Appendix A: Specifications

This appendix contains complete specifications for the TDS 340A, TDS 360, and TDS 380. The specifications are divided into three subsections, one for each of three classes of traits: *Warranted Characteristics, Typical Characteristics,* and *Nominal Traits*.

Warranted Characteristics

Warranted characteristics are described in terms of quantifiable performance limits that are warranted. This subsection lists only warranted characteristics.

***NOTE**. In these tables, those warranted characteristics that are checked in the* Performance Tests*, starting on page 0–5, appear in **boldface type** under the column* **Name**.

Performance Conditions

The electrical characteristics found in these tables of warranted characteristics apply when the oscilloscope has been adjusted at an ambient temperature between +20° C and +30° C, has had a warm-up period of at least 20 minutes, and is operating at an ambient temperature between –10° C and +55° C (unless otherwise noted).

Table A–1: Warranted characteristics — signal acquisition system
The minimum single pulse widths for guaranteed 50% or greater amplitude capture are as follows:

Name	Description	
Accuracy, DC Voltage Measurement, Average Acquisition Mode	**Measurement type**	**DC accuracy**
	Average of ≥16 waveforms	±(2.0% × |(reading – Net Offset[1])| + Offset Accuracy + 0.1 div)
	Delta volts between any two averages of ≥16 waveforms acquired under the same setup and ambient conditions	±(2.0% × |reading| + 0.15 div + 0.3 mV)
Accuracy, DC Gain, Sample or Average Acquisition Modes	±2%	
Pulse Response, Peak Detect and Envelope Mode	**Sec/Div setting**	**Minimum pulse width**
	5 s/div – 25 µs/div	10 ns
	TDS 340A: 10 µs/div – 5 ns/div TDS 360: 10 µs/div – 2.5 ns/div TDS 380: 10 µs/div – 1 ns/div	The greater of 10 ns or 0.02 × sec/div setting

Table A–1: Warranted characteristics — signal acquisition system (Cont.)
The minimum single pulse widths for guaranteed 50% or greater amplitude capture are as follows:

Name	Description	
Accuracy, Offset	**Volts/Div setting**	**Offset accuracy**
	2 mV/div – 99.5 mV/div	±(0.4% × |Net Offset[1]| + 3 mV + 0.1 div × V/div setting)
	100 mV/div – 995 mV/div	±(0.4% × |Net Offset[1]| + 30 mV + 0.1 div × V/div setting)
	1 V/div – 10 V/div	±(0.4% × |Net Offset[1]| + 300 mV + 0.1 div × V/div setting)
Analog Bandwidth, DC Coupled	TDS 340A: DC – ≥100 MHz TDS 360: DC – ≥200 MHz; DC – ≥180 MHz for 2 mV/div TDS 380: DC – ≥400 MHz; DC – ≥250 MHz for 2 mV/div	
Cross Talk (Channel Isolation)	≥100:1 at 50 MHz with equal Volts/Div settings on each channel	
Input Impedance, DC-Coupled	TDS 340A: 1 MΩ ±1% in parallel with 20 pF ±2.0 pF TDS 360: 1 MΩ ±1% in parallel with 20 pF ±2.0 pF TDS 380: 1 MΩ ±1% in parallel with 12 pF ±2.0 pF	
Input Voltage, Maximum	±300 V (DC or AC) CAT II; derate at 20 dB/decade above 100 kHz to 13 V peak AC at 3 MHz and above	
Lower Frequency Limit, AC Coupled[2]	≤10 Hz	

1 **Net Offset = Offset – (Position × Volts/Div). Net offset is the voltage level at the center of the A-D converter dynamic range. Offset Accuracy is the accuracy of this voltage level.**

2 **The AC Coupled Lower Frequency Limits are reduced by a factor of 10 when 10X, passive probes are used.**

Table A–2: Warranted characteristics — time base system

Name	Description
Accuracy, Long Term Sample Rate and Delay Time	±100 ppm over any ≥1 ms interval
Accuracy, Delta Time Measurements[1, 2]	For single-shot acquisitions using sample acquisition mode and a bandwidth limit setting of FULL: ±(1 WI + 100 ppm × |Reading| + 0.6 ns) For repetitive acquisitions using average acquisition mode with ≥16 averages and a bandwidth limit setting of FULL: ±(1 WI + 100 ppm × |Reading| + 0.4 ns)

