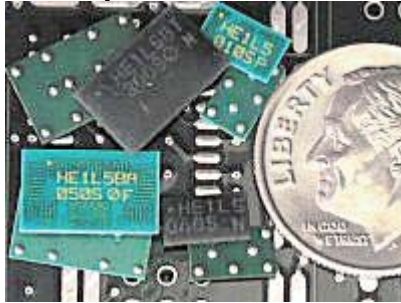


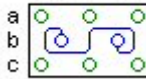
**BGA (HE) Delay Lines (Patent Pending)****HE1L5(A,B)(A,T)\*\*\*S Series****Description**

High-efficiency delay lines for clock and data deskew in single-ended circuit designs requiring precise timing control in a small, low profile BGA package. The single-ended delay lines are constructed as microstrip transmission lines on ceramic. These designs feature the ground plane on the solder ball side.

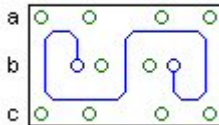
This product is currently available with solder finishes of Sn63/Pb37, as well as a RoHS compliant, Pb free solder finish of Sn95.5/Ag3.8/Cu0.7. For the RoHS compliant part, the customer must specify this upon ordering by following the instructions in the part numbering section of this specification.

**Electrical****Size A**

1 2 3 4 5

**Size B**

1 234 567 8



Size Designator:	A	B
Delay Range:	0.1 to 1.2 ns	0.1 & 0.5 to 3.5 ns
Standard Delay Increment:	0.1 ns	0.5 ns
Delay Tolerance*:	± (15 ps + 2% of nominal)	
Impedance:	50 Ω ± 10%	
DC Resistance:	< 1 Ω or 1Ω/ns (whichever is greater)	
Rated Current:	100 mA	
Temp. Coef. of Time Delay:	< 150 ppm/C	
Insulation Resistance:	> 100 MΩ (100Vdc)	
Isolation Resistance:	> 100 MΩ (100Vdc)	
Operating Temperature:	-40 to +85°C	
Storage Temperature:	-55 to +125°C	

\* Example for a 1ns delay value: ± 15ps + (2% of 1ns) = ± 35ps

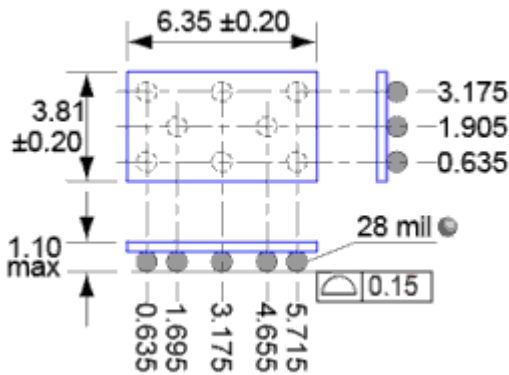
**Electrical Performance Characteristics:**

Part Number	Nominal Time Delay	Time Delay Tolerance	Typical Rise Time (20%-80%)	Typical Insertion Loss (-3dB)	Typical Return Loss (-15dB)
<a href="#">HE1L5AA010S</a>	0.10 ns	±15 ps +2% of Nom.	19 ps	5.91 GHz	4.06 GHz
<a href="#">HE1L5AA020S</a>	0.20 ns	±15 ps +2% of Nom.	25 ps	3.17 GHz	2.26 GHz
<a href="#">HE1L5AA030S</a>	0.30 ns	±15 ps +2% of Nom.	30 ps	7.10 GHz	4.70 GHz
<a href="#">HE1L5AT040S</a>	0.40 ns	±15 ps +2% of Nom.	58 ps	3.20 GHz	0.93 GHz
<a href="#">HE1L5AT050S</a>	0.50 ns	±15 ps +2% of Nom.	78 ps	2.35 GHz	0.70 GHz
<a href="#">HE1L5AT060S</a>	0.60 ns	±15 ps +2% of Nom.	86 ps	1.89 GHz	0.62 GHz
<a href="#">HE1L5AT070S</a>	0.70 ns	±15 ps +2% of Nom.	238 ps	1.58 GHz	0.53 GHz
<a href="#">HE1L5AT080S</a>	0.80 ns	±15 ps +2% of Nom.	244 ps	2.09 GHz	0.49 GHz

