

AQxx-01FLTG Series

200 W, Unidirectional TVS General Purpose ESD Protection, SOD323FL



Pinout



Functional Block Diagram



Description

The AQxx-01FLTG series unidirectional TVS diode utilizes a proprietary silicon avalanche technology. These diodes provide electronic equipment with high ESD (electrostatic discharge) protection.

The AQxx-01FLTG series TVS diodes can safely absorb repetitive ESD strikes of ± 30 kV (contact and air discharge as defined in IEC 61000-4-2) without any performance degradation. In addition, it can safely dissipate a 200 W peak pulse power at 10/1000 μ s waveform.

Features

- ESD, IEC 61000-4-2, ± 30 kV contact/air
- ESD, ISO 10605, 330 pF 330 Ω , ± 30 kV contact/air
- EFT, IEC 61000-4-4, 40 A (5/50 ns)
- Peak pulse power, 200 W, 10/1000 μ s waveform
- Surge tolerance: IEC 61000-4-5 2nd edition, 10~99 A ($t_p = 8/20 \mu$ s)
- Halogen-free, lead-free, and RoHS-compliant
- Moisture sensitivity level (MSL-1)
- AEC-Q101-qualified and PPAP-capable

Applications

- Battery protection
- - Computer peripherals
- - Medical equipment
- - Notebooks / desktops / servers
- - Test equipment / instrumentation
- - V_{CC}

Life Support Note:

Not Intended for Use in Life Support or Life Saving Applications

The products shown herein are not designed for life-sustaining or life-saving applications unless expressly indicated.

AQxx-01FLTG Series**200 W, Unidirectional TVS General Purpose ESD Protection, SOD323FL****Absolute Maximum Ratings**

Symbol	Parameter	Value	Units
P_{PPM}	Peak pulse power dissipation	10/1000 μ s	200 W
		8/20 μ s	1000 W
T_{OP}	Operating temperature	-40 to 150	°C
T_{STOR}	Storage temperature	-55 to 150	°C

Caution:

Stresses above those listed under "Absolute Maximum Ratings" may cause permanent damage to the component. This rating is "stress only," and the operation of the component at these or any other conditions above those indicated in the operational sections of this specification are not implied or recommended.

AQ05-01FLTG Electrical Characteristics ($T_{OP} = 25\text{ °C}$)

Parameter	Symbol	Test Conditions	Min	Typ	Max	Units
Reverse Standoff Voltage	V_{RWM}				5	V
Breakdown Voltage	V_{BR}	$I_R = 1\text{ mA}$, I/O to GND	6.4		7.0	V
Reverse Leakage Current	I_{LEAK}	$V_R = 5\text{ V}$, I/O to GND			400	μ A
Clamp Voltage ¹	V_C	$I_{PP} = 1\text{ A}$, $t_p = 10/1000\text{ }\mu$ s, I/O to GND		7.5	9.0	V
		$I_{PP} = 22\text{ A}$, $t_p = 10/1000\text{ }\mu$ s, I/O to GND		9.5	11.0	V
		$I_{PP} = 1\text{ A}$, $t_p = 8/20\text{ }\mu$ s, I/O to GND		7.5	9.0	V
		$I_{PP} = 99\text{ A}$, $t_p = 8/20\text{ }\mu$ s, I/O to GND		11.0	13.0	V
Dynamic Resistance ²	R_{DYN}	TLP, $t_p = 100\text{ ns}$, I/O to GND		0.03		Ω
ESD Withstand Voltage ^{1,3}	V_{ESD}	IEC 61000-4-2 (Contact Discharge)	± 30			kV
		IEC 61000-4-2 (Air Discharge)	± 30			kV
		ISO 10605 (Contact Discharge)	± 30			kV
		ISO 10605 (Air Discharge)	± 30			kV
Diode Capacitance ¹	C_{IO-GND}	Reverse Bias = 0 V, $f = 1\text{ MHz}$, I/O to GND		1320		pF

AQ12-01FLTG Electrical Characteristics ($T_{OP} = 25\text{ °C}$)

Parameter	Symbol	Test Conditions	Min	Typ	Max	Units
Reverse Standoff Voltage	V_{RWM}				12	V
Breakdown Voltage	V_{BR}	$I_R = 1\text{ mA}$, I/O to GND	13.3		14.7	V
Reverse Leakage Current	I_{LEAK}	$V_R = 12\text{ V}$, I/O to GND			2.5	μ A
Clamp Voltage ¹	V_C	$I_{PP} = 1\text{ A}$, $t_p = 10/1000\text{ }\mu$ s, I/O to GND		15.5	18.0	V
		$I_{PP} = 11\text{ A}$, $t_p = 10/1000\text{ }\mu$ s, I/O to GND		19.5	22.5	V
		$I_{PP} = 1\text{ A}$, $t_p = 8/20\text{ }\mu$ s, I/O to GND		15.5	18.0	V
		$I_{PP} = 46.5\text{ A}$, $t_p = 8/20\text{ }\mu$ s, I/O to GND		22.0	25.5	V
Dynamic Resistance ²	R_{DYN}	TLP, $t_p = 100\text{ ns}$, I/O to GND		0.08		Ω
ESD Withstand Voltage ^{1,3}	V_{ESD}	IEC 61000-4-2 (Contact Discharge)	± 30			kV
		IEC 61000-4-2 (Air Discharge)	± 30			kV
		ISO 10605 (Contact Discharge)	± 30			kV
		ISO 10605 (Air Discharge)	± 30			kV
Diode Capacitance ¹	C_{IO-GND}	Reverse Bias = 0 V, $f = 1\text{ MHz}$, I/O to GND		470		pF