1 **For input signals ≥5 divisions in amplitude and a slew rate of ≥2.0 divisions/ns at the delta time measurement points. Signal must be acquired at a volts/division setting ≥5 mV/division.**

2 **The WI (waveform interval) is the time between the samples in the waveform record. Also, see the footnotes for *Sample Rate Range* and *Equivalent Time or Interpolated Waveform Rates* in Table A–11 on page A–8.**

Table A–3: Warranted characteristics — triggering system

Name	Description	
Accuracy, Trigger Level, DC Coupled	**Trigger source**	**Sensitivity**
	CH1 or CH2	±(3% of |Setting – Net Offset[1]| + 0.2 div × volts/div setting + Offset Accuracy)
	External	±(6% of |Setting| + 20 mV)
	External/10	±(6% of |Setting| + 200 mV)
Sensitivity, Edge-Type Trigger, DC Coupled	**Trigger source**	**Sensitivity**
	CH1 or CH2	TDS 340A: 0.35 division from DC to 20 MHz, increasing to 1 div at 100 MHz TDS 360: 0.35 division from DC to 50 MHz, increasing to 1 div at 200 MHz TDS 380: 0.35 division from DC to 50 MHz, increasing to 1 div at 400 MHz
	External	TDS 340A: 50 mV from DC to 20 MHz, increasing to 150 mV at 100 MHz TDS 360: 50 mV from DC to 50 MHz, increasing to 150 mV at 200 MHz TDS 380: 50 mV from DC to 50 MHz, increasing to 500 mV at 400 MHz
	External/10	TDS 340A: 500 mV from DC to 20 MHz, increasing to 1.5 V at 100 MHz TDS 360: 500 mV from DC to 50 MHz, increasing to 1.5 V at 200 MHz TDS 380: 500 mV from DC to 50 MHz, increasing to 5.0 V at 400 MHz
Input Impedance, External Trigger	1 MΩ ±2% in parallel with 20 pF ±2 pF	
Maximum Input Voltage, External Trigger	±300 V (DC or AC) CAT II; derate at 20 dB/decade above 100 kHz to 13 V peak AC at 3 MHz and above	

[1] **Net Offset = Offset – (Position × Volts/Div). Net Offset is the voltage level at the center of the A-D converter dynamic range. Offset Accuracy is the accuracy of this voltage level.**

Table A–4: Power Requirements

Name	Description
Source Voltage and Frequency	90 to 132 VAC_{RMS}, continuous range, for 47 Hz through 440 Hz 132 to 250 VAC_{RMS}, continuous range, for 47 Hz through 63 Hz
Power Consumption	≤65 Watts (120 VA)

Table A–5: Warranted characteristics — environmental

Name	Description
Atmospherics	Temperature without diskette in floppy disk drive: +4° C to +50° C, operating; –22° C to +60° C, non-operating Temperature with diskette in floppy disk drive: +10° C to +50° C, operating or non-operating Relative humidity without diskette in floppy disk drive: to 80% at or below +29° C, or to 20% from +30° C to +50° C, operating; to 90% at or below +40° C, or to 5% from +41° C to +50° C, non-operating; Relative humidity with diskette in floppy disk drive: to 80% at or below +29° C, or to 20% from +30° C to +50° C, operating or non-operating Altitude: To 15,000 ft (4570 m), operating; to 40,000 ft (12190 m), non-operating
Dynamics	Random vibration without diskette in floppy disk drive: 0.31 g_{RMS}, from 5 to 500 Hz, 10 minutes each axis, operating; 2.46 g_{RMS}, from 5 to 500 Hz, 10 minutes each axis, non-operating

Typical Characteristics

Typical characteristics are described in terms of typical or average performance. Typical characteristics are not warranted.