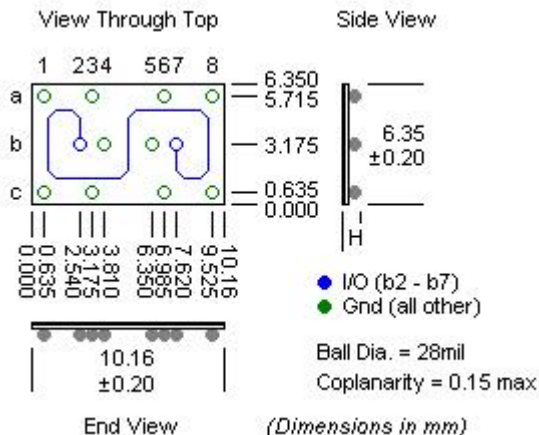
<a href="#">HE1L5AT090S</a>	0.90 ns ±15 ps +2% of Nom.	218 ps	1.08 GHz	0.83 GHz
<a href="#">HE1L5AT100S</a>	1.00 ns ±15 ps +2% of Nom.	227 ps	1.89 GHz	0.76 GHz
<a href="#">HE1L5AT110S</a>	1.10 ns ±15 ps +2% of Nom.	241 ps	1.79 GHz	0.71 GHz
<a href="#">HE1L5AT120S</a>	1.20 ns ±15 ps +2% of Nom.	245 ps	1.61 GHz	0.67 GHz
<a href="#">HE1L5BA010S</a>	0.10 ns ±15 ps +2% of Nom.	15 ps	10.10 GHz	6.92 GHz
<a href="#">HE1L5BA050S</a>	0.50 ns ±15 ps +2% of Nom.	48 ps	8.57 GHz	5.51 GHz
<a href="#">HE1L5BA100S</a>	1.00 ns ±15 ps +2% of Nom.	94 ps	4.85 GHz	3.59 GHz
<a href="#">HE1L5BT150S</a>	1.50 ns ±15 ps +2% of Nom.	274 ps	1.30 GHz	0.53 GHz
<a href="#">HE1L5BT200S</a>	2.00 ns ±15 ps +2% of Nom.	347 ps	0.98 GHz	0.39 GHz
<a href="#">HE1L5BT250S</a>	2.50 ns ±15 ps +2% of Nom.	594 ps	0.79 GHz	0.31 GHz
<a href="#">HE1L5BT300S</a>	3.00 ns ±15 ps +2% of Nom.	639 ps	0.69 GHz	0.27 GHz
<a href="#">HE1L5BT350S</a>	3.50 ns ±15 ps +2% of Nom.	715 ps	0.65 GHz	0.24 GHz

**Mechanical**

**Size A**



**Size B**



**Height Designator**

TD	Height, H (mm)	Code
0.1 - 0.3ns	1.1 max	A
0.4 - 1.2ns	1.6 max	T

**Notes:**

Delay Line I/O = b2 & b4
Either b2 or b4 can be used for the input.
The following positions do not have a ball: a2, a4, b1, b3, b5, c2, c4
Ground = all other

**Height Designator**

TD	Height, H (mm)	Code
0.1 - 1.0ns	1.1 max	A
1.0 - 3.5ns	1.6 max	T

**Notes:**

Delay Line I/O = b2 & b7
Either b2 or b7 can be used for the input.
The following positions do not have a ball: a2, a4, a5, a7, b1, b3, b6, b8, c2, c4, c5, c7
Ground = all other

**Marking**

**Size A**

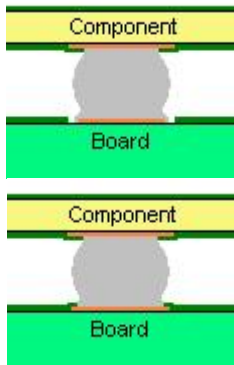


**Size B**



Part number code will be marked on the top of the part in 2 rows followed by a TFT "don't stop" logo ("B" size only) and a 1 digit monthly date code  
 A '1' pin identifier (dot) will be located as shown above

**Land Pattern**



Copper Defined Land Pattern:	Dimensions (mm)
Copper Land diameter	0.66 - 0.71
Soldermask diameter	0.81 - 0.86
Soldermask clearance	0.07 min