AQxx-01FLTG Series

200 W, Unidirectional TVS General Purpose ESD Protection, SOD323FL

AQ15-01FLTG Electrical Characteristics ($T_{OP} = 25\text{ }^{\circ}\text{C}$)

Parameter	Symbol	Test Conditions	Min	Typ	Max	Units
Reverse Standoff Voltage	V_{RWM}				15	V
Breakdown Voltage	V_{BR}	$I_R = 1\text{ mA}$, I/O to GND	16.7		18.5	V
Reverse Leakage Current	I_{LEAK}	$V_R = 15\text{ V}$, I/O to GND			1.0	μA
Clamp Voltage ¹	V_C	$I_{PP} = 1\text{ A}$, $t_p = 10/1000\text{ }\mu\text{s}$, I/O to GND		19.0	22.0	V
		$I_{PP} = 9\text{ A}$, $t_p = 10/1000\text{ }\mu\text{s}$, I/O to GND		23.5	27.0	V
		$I_{PP} = 1\text{ A}$, $t_p = 8/20\text{ }\mu\text{s}$, I/O to GND		19.0	22.0	V
		$I_{PP} = 42\text{ A}$, $t_p = 8/20\text{ }\mu\text{s}$, I/O to GND		26.5	30.5	V
Dynamic Resistance ²	R_{DYN}	TLP, $t_p = 100\text{ ns}$, I/O to GND		0.10		Ω
ESD Withstand Voltage ^{1,3}	V_{ESD}	IEC 61000-4-2 (Contact Discharge)	± 30			kV
		IEC 61000-4-2 (Air Discharge)	± 30			kV
		ISO 10605 (Contact Discharge)	± 30			kV
		ISO 10605 (Air Discharge)	± 30			kV
Diode Capacitance ¹	C_{IO-GND}	Reverse Bias = 0 V, $f = 1\text{ MHz}$, I/O to GND		410		pF

AQ22-01FLTG Electrical Characteristics ($T_{OP} = 25\text{ }^{\circ}\text{C}$)

Parameter	Symbol	Test Conditions	Min	Typ	Max	Units
Reverse Standoff Voltage	V_{RWM}				22	V
Breakdown Voltage	V_{BR}	$I_R = 1\text{ mA}$, I/O to GND	24.4		26.9	V
Reverse Leakage Current	I_{LEAK}	$V_R = 22\text{ V}$, I/O to GND			1.0	μA
Clamp Voltage ¹	V_C	$I_{PP} = 1\text{ A}$, $t_p = 10/1000\text{ }\mu\text{s}$, I/O to GND		27.5	31.5	V
		$I_{PP} = 6\text{ A}$, $t_p = 10/1000\text{ }\mu\text{s}$, I/O to GND		33.5	38.5	V
		$I_{PP} = 1\text{ A}$, $t_p = 8/20\text{ }\mu\text{s}$, I/O to GND		27.0	31.0	V
		$I_{PP} = 25.5\text{ A}$, $t_p = 8/20\text{ }\mu\text{s}$, I/O to GND		37.0	42.5	V
Dynamic Resistance ²	R_{DYN}	TLP, $t_p = 100\text{ ns}$, I/O to GND		0.17		Ω
ESD Withstand Voltage ^{1,3}	V_{ESD}	IEC 61000-4-2 (Contact Discharge)	± 30			kV
		IEC 61000-4-2 (Air Discharge)	± 30			kV
		ISO 10605 (Contact Discharge)	± 30			kV
		ISO 10605 (Air Discharge)	± 30			kV
Diode Capacitance ¹	C_{IO-GND}	Reverse Bias = 0 V, $f = 1\text{ MHz}$, I/O to GND		285		pF

AQxx-01FLTG Series

200 W, Unidirectional TVS General Purpose ESD Protection, SOD323FL

AQ24-01FLTG Electrical Characteristics ($T_{OP} = 25\text{ }^{\circ}\text{C}$)

Parameter	Symbol	Test Conditions	Min	Typ	Max	Units
Reverse Standoff Voltage	V_{RWM}				24	V
Breakdown Voltage	V_{BR}	$I_R = 1\text{ mA}$, I/O to GND	26.7		29.5	V
Reverse Leakage Current	I_{LEAK}	$V_R = 24\text{ V}$, I/O to GND			1.0	μA
Clamp Voltage ¹	V_C	$I_{PP} = 1\text{ A}$, $t_p = 10/1000\text{ }\mu\text{s}$, I/O to GND		30.0	34.5	V
		$I_{PP} = 5.5\text{ A}$, $t_p = 10/1000\text{ }\mu\text{s}$, I/O to GND		37.0	42.5	V
		$I_{PP} = 1\text{ A}$, $t_p = 8/20\text{ }\mu\text{s}$, I/O to GND		29.0	33.5	V
		$I_{PP} = 25\text{ A}$, $t_p = 8/20\text{ }\mu\text{s}$, I/O to GND		42.5	49.0	V
Dynamic Resistance ²	R_{DYN}	TLP, $t_p = 100\text{ ns}$, I/O to GND		0.30		Ω
ESD Withstand Voltage ^{1,3}	V_{ESD}	IEC 61000-4-2 (Contact Discharge)	± 30			kV
		IEC 61000-4-2 (Air Discharge)	± 30			kV
		ISO 10605 (Contact Discharge)	± 30			kV
		ISO 10605 (Air Discharge)	± 30			kV
Diode Capacitance ¹	C_{IO-GND}	Reverse Bias = 0 V, $f = 1\text{ MHz}$, I/O to GND		240		pF

