



**THE DATASHEET OF  
AQ12-02HTG**



## AQxx-02HTG Series 500W TVS Diode Array

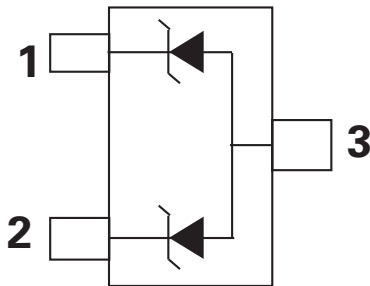


### Description

The AQxx-02HTG Series TVS Diode Array is designed to protect sensitive equipment from damage due to electrostatic discharge (ESD), electrical fast transients (EFT), and lightning induced surges.

This AQxx-02HTG series can safely absorb repetitive ESD strikes of  $\pm 30$  kV (contact and air discharge as defined in IEC 61000-4-2) without any performance degradation. Additionally, the AQ05 can safely conduct a 33A 8/20 surge event as defined in IEC 61000-4-5 2<sup>nd</sup> edition at low voltage clamping levels.

### Pinout and Functional Block Diagram



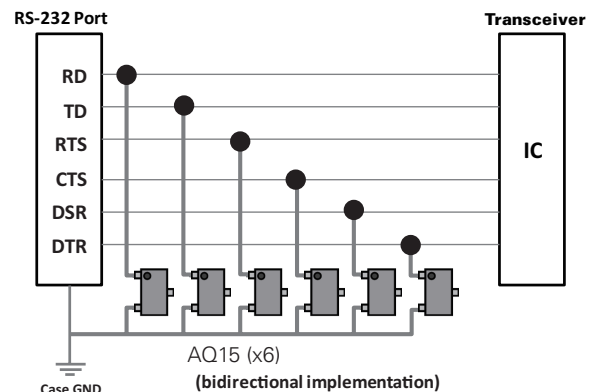
### Features

- ESD, IEC 61000-4-2,  $\pm 30$ kV contact,  $\pm 30$ kV air
- EFT, IEC 61000-4-4, 50A (5/50ns)
- Lightning, 33A (8/20 as defined in IEC 61000-4-5 2<sup>nd</sup> edition) for the AQ05
- Working voltages: 5V, 12V, 15V, 24V and 36V
- Low clamping voltage
- Low leakage current
- AEC-Q101 qualified
- Moisture Sensitivity Level (MSL -1)
- Halogen free, lead free and RoHS compliant
- PPAP capable

### Applications

- Industrial Equipment
- Test and Medical Equipment
- Point-of-Sale Terminals
- Motor Controls
- Legacy Ports (RS-232, RS-485)
- Security and Alarm Systems

### RS-232 Application Example



Life Support Note:

#### Not Intended for Use in Life Support or Life Saving Applications

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

### Absolute Maximum Ratings

Symbol	Parameter	Value	Units
$P_{PK}$	Peak Pulse Power ( $t_p=8/20\mu s$ )	500	W
$T_{OP}$	Operating Temperature	-40 to 150	°C
$T_{STOR}$	Storage Temperature	-55 to 150	°C

Notes:

