

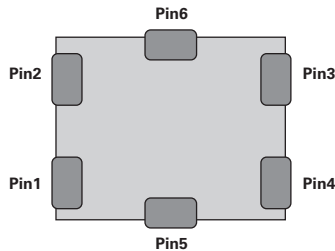
**LCFE Series**

RoHS



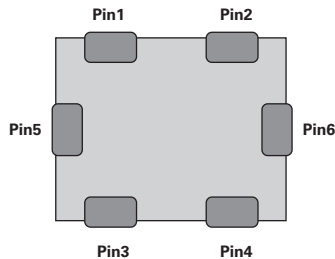
**Pinout**

0605mm Size



| Item                        | Description                      | Source         | Equipment        |
|-----------------------------|----------------------------------|----------------|------------------|
| R <sub>dc</sub>             | Pin 1-4, 2-3                     | 10mA DC Source | Source Meter     |
| CM Impedance                | Pin 1-2(Short) to Pin 3-4(Short) | 500mV          | LCR Meter (3GHz) |
| IL                          | Pin 5 or 6 to Pin 1,2,3,4        | 5V DC Source   | Source Meter     |
| I <sub>R<sub>CR</sub></sub> | Pin 1-2 or Pin 3-4               | 5V DC Source   | Source Meter     |

0806mm Size



| Item                        | Description                      | Source         | Equipment        |
|-----------------------------|----------------------------------|----------------|------------------|
| R <sub>dc</sub>             | Pin 1-3, 2-4                     | 10mA DC Source | Source Meter     |
| CM Impedance                | Pin 1-2(Short) to Pin 3-4(Short) | 500mV          | LCR Meter (3GHz) |
| IL                          | Pin 5 or 6 to Pin 1,2,3,4        | 5V DC Source   | Source Meter     |
| I <sub>R<sub>CR</sub></sub> | Pin 1-2 or Pin 3-4               | 5V DC Source   | Source Meter     |

**Description**

This specification covers the engineering requirements for both Common Mode Noise Filter (CMF) and ESD Protection, especially high speed differential serial interfaces, such as USB 3.1, USB 3.0, MIPI D-PHY or HDMI.

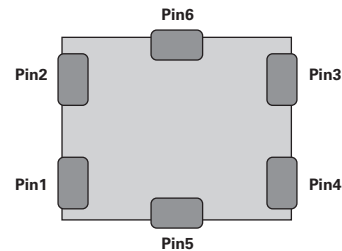
**Features**

- Effective for suppressing common mode noise and almost no effect for high speed differential data line
- Differential mode cut-off frequency up to 10.5GHz at -3dB
- One common mode filters and two ESD suppression devices integrated
- Ultra low profile as low as 0.68x0.55x0.35mm
- Ceramic multilayer type SMD component
- Non-polarized product
- Conforming to RoHS directive
- ±15kV air, ±8kV contact ESD protection (IEC 61000-4-2 Level 4)
- High temperature soldering guaranteed: 260°C/10 seconds

**Applications**

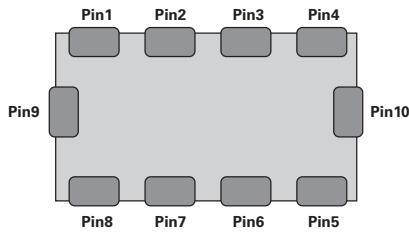
- Mobile Phone and Tablet
- USB 3.1 Gen 1 and 2 (5 and 10Gbps) with Type C
- Display Port 1.2 (5.4Gbps)
- HDMI 2.0 (6.0Gbps)
- MDDI, MIPI, MHL
- Portable/Wearable Devices
- Game console, POS, VR, Dongle
- Consumer Products
- PDP, LCD TV, DVD Player, PC, Audio player, DSC, Set top box, Laptop, SSD, Home Automation, IoT module