AQ28-01FLTG Electrical Characteristics ($T_{OP} = 25\text{ }^{\circ}\text{C}$)

Parameter	Symbol	Test Conditions	Min	Typ	Max	Units
Reverse Standoff Voltage	V_{RWM}				28	V
Breakdown Voltage	V_{BR}	$I_R = 1\text{ mA}$, I/O to GND	31.1		34.4	V
Reverse Leakage Current	I_{LEAK}	$V_R = 28\text{ V}$, I/O to GND			1.0	μA
Clamp Voltage ¹	V_C	$I_{PP} = 1\text{ A}$, $t_p = 10/1000\text{ }\mu\text{s}$, I/O to GND		38.5	44.5	V
		$I_{PP} = 4.5\text{ A}$, $t_p = 10/1000\text{ }\mu\text{s}$, I/O to GND		47.0	54.0	V
		$I_{PP} = 1\text{ A}$, $t_p = 8/20\text{ }\mu\text{s}$, I/O to GND		34.5	40.0	V
		$I_{PP} = 24.5\text{ A}$, $t_p = 8/20\text{ }\mu\text{s}$, I/O to GND		54.0	62.0	V
Dynamic Resistance ²	R_{DYN}	TLP, $t_p = 100\text{ ns}$, I/O to GND		0.38		Ω
ESD Withstand Voltage ^{1,3}	V_{ESD}	IEC 61000-4-2 (Contact Discharge)	± 30			kV
		IEC 61000-4-2 (Air Discharge)	± 30			kV
		ISO 10605 (Contact Discharge)	± 30			kV
		ISO 10605 (Air Discharge)	± 30			kV
Diode Capacitance ¹	C_{IO-GND}	Reverse Bias = 0 V, $f = 1\text{ MHz}$, I/O to GND		200		pF

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200 W, Unidirectional TVS General Purpose ESD Protection, SOD323FL

AQ30-01FLTG Electrical Characteristics ($T_{OP} = 25\text{ }^{\circ}\text{C}$)

Parameter	Symbol	Test Conditions	Min	Typ	Max	Units
Reverse Standoff Voltage	V_{RWM}				30	V
Breakdown Voltage	V_{BR}	$I_R = 1\text{ mA}$, I/O to GND	33.3		36.8	V
Reverse Leakage Current	I_{LEAK}	$V_R = 30\text{ V}$, I/O to GND			1.0	μA
Clamp Voltage ¹	V_C	$I_{PP} = 1\text{ A}$, $t_p = 10/1000\text{ }\mu\text{s}$, I/O to GND		39.0	45.0	V
		$I_{PP} = 4.5\text{ A}$, $t_p = 10/1000\text{ }\mu\text{s}$, I/O to GND		48.0	55.0	V
		$I_{PP} = 1\text{ A}$, $t_p = 8/20\text{ }\mu\text{s}$, I/O to GND		37.5	43.0	V
		$I_{PP} = 20\text{ A}$, $t_p = 8/20\text{ }\mu\text{s}$, I/O to GND		54.0	62.0	V
Dynamic Resistance ²	R_{DYN}	TLP, $t_p = 100\text{ ns}$, I/O to GND		0.45		Ω
ESD Withstand Voltage ^{1,3}	V_{ESD}	IEC 61000-4-2 (Contact Discharge)	± 30			kV
		IEC 61000-4-2 (Air Discharge)	± 30			kV
		ISO 10605 (Contact Discharge)	± 30			kV
		ISO 10605 (Air Discharge)	± 30			kV
Diode Capacitance ¹	C_{IO-GND}	Reverse Bias = 0 V, $f = 1\text{ MHz}$, I/O to GND		195		pF

AQ33-01FLTG Electrical Characteristics ($T_{OP} = 25\text{ }^{\circ}\text{C}$)