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

### AQ05 Electrical Characteristics ( $T_{OP}=25^\circ C$ )

Parameter	Symbol	Test Conditions	Min	Typ	Max	Units
Reverse Standoff Voltage	$V_{RWM}$	$I_R=1\mu A$			5.0	V
Breakdown Voltage	$V_{BR}$	$I_R=1mA$	6.0	7.0		V
Reverse Leakage Current	$I_{LEAK}$	$V_R=5V$			1.0	$\mu A$
Clamp Voltage <sup>1</sup>	$V_C$	$I_{PP}=1A, t_p=8/20\mu s$ , Pin 1 or Pin 2 to Pin 3		8.0	9.8	V
		$I_{PP}=10A, t_p=8/20\mu s$ , Pin 1 or Pin 2 to Pin 3		10.5	13.0	V
Dynamic Resistance <sup>2</sup>	$R_{DYN}$	TLP, $t_p=100ns$ , Pin 1 or Pin 2 to Pin 3		0.19		$\Omega$
Peak Pulse Current <sup>1</sup>	$I_{PP}$	$t_p=8/20\mu s$			33	A
ESD Withstand Voltage <sup>1</sup>	$V_{ESD}$	IEC 61000-4-2 (Contact Discharge)	$\pm 30$			kV
		IEC 61000-4-2 (Air Discharge)	$\pm 30$			kV
Diode Capacitance <sup>1</sup>	$C_{I/O-GND}$	Reverse Bias=0V, f=1MHz		290	350	pF
	$C_{I/O-I/O}$	Reverse Bias=0V, f=1MHz		145	180	pF

### AQ12 Electrical Characteristics ( $T_{OP}=25^\circ C$ )

Parameter	Symbol	Test Conditions	Min	Typ	Max	Units
Reverse Standoff Voltage	$V_{RWM}$	$I_R=1\mu A$			12.0	V
Breakdown Voltage	$V_{BR}$	$I_R=1mA$	13.3	14.2		V
Reverse Leakage Current	$I_{LEAK}$	$V_R=12V$			1.0	$\mu A$
Clamp Voltage <sup>1</sup>	$V_C$	$I_{PP}=1A, t_p=8/20\mu s$ , Pin 1 or Pin 2 to Pin 3		16.0	18.5	V
		$I_{PP}=10A, t_p=8/20\mu s$ , Pin 1 or Pin 2 to Pin 3		20.0	22.5	V
Dynamic Resistance <sup>2</sup>	$R_{DYN}$	TLP, $t_p=100ns$ , Pin 1 or Pin 2 to Pin 3		0.25		$\Omega$
Peak Pulse Current <sup>1</sup>	$I_{PP}$	$t_p=8/20\mu s$			20	A
ESD Withstand Voltage <sup>1</sup>	$V_{ESD}$	IEC 61000-4-2 (Contact Discharge)	$\pm 30$			kV
		IEC 61000-4-2 (Air Discharge)	$\pm 30$			kV
Diode Capacitance <sup>1</sup>	$C_{I/O-GND}$	Reverse Bias=0V, f=1MHz		110	135	pF
	$C_{I/O-I/O}$	Reverse Bias=0V, f=1MHz		55	85	pF

### AQ15 Electrical Characteristics (T<sub>op</sub>=25°C)

Parameter	Symbol	Test Conditions	Min	Typ	Max	Units
Reverse Standoff Voltage	V <sub>RWM</sub>	I <sub>R</sub> =1μA			15.0	V
Breakdown Voltage	V <sub>BR</sub>	I <sub>R</sub> =1mA	16.7	18.5		V
Reverse Leakage Current	I <sub>LEAK</sub>	V <sub>R</sub> =15V			1.0	μA
Clamp Voltage <sup>1</sup>	V <sub>C</sub>	I <sub>PP</sub> =1A, t <sub>p</sub> =8/20μs, Pin 1 or Pin 2 to Pin 3		20.5	24.0	V
		I <sub>PP</sub> =10A, t <sub>p</sub> =8/20μs, Pin 1 or Pin 2 to Pin 3		26.6	30.0	V
Dynamic Resistance <sup>2</sup>	R <sub>DYN</sub>	TLP, t <sub>p</sub> =100ns, Pin 1 or Pin 2 to Pin 3		0.30		Ω
Peak Pulse Current <sup>1</sup>	I <sub>PP</sub>	t <sub>p</sub> =8/20μs			15	A
ESD Withstand Voltage <sup>1</sup>	V <sub>ESD</sub>	IEC 61000-4-2 (Contact Discharge)	±30			kV
		IEC 61000-4-2 (Air Discharge)	±30			kV
Diode Capacitance <sup>1</sup>	C <sub>I/O-GND</sub>	Reverse Bias=0V, f=1MHz		85	100	pF
	C <sub>I/O-I/O</sub>	Reverse Bias=0V, f=1MHz		45	75	pF