Table A–6: Typical characteristics — signal acquisition system

Name	Description			
Accuracy, DC Gain, Envelope Acquisition Mode	±3% for sec/div settings from 5 Sec/Div to 25 µsec/div; ±2% for sec/div settings from 10 µs/div to 5 ns/div (TDS 340A); ±2% for sec/div settings from 10 µs/div to 2.5 ns/div (TDS 360); ±2% for sec/div settings from 10 µs/div to 1 ns/div (TDS 380)			
Accuracy, DC Voltage Measurement, Sample Acquisition Mode	**Measurement type**		**DC accuracy**	
	Any Sample		±(2.0% × (|reading – Net Offset[1]|) + Offset Accuracy + 0.13 div + 0.6 mV)	
	Delta Volts between any two samples[2] acquired under the same setup and ambient conditions		±(2.0% × |reading| + 0.26 div + 1.2 mV)	
Frequency Limit, Upper, 20 MHz Bandwidth Limited	20 MHz			
Step Response Settling Error	**Volts/Div setting**	**Step amplitude**	**Settling error (%)[3]**	
			100 ns	**20 ms**
	2 mV/div – 99.5 mV/div	≤2 V	≤1.0	≤0.1
	100 mV/div – 995 mV/div	≤20 V	≤1.5	≤0.2
	1 V/div – 10 V/div	≤200 V	≤2.5	≤0.2
Common Mode Rejection Ratio (CMRR)	100:1 at 60 Hz, reducing to 20:1 at 50 MHz, with equal Volts/Div and Coupling settings on each channel.			

1 Net Offset = Offset – (Position × Volts/Div). Net Offset is the voltage level at the center of the A-D converter dynamic range. Offset Accuracy is the accuracy of this voltage level.

2 The samples must be acquired under the same setup and ambient conditions.

3 The values given are the maximum absolute difference between the value at the end of a specified time interval after the mid-level crossing of the step, and the value one second after the mid-level crossing of the step, expressed as a percentage of the step amplitude.

Table A–7: Typical characteristics — triggering system

Name	Description	
Error, Trigger Position, Edge Triggering	**Acquire mode**	**Trigger-position error[1,2]**
	Sample, Average	±(1 WI + 2 ns)
	Peak Detect, Envelope	±(2 WI + 2 ns)
Sensitivity, Video-Type Trigger	**Source**	**Typical sensitivity**
	CH1 or CH2 External External/10	0.6 division of video sync signal 75 mV of video sync signal 750 mV of video sync signal
Lowest Frequency for Successful Operation of "Set Level to 50%" Function	50 Hz	
Sensitivity, Edge Type Trigger, Not DC Coupled[3]	**Trigger coupling**	**Typical signal level for stable triggering**
	AC	Same as DC-coupled limits[4] for frequencies above 60 Hz. Attenuates signals below 60 Hz.
	Noise Reject	Three and one half times the DC-coupled limits.[4]
	High Frequency Reject	One and one half times times the DC-coupled limits[4] from DC to 30 kHz. Attenuates signals above 30 kHz.
	Low Frequency Reject	One and one half times the DC-coupled limits[4] for frequencies above 80 kHz. Attenuates signals below 80 kHz.

1 **The trigger position errors are typically less than the values given here. These values are for triggering signals having a slew rate at the trigger point of ±0.5 division/ns.**

2 **The waveform interval (WI) is the time between the samples in the waveform record. Also, see the footnote for the characteristics *Sample Rate Range* and *Equivalent Time or Interpolated Waveform Rates* in Table A–11 on page A–8.**

3 **The minimum sensitivity for obtaining a stable trigger. A stable trigger results in a uniform, regular display triggered on the selected slope. The trigger point must not switch between opposite slopes on the waveform, and the display must not "roll" across the screen on successive acquisitions. The TRIG'D LED stays constantly lighted when the SEC/DIV setting is 2 ms or faster but may flash when the SEC/DIV setting is 10 ms or slower.**

4 **See the characteristic *Sensitivity, Edge-Type Trigger, DC Coupled* in Table A–3, which begins on page A–3.**

Table A–8: Typical characteristics — probe compensator output

Name	Description	
Output Voltage and Frequency, Probe Compensator	**Characteristic**	
	Voltage	5.0 V (low-high) into a 1 MΩ load
	Frequency	1 kHz

Table A–9: Typical characteristics — data handling

Name	Description
Time, Data-Retention, Nonvolatile Memory[1,2]	≥5 Years

1 **The time that reference waveforms, stored setups, and calibration constants are retained when there is no power to the oscilloscope.**

2 **Data is maintained by a lithium poly-carbon monofluoride battery.**

Nominal Traits

Nominal traits are described using simple statements of fact such as "Two, identical" for the trait "Input Channels, Number of," rather than in terms of limits that are performance requirements.