Parameter	Symbol	Test Conditions	Min	Typ	Max	Units
Reverse Standoff Voltage	V_{RWM}				33	V
Breakdown Voltage	V_{BR}	$I_R = 1\text{ mA}$, I/O to GND	36.7		40.6	V
Reverse Leakage Current	I_{LEAK}	$V_R = 33\text{ V}$, I/O to GND			1.0	μA
Clamp Voltage ¹	V_C	$I_{PP} = 1\text{ A}$, $t_p = 10/1000\text{ }\mu\text{s}$, I/O to GND		44.0	50.5	V
		$I_{PP} = 4\text{ A}$, $t_p = 10/1000\text{ }\mu\text{s}$, I/O to GND		53.5	61.5	V
		$I_{PP} = 1\text{ A}$, $t_p = 8/20\text{ }\mu\text{s}$, I/O to GND		41.5	48.0	V
		$I_{PP} = 20\text{ A}$, $t_p = 8/20\text{ }\mu\text{s}$, I/O to GND		59.5	68.5	V
Dynamic Resistance ²	R_{DYN}	TLP, $t_p = 100\text{ ns}$, I/O to GND		0.53		Ω
ESD Withstand Voltage ^{1,3}	V_{ESD}	IEC 61000-4-2 (Contact Discharge)	± 30			kV
		IEC 61000-4-2 (Air Discharge)	± 30			kV
		ISO 10605 (Contact Discharge)	± 30			kV
		ISO 10605 (Air Discharge)	± 30			kV
Diode Capacitance ¹	C_{IO-GND}	Reverse Bias = 0 V, $f = 1\text{ MHz}$, I/O to GND		180		pF

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200 W, Unidirectional TVS General Purpose ESD Protection, SOD323FL

AQ45-01FLTG Electrical Characteristics ($T_{op} = 25\text{ }^{\circ}\text{C}$)

Parameter	Symbol	Test Conditions	Min	Typ	Max	Units
Reverse Standoff Voltage	V_{RWM}				45	V
Breakdown Voltage	V_{BR}	$I_R = 1\text{ mA}$, I/O to GND	50.0		55.3	V
Reverse Leakage Current	I_{LEAK}	$V_R = 45\text{ V}$, I/O to GND			1.0	μA
Clamp Voltage ¹	V_C	$I_{PP} = 1\text{ A}$, $t_p = 10/1000\text{ }\mu\text{s}$, I/O to GND		60.0	69.0	V
		$I_{PP} = 3\text{ A}$, $t_p = 10/1000\text{ }\mu\text{s}$, I/O to GND		73.5	84.5	V
		$I_{PP} = 1\text{ A}$, $t_p = 8/20\text{ }\mu\text{s}$, I/O to GND		55.5	64.0	V
		$I_{PP} = 15\text{ A}$, $t_p = 8/20\text{ }\mu\text{s}$, I/O to GND		82.0	94.5	V
Dynamic Resistance ²	R_{DYN}	TLP, $t_p = 100\text{ ns}$, I/O to GND		1.0		Ω
ESD Withstand Voltage ^{1,3}	V_{ESD}	IEC 61000-4-2 (Contact Discharge)	± 30			kV
		IEC 61000-4-2 (Air Discharge)	± 30			kV
		ISO 10605 (Contact Discharge)	± 30			kV
		ISO 10605 (Air Discharge)	± 30			kV
Diode Capacitance ¹	C_{IO-GND}	Reverse Bias = 0 V, $f = 1\text{ MHz}$, I/O to GND		140		pF

AQ60-01FLTG Electrical Characteristics ($T_{op} = 25\text{ }^{\circ}\text{C}$)

Parameter	Symbol	Test Conditions	Min	Typ	Max	Units
Reverse Standoff Voltage	V_{RWM}				60	V
Breakdown Voltage	V_{BR}	$I_R = 1\text{ mA}$, I/O to GND	66.7		73.7	V
Reverse Leakage Current	I_{LEAK}	$V_R = 60\text{ V}$, I/O to GND			1.0	μA
Clamp Voltage ¹	V_C	$I_{PP} = 1\text{ A}$, $t_p = 10/1000\text{ }\mu\text{s}$, I/O to GND		85.0	97.5	V
		$I_{PP} = 2.5\text{ A}$, $t_p = 10/1000\text{ }\mu\text{s}$, I/O to GND		96.5	111.0	V
		$I_{PP} = 1\text{ A}$, $t_p = 8/20\text{ }\mu\text{s}$, I/O to GND		74.5	85.5	V
		$I_{PP} = 10\text{ A}$, $t_p = 8/20\text{ }\mu\text{s}$, I/O to GND		101.0	116.0	V
Dynamic Resistance ²	R_{DYN}	TLP, $t_p = 100\text{ ns}$, I/O to GND		1.55		Ω
ESD Withstand Voltage ^{1,3}	V_{ESD}	IEC 61000-4-2 (Contact Discharge)	± 30			kV
		IEC 61000-4-2 (Air Discharge)	± 30			kV
		ISO 10605 (Contact Discharge)	± 30			kV
		ISO 10605 (Air Discharge)	± 30			kV
Diode Capacitance ¹	C_{IO-GND}	Reverse Bias = 0 V, $f = 1\text{ MHz}$, I/O to GND		110		pF

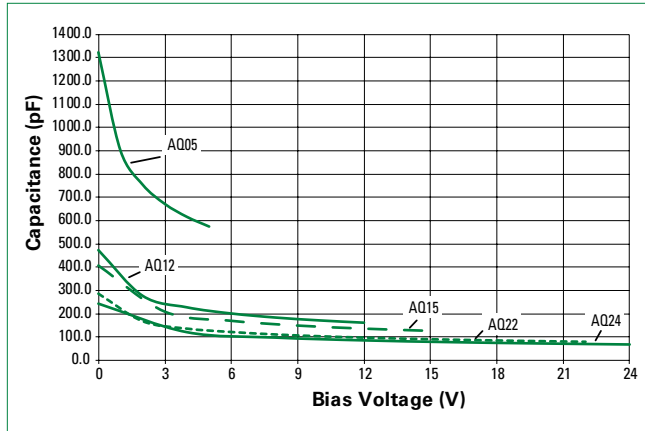
Note:

- Parameter is guaranteed by design and/or component characterization.
- Transmission Line Pulse (TLP) with 100 ns width, 0.2 ns rise time, and average window $t_1 = 70\text{ ns}$ to $t_2 = 90\text{ ns}$.
- Device stressed with ten non-repetitive ESD pulses.

