	415/240 (1)	11 kV 6.6 kV 3.3 kV 415/240 (1)	(i)
Martinique (France)	50	127 (6, a)	220/127 (1) 127 (6)	220/127 (1, c)	(i)
Mauritania	50	220 (6)	220 (6)	200 (10)	(i)
Mauritius	50 ±1.0	230 (6, 1)	400/230 (1)	400/230 (1, c)	±6
Mexico	60 ±0.2	220/127 (1) 220 (6) 120 (12)	220/127 (1) 220 (6) 120 (12)	13.8 kV 13.2 kV 480/277 (1) 220/127 (7)	±6
Monaco	50	380/220 (1) 220 (6) 220/127 (1) 127 (6)	380/220 (1) 220 (6)	380/220 (1, c)	(i)
Montserrat	60	230 (6, a)	400/230 (1)	400/230 (1, c)	(i)
Morocco	50	220/127 (1) 200/115 (1)	380/220 (1)	380/220 (1, c)	(i)
Mozambique	50	380/220 (1) 220 (6)	380/220 (1)	380/220 (1)	(i)
Nepal	50 ±1	220 (6, a)	400/220 (1) 220 (6)	11 kV 400/220 (1)	±10
Netherlands	50 ±0.4	380/220 (1) 220 (2, 6)	380/220 (1)	10 kV 3 kV 380/220 (1)	±6

Table A-1. Summary of Worldwide Power Information (page 8 of 13)

Country	Frequency (Hz) and Tolerance (%)	Residential Voltage	Commercial Voltage	Industrial Voltage	Voltage Tolerance (%)
Netherlands Antilles	50 & 60	220 (6, a) 127 (6, a) 120 (6, a) 115 (6, a)	380/220 (1) 230/115 (5) 220/127 (1) 208/120 (1)	380/220 (1, c) 230/115 (3) 220/127 (1) 208/120 (1)	(i)
New Caledonia (France)	50	220 (6)	380/220 (1)	380/220 (1)	
New Zealand	50 ±1.5	400/230 (1, 2) 230 (6) 240 (6)	415/240 (1, 2) 400/230 (1, 2) 230 (6) 240 (6)	11 kV 400/230 (1) 415/240 (1) 440 (f)	±5
Nicaragua	60	240/120 (3, 5)	240/120 (3, 5)	13.2 kV 7.6 kV 240/120 (3)	(i)
Niger	50 ±1	220 (6, a)	15 kV 380/220 (1)	15 kV 380/220 (1)	±2.5
Nigeria	50 ±1	230 (6, a) 220 (6, a)	400/230 (1) 380/220 (1)	15 kV 11 kV 400/230 (1) 380/220 (1)	±5
Norway	50 ±0.2	230 (7)	380/220 (1) 230 (7)	20 kV 10 kV 5 kV 380/220 (1) 230 (7)	±10
Okinawa (Japan)	60	200/100 (5) 100 (6)	200/100 (5) 100 (6)		(i)
Oman Muscat	50	240 (6, a)	415/240 (1) 240 (6)	415/240 (1, c)	(i)
Pakistan	50	230 (6, a)	400/230 (1) 230 (6)	400/230 (1, c)	(i)
Panama	60 ±0.17	240/120 (5)	480/277 (1) 240/120 (5)	12 kV 480/277 (1) 208/120 (1)	±5
Papua New Guinea	50 ±2	240 (6, 1)	415/240 (1) 240 (6)	22 kV 11 kV 415/240 (1)	±5
Paraguay	50	220 (6, a)	440/220 (5) 380/220 (1)	440/220 (3, c) 380/220 (1)	(i)
Peru	60	225 (7, 12)	225 (7, 12)	10 kV 6 kV 225 (7)	(i)

Table A-1. Summary of Worldwide Power Information (page 9 of 13)