### AQ24 Electrical Characteristics (T<sub>op</sub>=25°C)

Parameter	Symbol	Test Conditions	Min	Typ	Max	Units
Reverse Standoff Voltage	V <sub>RWM</sub>	I <sub>R</sub> =1μA			24.0	V
Breakdown Voltage	V <sub>BR</sub>	I <sub>R</sub> =1mA	26.7	28		V
Reverse Leakage Current	I <sub>LEAK</sub>	V <sub>R</sub> =24V			1.0	μA
Clamp Voltage <sup>1</sup>	V <sub>C</sub>	I <sub>PP</sub> =1A, t <sub>p</sub> =8/20μs, Pin 1 or Pin 2 to Pin 3		30.0	36.0	V
		I <sub>PP</sub> =5A, t <sub>p</sub> =8/20μs, Pin 1 or Pin 2 to Pin 3		36.0	42.0	V
Dynamic Resistance <sup>2</sup>	R <sub>DYN</sub>	TLP, t <sub>p</sub> =100ns, Pin 1 or Pin 2 to Pin 3		0.50		Ω
Peak Pulse Current <sup>1</sup>	I <sub>PP</sub>	t <sub>p</sub> =8/20μs			9	A
ESD Withstand Voltage <sup>1</sup>	V <sub>ESD</sub>	IEC 61000-4-2 (Contact Discharge)	±30			kV
		IEC 61000-4-2 (Air Discharge)	±30			kV
Diode Capacitance <sup>1</sup>	C <sub>I/O-GND</sub>	Reverse Bias=0V, f=1MHz		60	65	pF
	C <sub>I/O-I/O</sub>	Reverse Bias=0V, f=1MHz		30	50	pF

### AQ36 Electrical Characteristics (T<sub>op</sub>=25°C)

Parameter	Symbol	Test Conditions	Min	Typ	Max	Units
Reverse Standoff Voltage	V <sub>RWM</sub>	I <sub>R</sub> =1μA			36.0	V
Breakdown Voltage	V <sub>BR</sub>	I <sub>R</sub> =1mA	40.0	41.8		V
Reverse Leakage Current	I <sub>LEAK</sub>	V <sub>R</sub> =36V			1.0	μA
Clamp Voltage <sup>1</sup>	V <sub>C</sub>	I <sub>PP</sub> =1A, t <sub>p</sub> =8/20μs, Pin 1 or Pin 2 to Pin 3		45.0	52.0	V
		I <sub>PP</sub> =5A, t <sub>p</sub> =8/20μs, Pin 1 or Pin 2 to Pin 3		58.5	62.0	V
Dynamic Resistance <sup>2</sup>	R <sub>DYN</sub>	TLP, t <sub>p</sub> =100ns, Pin 1 or Pin 2 to Pin 3		0.65		Ω
Peak Pulse Current <sup>1</sup>	I <sub>PP</sub>	t <sub>p</sub> =8/20μs			7	A
ESD Withstand Voltage <sup>1</sup>	V <sub>ESD</sub>	IEC 61000-4-2 (Contact Discharge)	±30			kV
		IEC 61000-4-2 (Air Discharge)	±30			kV
Diode Capacitance <sup>1</sup>	C <sub>I/O-GND</sub>	Reverse Bias=0V, f=1MHz		45	50	pF
	C <sub>I/O-I/O</sub>	Reverse Bias=0V, f=1MHz		25	40	pF

Note:

<sup>1</sup> Parameter is guaranteed by design and/or component characterization.