Table A–10: Nominal traits — signal acquisition system

Name	Description	
Bandwidth Selections	20 MHz and FULL	
Digitizers, Number of	Two, identical, digitized simultaneously	
Digitized Bits, Number of	8 bits[1]	
Input Channels, Number of	Two, identical, called CH 1 and CH 2	
Input Coupling	DC, AC, or GND	
Ranges, Offset, All Channels	**Volts/Div setting**	**Offset range**
	2 mV/div – 99.5 mV/div	±1 V
	100 mV/div – 995 mV/div	±10 V
	1 V/div – 10 V/div	±100 V
Range, Position	±5 divisions	
Range, Sensitivity[2]	2 mV/div to 10 V/div	
Rise Time	TDS 340A: 3.5 ns TDS 360: 1.75 ns TDS 380: 875 ps	
TekProbe Interface	Level one probe coding	

1 **Displayed vertically with 25 digitization levels (DLs) per division and 10.24 divisions dynamic range with zoom off. A DL is the smallest voltage level change that the 8-bit A-D Converter can resolve, with the input scaled to the volts/division setting of the channel used. Expressed as a voltage, a DL is equal to 1/25 of a division times the volts/division setting.**

2 **The sensitivity ranges from 2 mV/div to 10 V/div in a 1–2–5 sequence of coarse settings. Between consecutive coarse settings, the sensitivity can be finely adjusted with a resolution of 1% of the more sensitive setting. For example, between 50 mV/div and 100 mV/div, the volts/division can be set with 0.5 mV resolution.**

Table A–11: Nominal traits — time base system

Name	Description
Range, Sample-Rate[1,2]	TDS 340A: 10 Samples/s to 500 MSamples/s in a 1–2–5 sequence TDS 360: 10 Samples/s to 1 GSamples/s in a 1–2–5 sequence TDS 380: 10 Samples/s to 2 GSamples/s in a 1–2–5 sequence
Range, Seconds/Division	TDS 340A: 5 ns/div to 5 s/div in a 1–2.5–5 sequence TDS 360: 2.5 ns/div to 5 s/div in a 1–2.5–5 sequence TDS 380: 1 ns/div to 5 s/div in a 1–2.5–5 sequence
Range, Time Base Delay Time	16.5 ns to 50 seconds
Record Length	1,000 samples

1 **The range of real-time rates, expressed in samples/second, at which a digitizer samples signals at its inputs and stores the samples in memory to produce a record of time-sequential samples**

2 **The Waveform Rate (WR) is the equivalent sample rate of a waveform record. For a waveform record acquired by real-time sampling of a single acquisition, the waveform rate is the same as the real-time sample rate; for a waveform created by interpolation of real-time samples from a single acquisition or by equivalent-time sampling of multiple acquisitions, the waveform rate is faster than the real time sample rate. For all three cases, the waveform rate is 1/(Waveform Interval) for the waveform record, where the waveform interval (WI) is the time between the samples in the waveform record.**

Table A–12: Nominal traits — triggering system

Name	Description	
Range, Hold Off	500 ns minimum to 10 seconds maximum	
Ranges, Trigger Level	**Source**	**Range**
	Any Channel	±12 divisions from center of screen
	External	±1.5 Volts
	External /10	±15 Volts
	Line	±300 Volts
Formats and Field Rates, Video Trigger	Triggers from sync-negative composite video, 525 to 625 lines, 50 Hz to 60 Hz, interlaced or noninterlaced systems with scan rates from 15 kHz to 65 kHz – such as NTSC, PAL, or SECAM	
TekProbe Interface, External Trigger	Level one probe coding	

Table A–13: Nominal traits — display system

Name	Description
CRT Type	7-inch (17.95 cm) diagonal, magnetic deflection; horizontal raster-scan; P31 green phosphor
Video Display Resolution	640 pixels horizontally by 480 pixels vertically Display area is 5.04 inch (12.92 cm) horizontally by 3.78 inch (9.69 cm) vertically
Waveform Display Graticule	A single graticule 401 × 501 pixels (8 × 10 divisions, with divisions that are approximately 1 cm by 1 cm)
Intensity Levels	Dim and Bright, with adjustable Overall Intensity and Contrast