Country	Frequency (Hz) and Tolerance (%)	Residential Voltage	Commercial Voltage	Industrial Voltage	Voltage Tolerance (%)
Philippines (excluding Manila metropolitan area)	60 ±1.6	220/110 (5)	13.8 kV 4.16 kV 2.4 kV 220/110 (4)	13.8 kV 4.16 kV 2.4 kV 440 (10) 220/110 (4)	±5
Manila metropolitan area	60 ±0.05	240/120 (4, 5) 240/120 (4)	240/120 (4, 5) 240/120 (4)	20 kV 6.24 kV 3.6 kV 240/120 (4)	±5
Poland	50 ±1	220 (6, a)	380/220 (1)	15 kV 6 kV 380/220 (1)	±5
Portugal	50 ±1	380/220 (1) 220 (6)	15 kV 5 kV 380/220 (1) 220 (6)	15 kV 5 kV 380/220 (1)	±5
Puerto Rico & Virgin Islands (U.S.)	60 ±10	240/120 (6)	480 (10) 240/120 (6)	8.32 kV 4.16 kV 480 (10)	±10
Qatar	50	240 (6, 1)	415/240 (1) 240 (6)	415/240 (1, c)	±6
Romania	50 ±1	220 (6, a)	380/220 (6)	20 kV 10 kV 6 kV 380/220 (1)	±5
Russia: See Commonwealth of Independent States					
Rwanda	50 ±1	220 (6, a)	380/220 (1)	15 kV 6.6 kV 380/220 (1)	±5
Sabah (Malaysia)	50 ±0.5	240 (6, a)	415/240 (1)	415/240 (1, c)	±6
St. Kitts & Nevis	60	230 (6, a)	400/230 (1)	400/230 (1, c)	(i)
St. Lucia	50	240 (6, a)	415/240 (1)	11 kV 415/240 (1)	(i)
St. Vincent	50	230 (6, a)	400/230 (1)	3.3 kV 400/230 (1)	(i)
Saudi Arabia	50 ±0.5 60 ±0.5	220/127 (1) 127 (6)	380/220 (1) 220/127 (1) 127 (6)	380/220 (1, c) 220/127 (1) 13.8 kV	±5
Senegal	50	127 (6, a)	220/127 (1) 127 (6)	220/127 (1, c)	(i)
Seychelles Islands	50	240 (6, a)	415/240 (1)	415/240 (1, c)	(i)
Sierra Leone	50	230 (6, a)	400/230 (1) 230 (6)	11 kV 400/230 (1)	(i)

Table A-1. Summary of Worldwide Power Information (page 10 of 13)

Country	Frequency (Hz) and Tolerance (%)	Residential Voltage	Commercial Voltage	Industrial Voltage	Voltage Tolerance (%)
Singapore	50 ±0.5	400/230 (1) 230 (6)	6.6 kV 400/230 (1)	22 kV 6.6 kV 400/230 (1)	±3
Slovakia	50 ±0.1	380/220 (1) 220 (6)	380/220 (1) 220 (6)	22 kV 15 kV 6 kV 3 kV 380/220 (1)	±10
Slovenia	50	380/220 (1) 220 (6)	380/220 (1) 220 (6)	10 kV 6.6 kV 380/220 (1)	(i)
Somalia Republic	50	230 (6) 220 (6) 110 (6, a)	440/220 (5) 220/110 (5) 230 (6)	440/220 (3, c) 220/110 (3)	(i)
South African Republic	50 ±2.5 25 (h)	433/250 (1, g) 400/230 (1, g) 380/220 (1) 220 (6)	11 kV 6.6 kV 3.3 kV 433/250 (1, g) 400/230 (1, g) 380/220 (1)	11 kV 6.6 kV 3.3 kV 500 (7) 380/220 (1)	±6
Spain	50 ±3	380/220 (1, 2) 220 (6) 220/127 (1, 2) 127 (6)	380/220 (1) 220/127 (1)	5 kV 11 kV 380/220 (1)	±7
Sri Lanka (Ceylon)	50 ±2	230 (6, 1)	400/230 (1) 230 (6)	11 kV 400/230 (1)	±6
Sudan	50	240 (6, a)	415/240 (1) 240 (6)	415/240 (1, c)	(i)
Suriname	50 & 60	115 (6) 127 (6, a)	230/115 (5) 220/127 (1) 220/110 (5)	230/115 (3, c) 220/127 (1) 220/110 (3)	(i)
Swaziland	50 ±2.5	230 (6, a)	400/230 (1) 230 (6)	11 kV 400/230 (1)	±6
Sweden	50 ±0.2	380/220 (1) 220 (6)	380/220 (1) 220 (6)	20 kV 10 kV 6 kV 380/220 (1)	±10
Switzerland	50 ±0.5	380/220 (1) 220 (6)	380/220 (1) 220 (6)	16 kV 11 kV 6 kV 380/220 (1)	±10
Syrian Arab. Republic.	50	220 (6, a) 115 (6, a)	380/220 (1) 220 (6) 220/115 (1) 115 (6)	380/220 (1, c) 200/115 (1)	(i)
Taiwan (j) (Formosa)	60 ±4	380/220 (1) 220 (6) 220/110 (5) 110 (6)	380/220 (1) 220/110 (4)	22.8 kV 11.4 kV 380/220 (1) 220 (4)	±5 ±10

Table A-1. Summary of Worldwide Power Information (page 11 of 13)