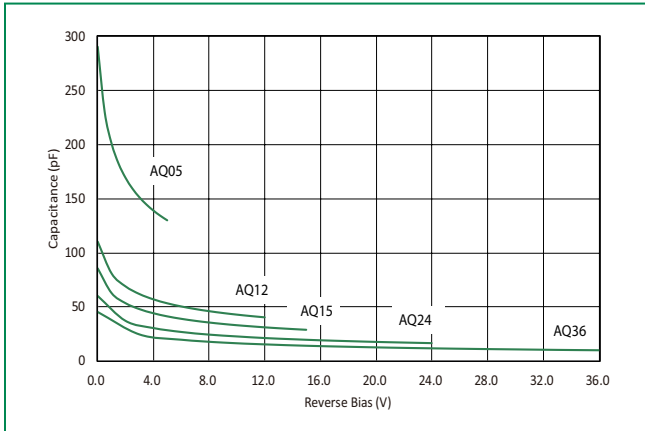
<sup>2</sup> Transmission Line Pulse (TLP) with 100ns width, 2ns rise time, and average window t1=70ns to t2= 90ns

©2018 Littelfuse, Inc.

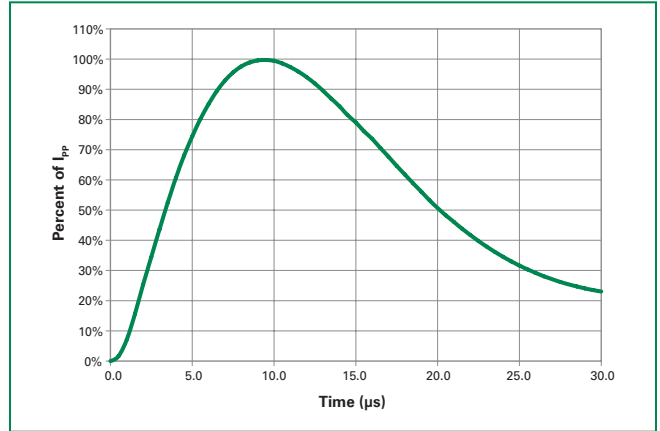
Specifications are subject to change without notice.

Revision: 10/17/18

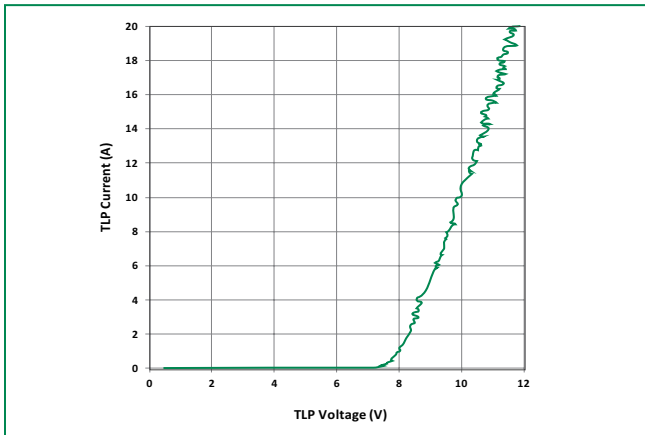
**Capacitance vs. Reverse Bias (Pin1 or Pin2 to Pin3)**