Table A–14: Nominal traits — I/O interface option

Name	Description
GPIB	Part of Option 14 I/O interface or TD3F14A I/O interface field upgrade kit; complies with IEEE Std 488–1987
RS-232	Part of Option 14 I/O interface or TD3F14A I/O interface field upgrade kit; a 9-pin male DTE RS-232 interface that complies with EIA/TIA 574–90
Centronics	Part of Option 14 I/O interface or TD3F14A I/O interface field upgrade kit; a 25-pin, IBM PC-type, parallel printer interface that complies electrically with Centronics C332–44, Rev A
Video Signal Output (Option 14 Only)	DB-9 rear panel Video connector; non-interlaced, with levels that comply with ANSI RS343A VGA compatible at a 30.6 kHz sync rate
Power Supply, Printer (Option 14 Only)	Power supply connector to supply power to the Option 3P Printer Pack

Table A–15: Nominal traits — power distribution system

Name	Description
Fuse Rating	5 mm × 20 mm, 3.15 A (T), 250 V; or 1.25 in × 0.25 in, 3 A (T), 250 V

Table A–16: Nominal traits — mechanical characteristics

Name	Description
Weight	
Standard	7.0 kg (15.5 lbs) stand-alone instrument; 8.6 kg (19 lbs) with front cover, accessories, and accessories pouch installed; 12.9 kg (28.5 lbs) when packaged for domestic shipment
Rackmount	6.6 kg (14.5 lbs), plus weight of rackmount parts (Option 1R); 14.7 kg (32.5 lbs) when the rackmounted oscilloscope is packaged for domestic shipment
Rackmount conversion kit	4.5 kg (10 lbs); 7.5 kg (17.5 lbs) when kit is packaged for domestic shipment
Overall Dimensions	
Standard Instrument (Figure A–1)	Height: 191 mm (7.5 in) with feet and accessories pouch installed 165 mm (6.5 in) without the accessories pouch installed Width: 362 mm (14.25 in) with handle Depth: 471 mm (18.55 in) stand-alone instrument 490 mm (19.28 in) with front cover installed 564 mm (22.2 in) with handle extended
Rackmount Instrument	Height: 178 mm (7 in) Width: 483 mm (19 in) Depth: 472 mm (18.6 in) without handles; 517 mm (20.35 in) including handles