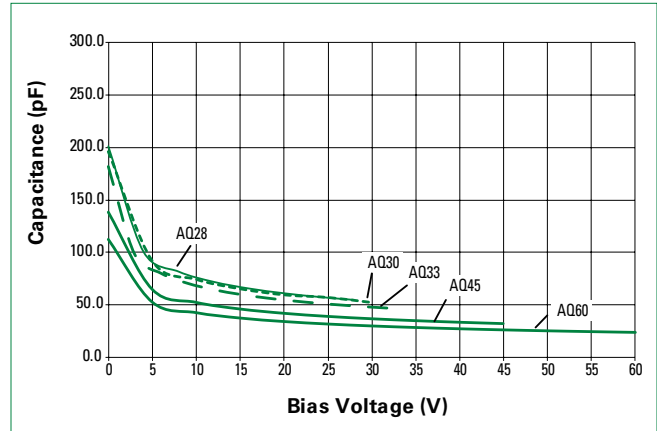
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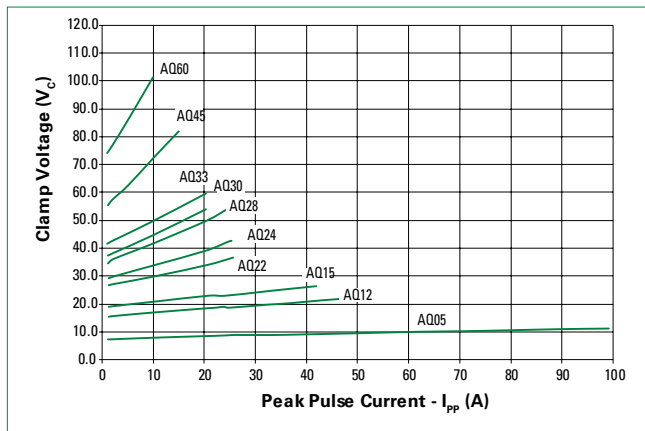
Capacitance vs. Reverse Bias for 5 V~ 24 V



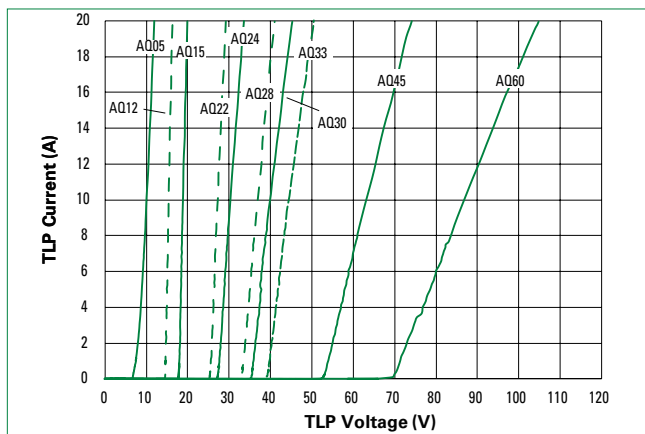
Capacitance vs. Reverse Bias for 28 V~ 60 V



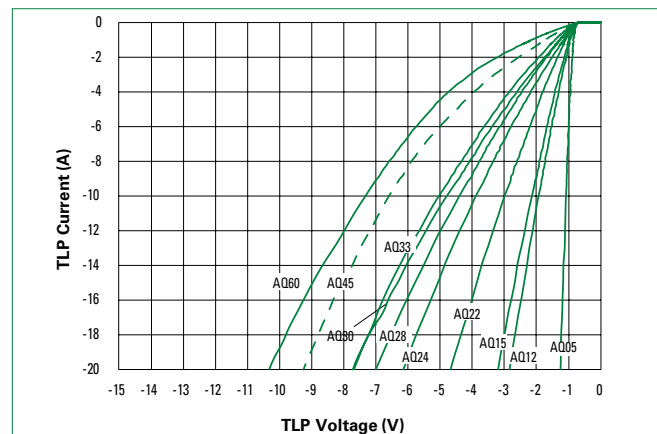
Clamping Voltage vs I_{PP}



Positive Transmission Line Pulsing (TLP) Plot



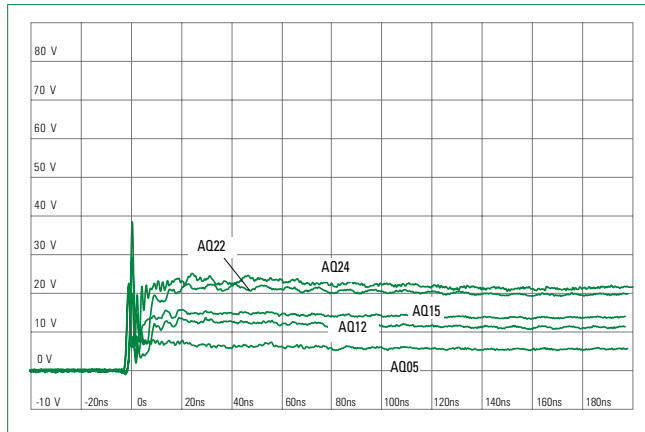
Negative Transmission Line Pulsing (TLP) Plot