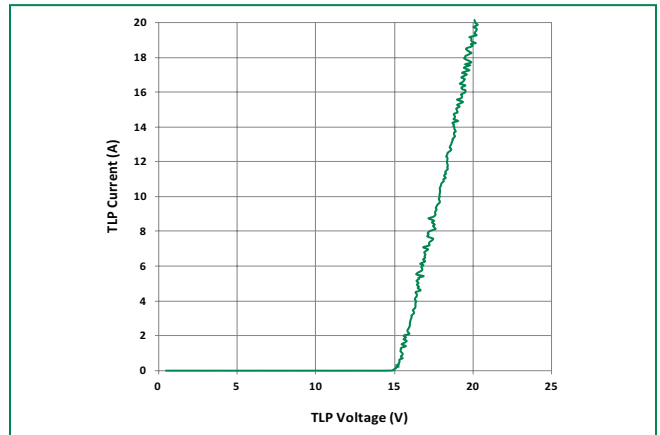
**8/20µs Pulse Waveform**



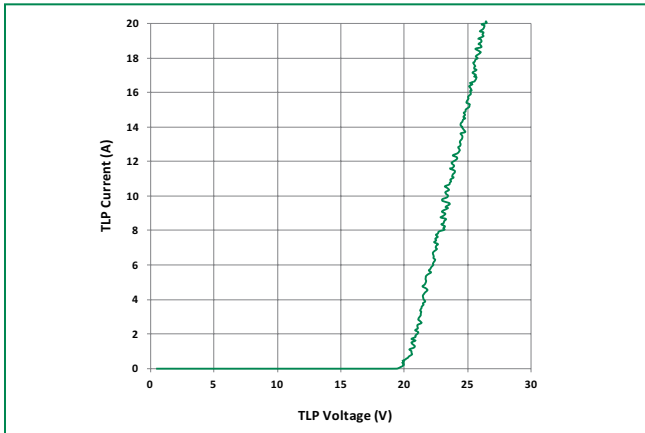
**AQ05 Transmission Line Pulsing(TLP) Plot**



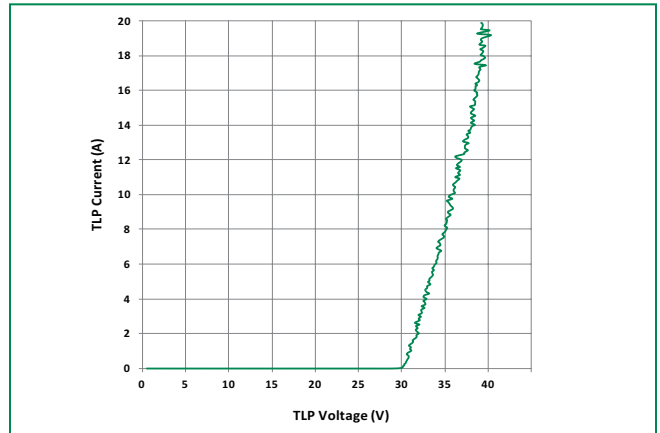
**AQ12 Transmission Line Pulsing(TLP) Plot**



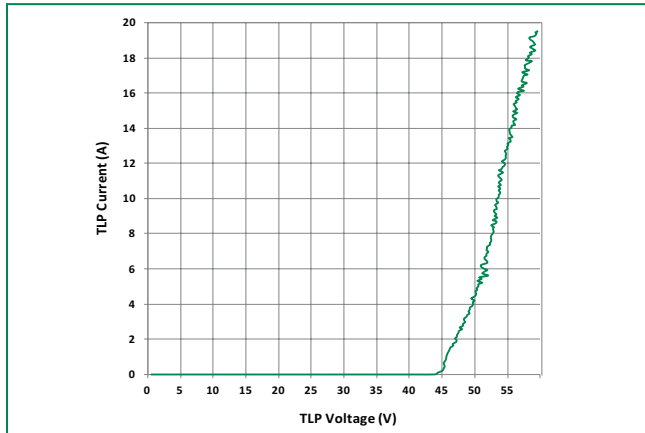
**AQ15 Transmission Line Pulsing(TLP) Plot**



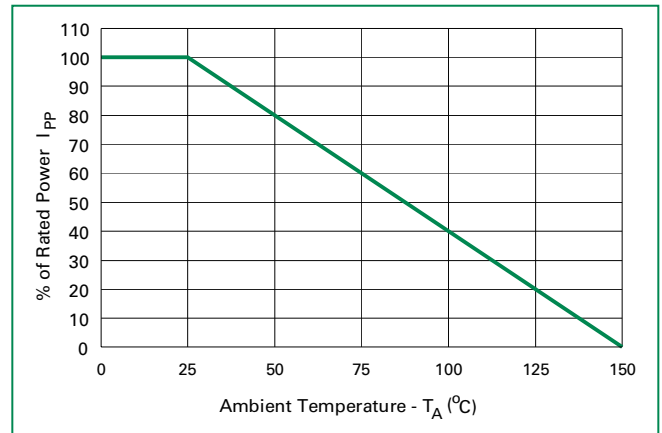
**AQ24 Transmission Line Pulsing(TLP) Plot**