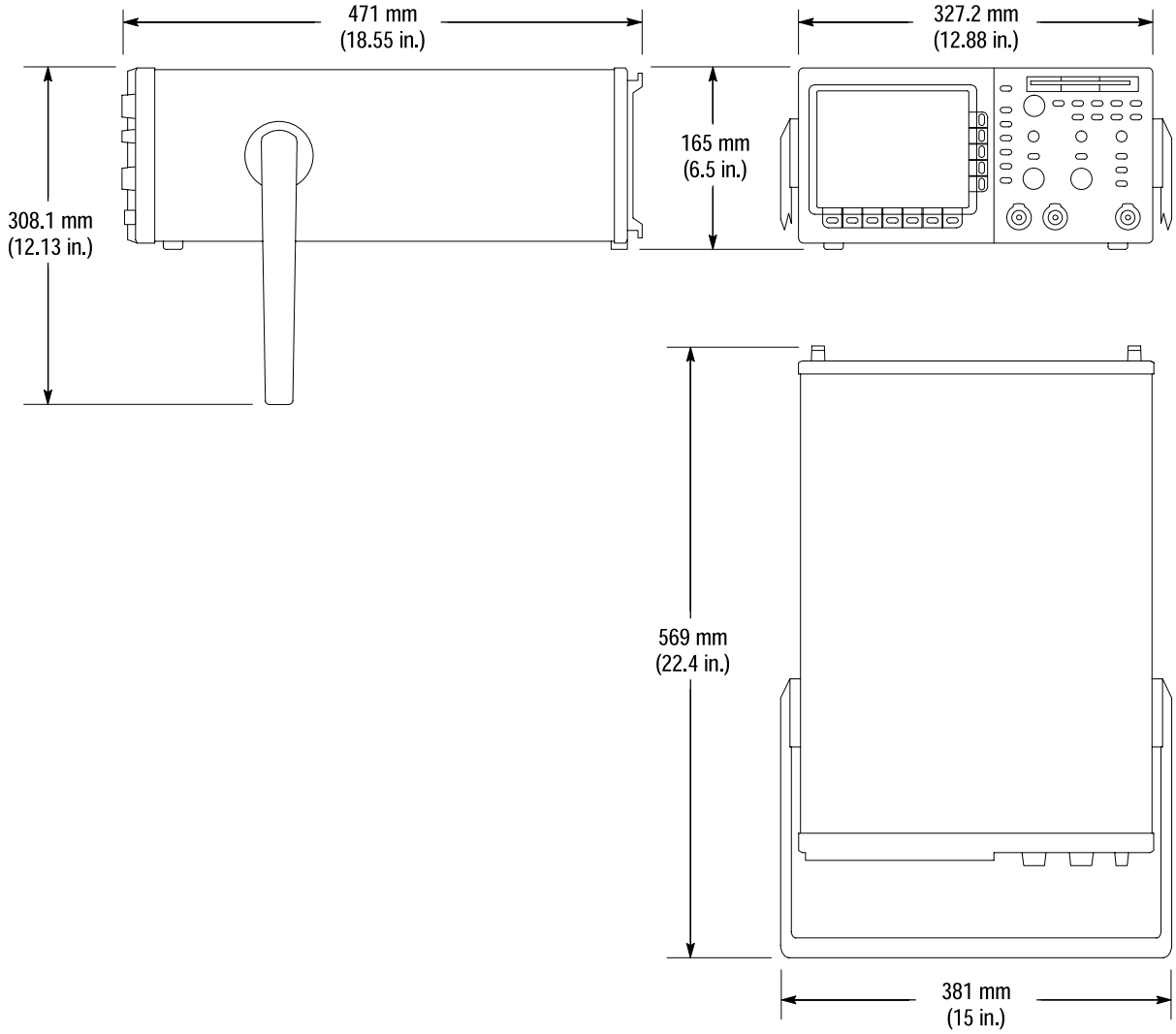

Figure A–1: TDS 340A, TDS 360, and TDS 380 dimensions

Table A–17: Certifications and compliances

EC Declaration of Conformity	Meets intent of Directive 89/336/EEC for Electromagnetic Compatibility and Low Voltage Directive 73/23/EEC for Product Safety. Compliance was demonstrated to the following specifications as listed in the Official Journal of the European Communities: EMC Directive 89/336/EEC: EN 55011 Class B Radiated and Conducted Emissions [1] EN 50081-1 Emissions: EN 60555-2 AC Power Line Harmonic Emissions EN 50082-1 Immunity: IEC 801-2 Electrostatic Discharge Immunity IEC 801-3 RF Electromagnetic Field Immunity [2] IEC 801-4 Electrical Fast Transient/Burst Immunity IEC 801-5 Power Line Surge Immunity Low Voltage Directive 73/23/EEC: EN 61010-1 Safety requirements for electrical equipment for measurement, control, and laboratory use 1 To maintain emission requirements when connecting to the I/O interface of this oscilloscope, use only a high-quality, double-shielded (braid and foil) cable. The cable shield must have low-impedance connections to both connector housings. The VGA cable must also have a ferrite core at both ends. Acceptable cables are listed in Table C–6 on page 0–4. 2 Performance criteria: ≤±0.3 division waveform displacement, or ≤0.6 division increase in p-p noise from 27 MHz to 500 MHz. Test conditions: both channel inputs terminated with grounding caps, both channels set to 10 mV/div, both channels set to DC Coupling, trigger source set to CH 1, acquisition mode set to Sample, and time base set to 250 µs/div.
Certifications	Underwriters Laboratories listing to Standard UL3111–1 for Electrical Measuring and Test Equipment. [3] [4] Canadian Standards Association certified to Standard CAN/CSA-C22.2 No. 1010.1–92. [3] 3 These standards are North American interpretations of IEC 1010. 4 Conditions for certification: operating temperature –10° C to +55° C, maximum operating altitude 2000 m, Safety Class I (IEC 1010-1 Annex H), Overvoltage Catagory II (IEC 1010-1 Annex J), Pollution Degree 2 (IEC 1010-1).
FCC Compliance	Emissions comply with FCC Code of Federal Regulations 47, Part 15, Subpart B, Class A Limits
CSA Certified Power Cords	CSA Certification includes the products and power cords appropriate for use in the North America power network. All other power cords supplied are approved for the country of use.
Overvoltage Category	Category: Examples of Products in this Category: CAT III Distribution-level mains, fixed installation CAT II Local-level mains, appliances, portable equipment CAT I Signal levels in special equipment or parts of equipment, telecommunications, electronics
Pollution Degree 2	Do not operate in environments where conductive pollutants may be present.