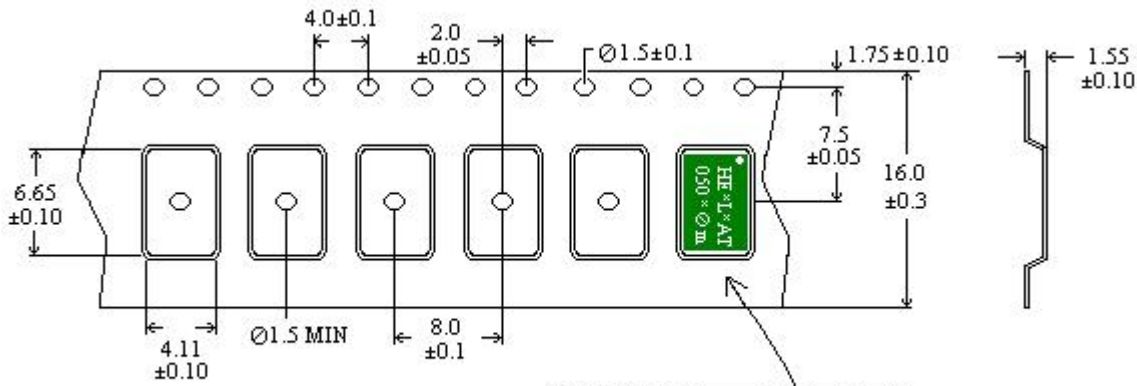
Copper Defined Land Pattern:	Dimensions (mm)
Soldermask diameter	0.66 - 0.71
Soldermask coverage	0.05 min

**Note:**

Adjust the copper land diameter accordingly to ensure the minimum soldermask coverage.  
 Recommended dimensions as per IPC-7095 "Design and Assembly Process Implementation for BGAs".

**Packaging**

**Size Designator A:**



Not Drawn To Scale

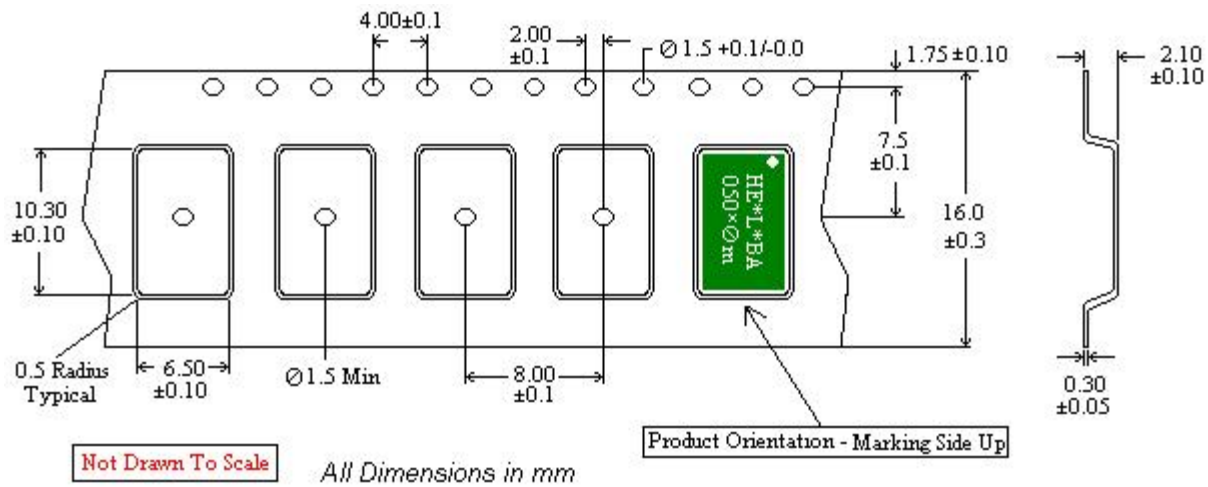
All Dimensions in mm

Product Orientation - Marking Side Up

**Additional Comments:**

- All taping done in accordance with EIA 481 standards
- Pieces taped with the marking up and showing through the cover tape
- Labels will contain the TFT part number and quantity of pieces taped
- Carrier Tape Part#: CT-9916H-123
- Carrier Tape Drawing#: 01-019491