### AQ36 Transmission Line Pulsing (TLP) Plot

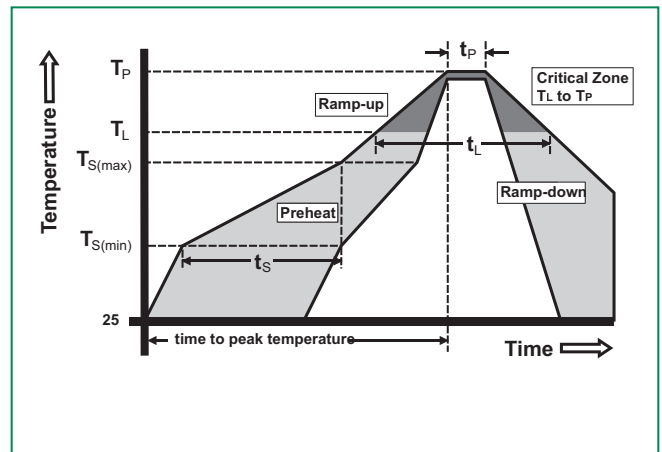


### Power Derating Curve



### 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 – 180 secs
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 <sup>+0/-5</sup> °C
Time within 5°C of actual peak Temperature ( $t_p$ )		20 – 40 seconds
Ramp-down Rate		6°C/second max
Time 25°C to peak Temperature ( $T_p$ )		8 minutes Max.
Do not exceed		260°C



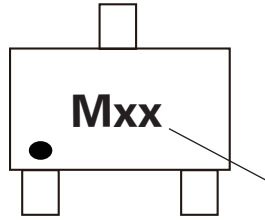
### Ordering Information

Part Number	Package	Min. Order Qty.
AQ05-02HTG	SOT23-3	3000
AQ12-02HTG	SOT23-3	3000
AQ15-02HTG	SOT23-3	3000
AQ24-02HTG	SOT23-3	3000
AQ36-02HTG	SOT23-3	3000

### Product Characteristics

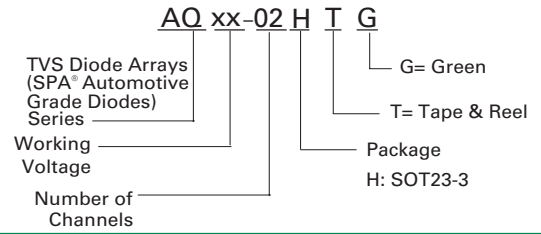
<b>Lead Plating</b>	Matte Tin
<b>Lead Material</b>	Copper Alloy
<b>Lead Coplanarity</b>	0.004 inches(0.102mm)
<b>Substrate Material</b>	Silicon
<b>Body Material</b>	Molded Compound
<b>Flammability</b>	UL Recognized compound meeting flammability rating V-0