Country	Frequency (Hz) and Tolerance (%)	Residential Voltage	Commercial Voltage	Industrial Voltage	Voltage Tolerance (%)
Tanzania (j)	50	400/230 (1)	400/230 (1)	11 kV 400/230 (1)	(i)
Thailand	50 ±1	220 (6, 1)	433/250 (1) 380/220 (1) 220 (6)	22 kV 380/220 (1, c)	±5
Togo	50	220 (6, a)	380/220 (1)	20 kV 5.5 kV 380/220 (1)	(i)
Tonga	50	415/240 (1) 240 (6) 110 (6)	415/240 (1) 240 (6) 110 (6)	11 kV 6.6 kV 415/240 (1)	(i)
Trinidad & Tobago	60 ±0.5	230/115 (5)	400/230 (1) 230/115 (3)	12 kV 400/230 (1)	±6
Tunisia (j)	50 ±2	380/220 (1) 220 (6)	380/220 (1) 220 (6)	15 kV 10 kV 380/220 (1)	±10
Turkey (j)	50 ±2	220 (6, a)	380/220 (1)	15 kV 6.3 kV 380/220 (1)	±10
Uganda	50 ±0.1	240 (6, a)	415/240 (1)	11 kV 415/240 (1)	±4.5
United Arab Emirates					
Abu Dhabi	50	415/240 (1)	415/240 (1)	415/240 (1, c)	(i)
Ajman	50	230 (6, a)	400/230 (1)	11 kV	(i)
Dubai	50 ±0.5	220 (6, a)	380/220 (1) 220 (6)	6.6 kV 380/220 (1)	±2 to 3
United Kingdom (excluding Northern Ireland)	50 ±1	240 (6, a)	415/240 (1)	22 kV 11 kV 6.6 kV 3.3 kV 415/240 (1)	±6
Upper Volta	50	220 (6)	380/220 (1)	380/220 (1)	
Uruguay	50 ±1	220 (7, 6)	220 (7, 6)	15 kV 6 kV 220 (7)	± 6

Table A-1. Summary of Worldwide Power Information (page 12 of 13)

Country	Frequency (Hz) and Tolerance (%)	Residential Voltage	Commercial Voltage	Industrial Voltage	Voltage Tolerance (%)
USA (d)					
Charlotte (North Carolina)	60 ±0.06	240/120 (5) 208/120 (1)	460/265 (1) 240/120 (5) 208/120 (1)	14.4 kV 7.2 kV 2.4 kV 575 (10) 460 (10) 240 (10) 480/277 (1) 240/120 (5) 208/120 (1)	±5 -2.5
Los Angeles (California)	60 ±0.2	240/120 (5) 208/120 (1)	480 (10) 240/120 (4) 208/120 (1)	13.2 kV 4.8 kV 4.16 kV 480 (10) 240/120 (4) 208/120 (1)	±4 -6.6
Detroit (j) (Michigan)	60 ±0.2	240/120 (5)	4.8 kV 240/120 (3)	4.8 kV 240/120 (3)	±5
Miami (Florida)	60 ±0.3	240/120 (5) 208/120 (1)	240/120 (5) 240/120 (4) 208/120 (1)	13.2 kV 2.4 kV 480/277 (1) 240/120 (4)	±5
New York (New York)	60	240/120 (5) 208/120 (1)	240/120 (5) 208/120 (1) 240 (10)	12.47 kV 4.16 kV 480/277 (1) 480 (10)	(i)
Pittsburgh (Pennsylvania)	60 ±0.03	240/120 (5)	460/265 (1) 240/120 (1) 208/120 (1) 460 (10) 230 (10)	13.2 kV 11.5 kV 2.4 kV 460/265 (1) 208/120 (1) 460 (10) 230 (10)	±5 (lighting) ±10 (power)
Portland (Oregon)	60	240/120 (5)	480/277 (1) 240/120 (5) 208/120 (1) 480 (10) 240 (10)	19.9 kV 12 kV 7.2 kV 2.4 kV 480/277 (1) 208/120 (1) 480 (10) 240 (10)	(i)
San Francisco (California)	60 ±0.08	240/120 (5)	480/277 (1) 240/120 (5)	20.8 kV 12 kV 4.16 kV 480/277 (1) 240/120 (3)	±5

Table A-1. Summary of Worldwide Power Information (page 13 of 13)

Country	Frequency (Hz) and Tolerance (%)	Residential Voltage	Commercial Voltage	Industrial Voltage	Voltage Tolerance (%)
USA (d) (Continued) Toledo (Ohio)	60 \pm 0.08	240/120 (5) 208/120 (1)	480/277 (8) 240/120 (4) 208/120 (5)	12.47 kV 7.2 kV 4.8 kV 4.16 kV 480 (10) 480/277 (1) 208/120 (1)	\pm 5
USSR: See Commonwealth of Independent States					
Venezuela	60	240/120 (3) 208/120 (1)	240/120 (3) 208/120 (1)	13.8 kV 12.47 kV 4.8 kV 4.16 kV 2.4 kV 240/120 (3) 208/120 (1)	(i)
Vietnam	50 \pm 0.1	220 (6, a) 120 (6, a)	380/220 (1) 208/120 (1)	15 kV 380/220 (1)	\pm 10
Western Samoa	50	400/230	(i)	(i)	(i)
Yemen Arab Republic	50	220	(i)	(i)	(i)
Yemen (PDR)	50 \pm 1	250 (6, a)	440/250 (1)	440/250 (1, c)	\pm 4
Yugoslavia	50	380/220 (1) 220 (6)	380/220 (1) 220 (6)	10 kV 6.6 kV 380/220 (1)	(i)
Zambia	50 \pm 2.5	230 (6, a)	400/230 (1)	400/230 (1, c)	\pm 3.75
Zimbabwe	50 \pm 2.5	225 (6, a)	390/225 (1)	11 kV 390/225 (1)	\pm 6.6