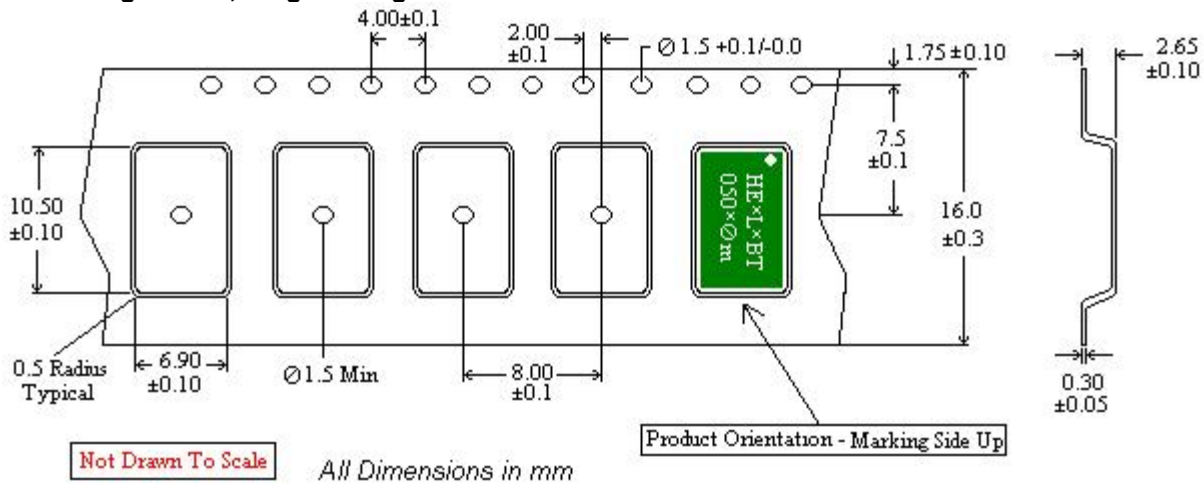
**Size Designator B, Height Designator A:**



#### Additional Comments:

- All taping done in accordance with EIA 481 standards
- Pieces taped with the marking up and showing through the cover tape
- Labels will contain the TFT part number and quantity of pieces taped
- Carrier Tape Part#: SOIC16-AC
- Carrier Tape Drawing#: A0103-89-14

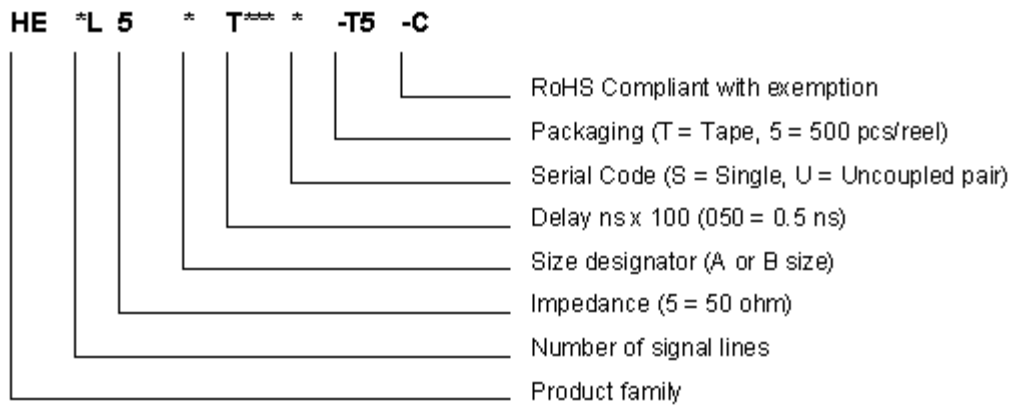
#### Size Designator B, Height Designator T:



#### Additional Comments:

- All taping done in accordance with EIA 481 standards
- Pieces taped with the marking up and showing through the cover tape
- Labels will contain the TFT part number and quantity of pieces taped
- Carrier Tape Part#: D-PAKM-A
- Carrier Tape Drawing#: A0613-89-2

### Part Number



RoHS compliant designator leave blank if ordering non-RoHS compliant part



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