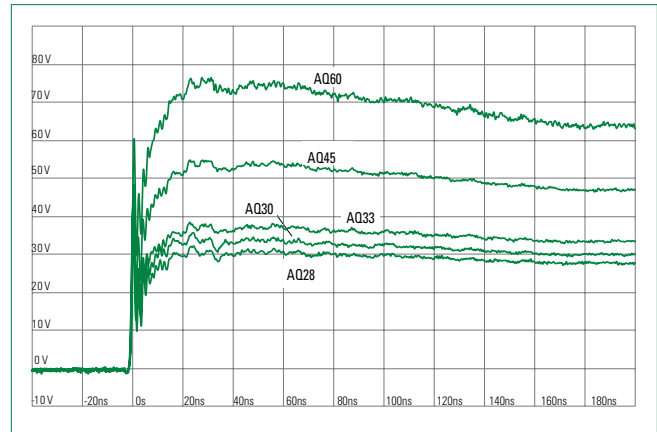
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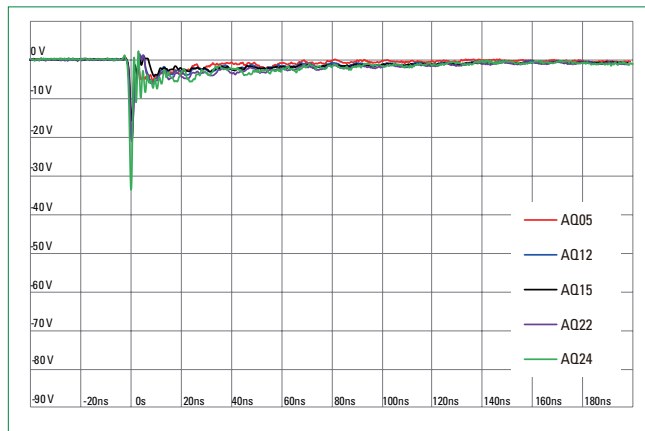
IEC 61000-4-2 +8 kV Contact ESD Clamping Voltage for 5 V - 24 V



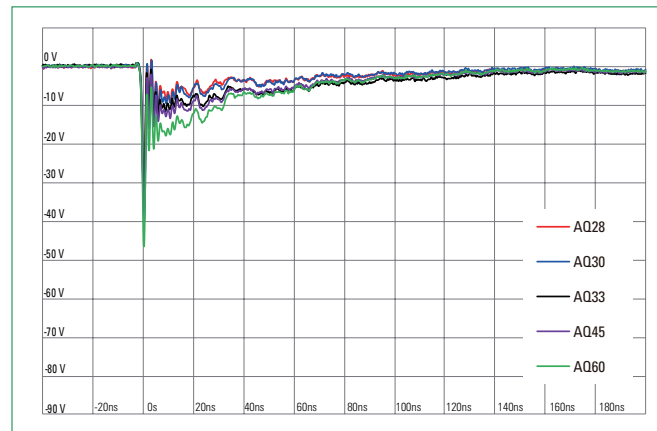
IEC 61000-4-2 +8 kV Contact ESD Clamping Voltage for 28 V - 60 V



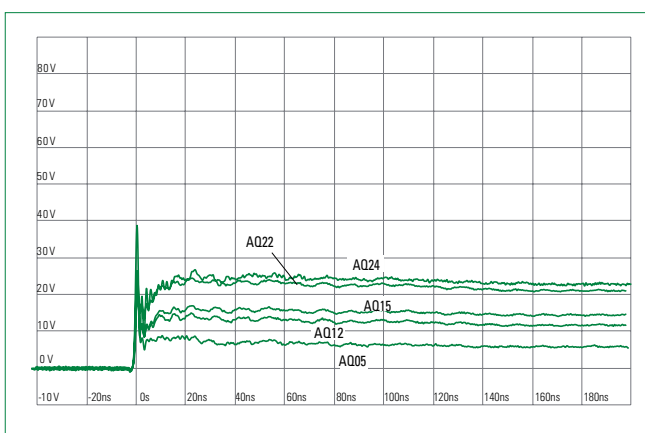
IEC 61000-4-2 -8 kV Contact ESD Clamping Voltage for 5 V - 24 V