**Part Marking System**

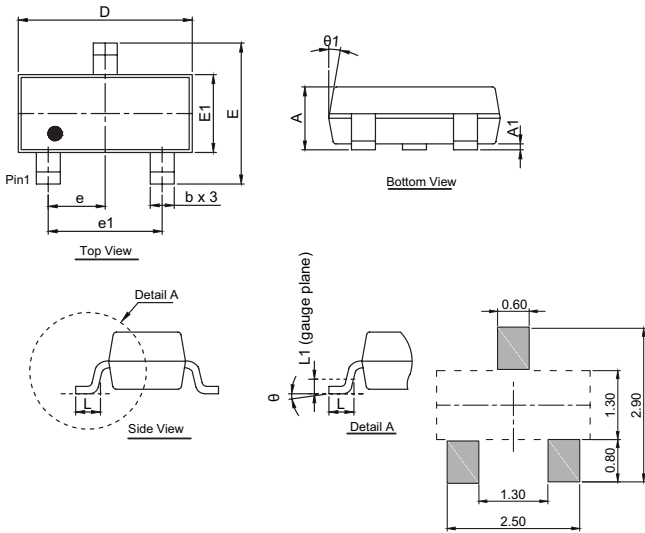


xx is the number of working voltage

**Part Numbering System**



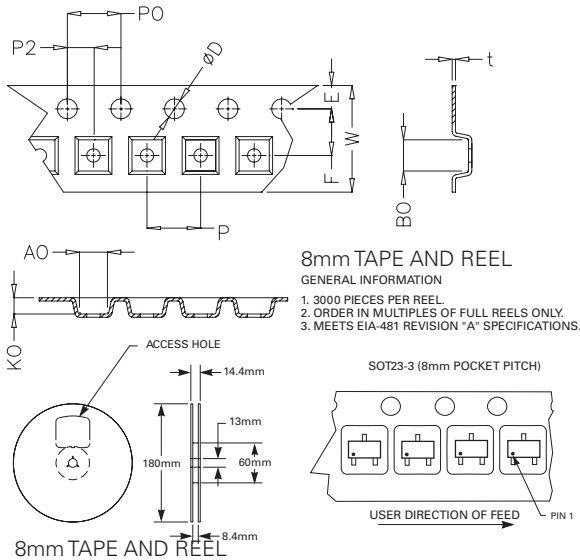
**Package Dimensions — SOT23-3**



Recommended soldering pad layout (unit :mm)  
Drawing#: H01-B

Symbol	Millimeters		Inches	
	Min	Max	Min	Max
A	0.90	1.10	0.035	0.043
A1	0.03	0.09	0.001	0.004
b	0.37	0.51	0.015	0.020
D	2.80	3.04	0.110	0.120
E	2.10	2.64	0.083	0.104
E1	1.20	1.40	0.047	0.055
e	0.95 BSC		0.037 BSC	
e1	1.90 BSC		0.075 BSC	
L	0.30	0.55	0.012	0.022
L1	0.25 BSC		0.010 BSC	
theta	0°	8°	0°	8°
theta1	7° TYP		7° TYP	

**Embossed Carrier Tape & Reel Specification — SOT23-3**



Symbol	Millimeters		Inches	
	Min	Max	Min	Max
E	1.65	1.85	0.065	0.073
F	3.40	3.60	0.134	0.142
P2	1.90	2.10	0.075	0.083
D	1.40	1.60	0.055	0.063
P0	3.90	4.10	0.154	0.161
W	7.70	8.30	0.303	0.327
P	3.90	4.10	0.154	0.161
A0	3.05	3.25	0.120	0.128
B0	2.67	2.87	0.105	0.113
K0	1.12	1.32	0.044	0.052
t	0.22	0.24	0.009	0.009

**Disclaimer Notice - Information furnished is believed to be accurate and reliable. However, users should independently evaluate the suitability of and test each product selected for their own applications. Littelfuse products are not designed for, and may not be used in, all applications.**

Read complete Disclaimer Notice at <http://www.littelfuse.com/disclaimer-electronics>.

# Mouser Electronics

Authorized Distributor



Click to View Pricing, Inventory, Delivery & Lifecycle Information:

[Littelfuse:](#)

[AQ05-02HTG](#) [AQ15-02HTG](#) [AQ24-02HTG](#) [AQ12-02HTG](#) [AQ36-02HTG](#)

## Looking for pricing, stock, or lifecycle information?

Click below to explore more details on WIN SOURCE:

-  [View AQ12-02HTG on WIN SOURCE](#)
-  [Littelfuse Inc. Information](#)

## Optimize Your Supply Chain with WIN SOURCE Solutions

-  Global Sourcing Solution
-  Obsolete Management
-  Cost Control Management
-  Shortage Management
-  Alternative Solution
-  Excess Inventory Management