



**Product Family:** [High Efficiency Delay Line - Coupled Differential](#)

**Part Number Series:** [HE-D Series](#)

	<p><b>Construction:</b></p> <ul style="list-style-type: none"> <li>• High Purity Alumina Substrate</li> <li>• Broadside Coupled Transmission Lines</li> <li>• BGA Package</li> <li>• Available in RoHS (Sn96.5/Ag3.0/Cu0.5) or Non-RoHS (Sn63/Pb37)</li> </ul>	<p><b>Features:</b></p> <ul style="list-style-type: none"> <li>• Coupled Differential (2 delay elements)</li> <li>• Time Delays of 0.1ns to 1.6ns</li> <li>• Tight Delay Tolerances</li> <li>• 100Ω Differential Impedance</li> <li>• High volume production suitable for commercial and special applications</li> </ul>
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**Description:**

This series features two broadside-coupled transmissions lines, ideal for differential applications. The BGA construction allows for smaller footprint and low height profile. The performance of these equally distributed capacitance delay lines is significantly better than lumped element delay lines and the physical size is much smaller than delays obtained by using cable.

**Product Dimensions and Schematic:**

<p><b>Size A</b></p>	<p><b>Size B</b></p>
<p><b>Notes:</b></p> <ol style="list-style-type: none"> <li>1) Dimensions: inches</li> <li>2) Schematic is indicated by colored transmission lines</li> <li>3) Locations B1 and B3 are input/output for one delay while locations C1 and C3 are input/output for the other delay</li> <li>4) All other locations are not electrically connected and are only present for mechanical stability (attach all to open pads on board)</li> <li>5) Either delay can be used for the inverted or non-inverted signals.</li> <li>6) Both signals should enter "1" and exit "2", or both should enter "2" and exit "1" location.</li> </ol>	<p><b>Notes:</b></p> <ol style="list-style-type: none"> <li>1) Dimensions: inches</li> <li>2) Schematic is indicated by colored transmission lines</li> <li>3) Locations A2 and B2 are input/output for one delay while locations A3 and B3 are input/output for the other delay</li> <li>4) All other locations are not electrically connected and are only present for mechanical stability (attach all to open pads on board)</li> <li>5) Either delay can be used for the inverted or non-inverted signals.</li> <li>6) Both signals should enter "A" and exit "B", or both should enter "B" and exit "A" location.</li> </ol>

**Recommended Land Pattern Dimensions:**

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- Adjust the copper land pattern accordingly to ensure the minimum soldermask coverage
- Recommended dimensions as per IPC-7095 - "Design and Assembly Process Implementation for BGA's"


**HE-D Series Part Numbering:** Ex: HE2LABA150D-C

Product Designator	Number of Elements	Impedance Code	Package Size	Package Height	Time Delay	Delay Type	T&R Packaging Quantity	RoHS Indicator
HE	2L = 2	A = 100Ω	A B (refer to dimensions)	A=0.043"	Three numeric characters representing nanoseconds x 100 (i.e. 150=1.50ns)	D=Coupled Differential	T1=100pcs/reel T5=500pcs/reel	-C = RoHS (leave blank for leaded)

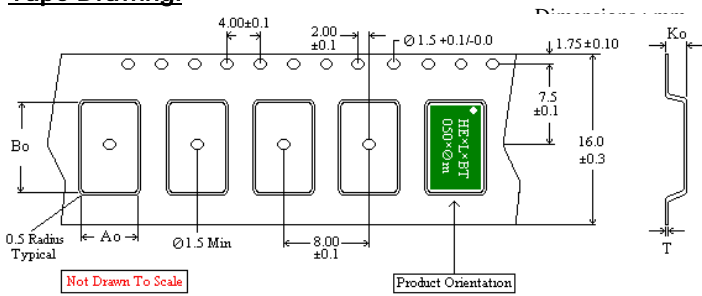
**Electrical Specifications:**

Product Size -->	Size A	Size B
Delay Range	0.1 to 0.5ns	0.1ns to 1.6ns
Time delay increments	0.1ns steps	0.1ns steps
Time delay tolerance	$\pm 15\text{ps} + 2\%$ of nominal (i.e. For a 1.0ns delay value: $\pm 15\text{ps} + (2\% \text{ of } 1.0\text{ns}) = \pm 35\text{ps}$ )	
Differential Impedance	$100\Omega \pm 10\%$	
DC Resistance	$0.1\text{ns} \sim 0.5\text{ns} = < 1.15 \Omega$ $> 0.5\text{ns} = < 2.30 \Omega/\text{ns}$	
Rated Current	100 mA	
Temp. coef. of time delay	150 ppm/°C	
Isolation Resistance (Sgn-Gnd)	100M $\Omega$ minimum @ 100 Vdc	
Insulation Resistance	100M $\Omega$ minimum @ 100 Vdc	
Operating Temp. Range	-40°C ~ +85°C	
Storage Temp. Range	-55°C ~ +125°C	
Packaging	100pcs/reel or 500pcs/reel	

**Marking:**

	<p>Product marking will be composed of the following:</p> <ul style="list-style-type: none"> <li>• Pin A1 identifier</li> <li>• Characters "HE2LAAA" or "HE2LABA". Size dependant.</li> <li>• 3-digit time delay code as explained in part numbering section</li> <li>• Character "D"</li> <li>• TFT "Don't Stop" logo</li> <li>• 1-digit manufacturing code</li> </ul>
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**Packaging:**

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