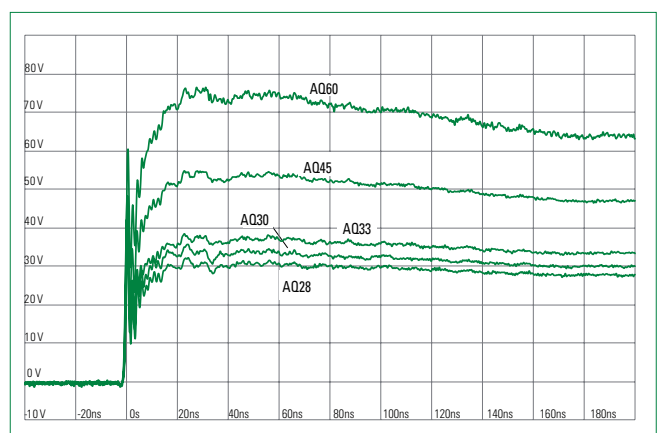
IEC 61000-4-2 -8 kV Contact ESD Clamping Voltage for 28 V - 60 V



ISO10605 Contact Discharge Plot at +8 kV for 5 V - 24 V



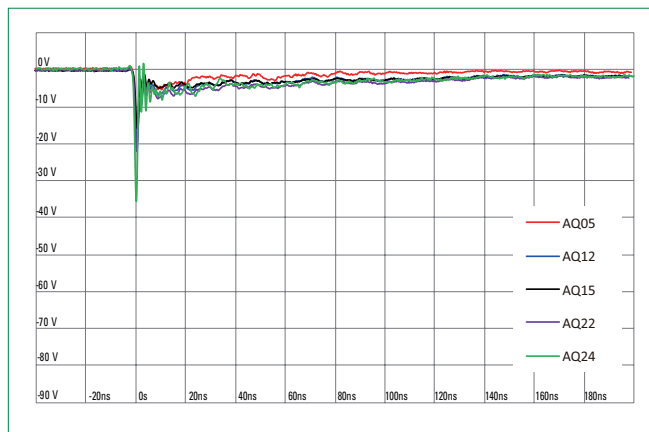
ISO10605 Contact Discharge Plot at +8 kV for 28 V - 60 V



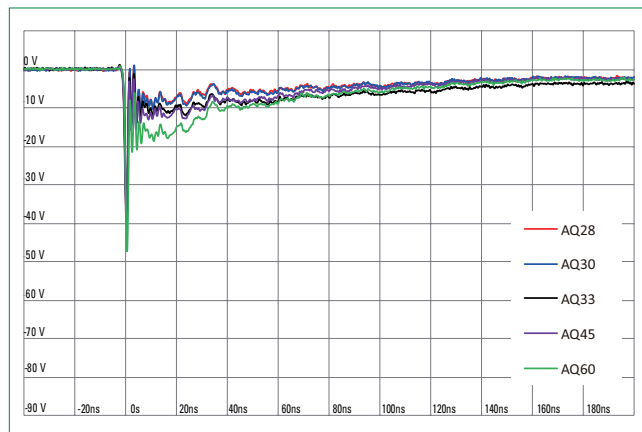
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ISO10605 Contact Discharge Plot at -8 kV for 5 V - 24 V

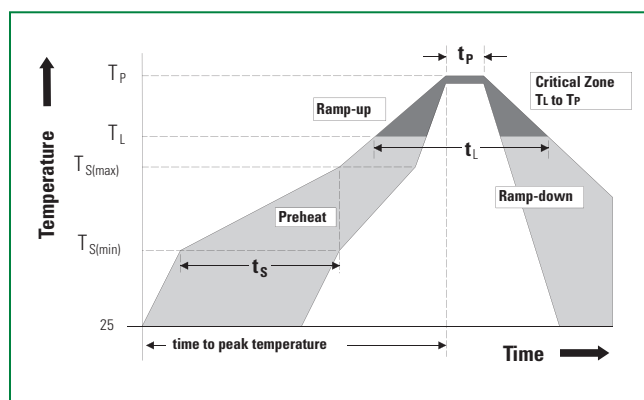


ISO10605 Contact Discharge Plot at -8 kV for 28 V - 60 V



Soldering Parameters

Reflow Condition		Pb – free assembly
Pre Heat	- Temperature Min ($T_{s(min)}$)	150 °C
	- Temperature Max ($T_{s(max)}$)	200 °C
	- Time (min to max) (t_s)	60 – 120 seconds
Average Ramp Up Rate (Liquidus) Temp (T_L) to Peak		3 °C/second max
$T_{s(max)}$ to T_L - Ramp-up Rate		3 °C/second max
Reflow	- Temperature (T_L) (Liquidus)	217 °C
	- Temperature (t_L)	60 – 150 seconds
Peak Temperature (T_p)		260 ^{+0/-5} °C
Time Within 5°C of Actual Peak Temperature (t_p)		30 seconds
Ramp-down Rate		6 °C/second max
Time 25°C to Peak Temperature (T_p)		8 minutes max
Do Not Exceed		260 °C



Ordering Information

Part Number	Package	Marking	Min. Order Qty.
AQ05-01FLTG	SOD323FL	J**	3000
AQ12-01FLTG	SOD323FL	A**	3000
AQ15-01FLTG	SOD323FL	B**	3000
AQ22-01FLTG	SOD323FL	C**	3000
AQ24-01FLTG	SOD323FL	D**	3000
AQ28-01FLTG	SOD323FL	E**	3000
AQ30-01FLTG	SOD323FL	F**	3000
AQ33-01FLTG	SOD323FL	G**	3000
AQ45-01FLTG	SOD323FL	H**	3000
AQ60-01FLTG	SOD323FL	I**	3000

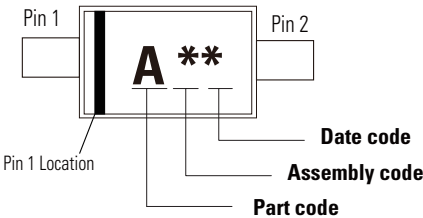
Product Characteristics

Lead plating	Matte tin
Lead material	Copper alloy
Body material	Molded compound
Flammability	UL recognized compound meeting flammability rating V-0

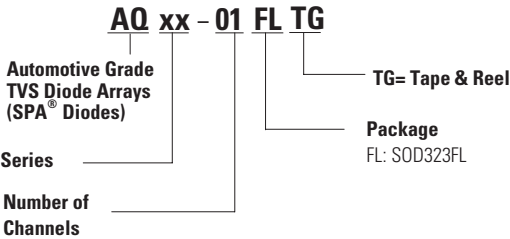
AQxx-01FLTG Series

200 W, Unidirectional TVS General Purpose ESD Protection, SOD323FL

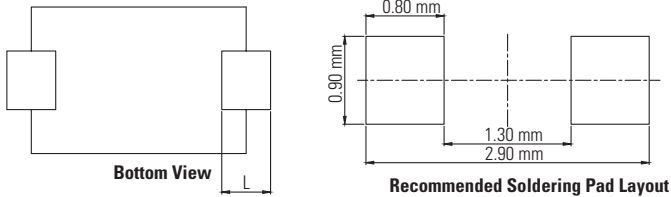
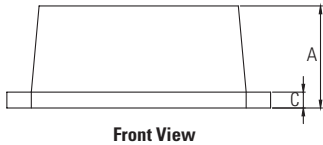
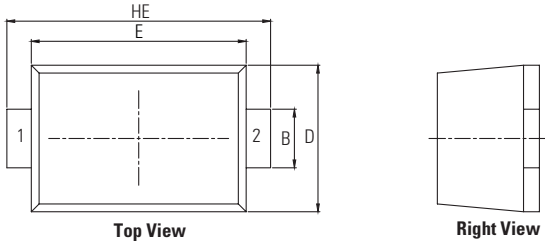
Part Marking System



Part Numbering System



Package Dimensions - SOD323FL

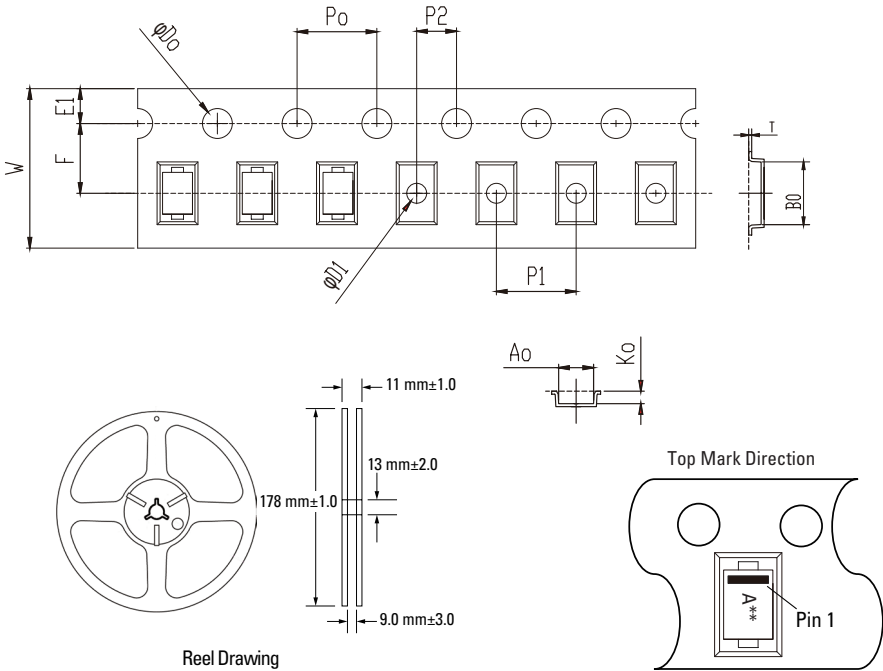


Symbol	Millimeters		Inches	
	Min	Max	Min	Max
A	0.90	1.08	0.035	0.043
B	0.50	0.70	0.020	0.028
C	0.10	0.25	0.004	0.010
D	1.40	1.60	0.055	0.063
E	2.00	2.20	0.079	0.087
L	0.35	0.65	0.014	0.026
HE	2.40	2.80	0.094	0.110

AQxx-01FLTG Series

200 W, Unidirectional TVS General Purpose ESD Protection, SOD323FL

Embossed Carrier Tape & Reel Specification — SOD323FL



Symbol	Millimeters
A0	1.80+/-0.10
B0	2.90+/-0.10
W	8.0+0.3/-0.10
D0	1.50+0.10
D1	1.00+0.25
E1	1.75+/-0.10
F	3.50+/-0.05
P0	4.00+/-0.10
P1	4.00+/-0.10
P2	2.00+/-0.05
K0	1.25+/-0.10
T	0.25+/-0.02

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