1210mm Size



| Item                        | Description                      | Source         | Equipment        |
|-----------------------------|----------------------------------|----------------|------------------|
| R <sub>dc</sub>             | Pin 1-4, 2-3                     | 10mA DC Source | Source Meter     |
| CM Impedance                | Pin 1-2(Short) to Pin 3-4(Short) | 500mV          | LCR Meter (3GHz) |
| IL                          | Pin 5 or 6 to Pin 1,2,3,4        | 5V DC Source   | Source Meter     |
| I <sub>R<sub>CR</sub></sub> | Pin 1-2 or Pin 3-4               | 5V DC Source   | Source Meter     |

### 1608mm Size



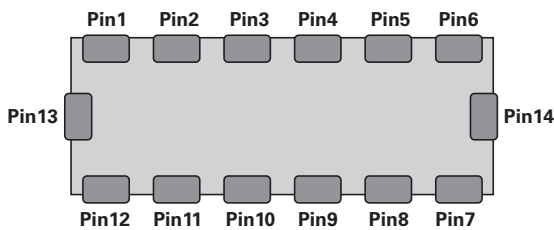
| Item         | Description  | Source         | Equipment        |
|--------------|--|----------------|------------------|
| Rdc          | Pin 1-8, 2-7, 3-6, 4-5   | 10mA DC Source | Source Meter     |
| CM Impedance | Pin 1-2(Short) to Pin 8-7(Short)<br>Pin 3-4(Short) to Pin 6-5(Short) | 500mV          | LCR Meter (3GHz) |
| IL           | Pin 9 or 10 to Pin 1~4 or 5~8  | 5V DC Source   | Source Meter     |

### 2012mm Size (LCFE201202A900TG, LCFE201202A121TG)



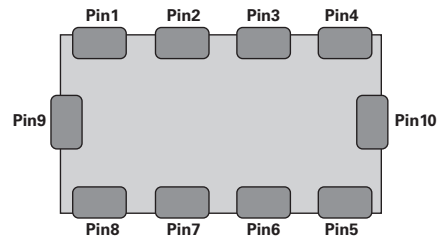
| Item             | Description                      | Source         | Equipment        |
|------------------|----------------------------------|----------------|------------------|
| Rdc              | Pin 1-3, 2-4                     | 10mA DC Source | Source Meter     |
| CM Impedance     | Pin 1-2(Short) to Pin 3-4(Short) | 500mV          | LCR Meter (3GHz) |
| IL               | Pin 5 or 6 to Pin 1,2,3,4        | 5V DC Source   | Source Meter     |
| IR <sub>CR</sub> | Pin 1-2 or Pin 3-4               | 5V DC Source   | Source Meter     |

### 3008mm Size



| Item         | Description   | Source         | Equipment        |
|--------------|---|----------------|------------------|
| Rdc          | Pin 1-12, 2-11, 3-10, 4-9, 5-8, 6-7   | 10mA DC Source | Source Meter     |
| CM Impedance | Pin 1-2(Short) to Pin 12-11(Short)<br>Pin 3-4(Short) to Pin 10-9(Short)<br>Pin 5-6(Short) to Pin 8-7(Short) | 500mV          | LCR Meter (3GHz) |
| IL           | Pin 13 or 14 to Pin 1~6 or 7~12   | 5V DC Source   | Source Meter     |

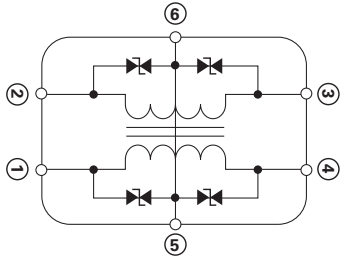
### 2012mm Size (LCFE201204A101TG)



| Item         | Description  | Source         | Equipment        |
|--------------|--|----------------|------------------|
| Rdc          | Pin 1-8, 2-7, 3-6, 4-5   | 10mA DC Source | Source Meter     |
| CM Impedance | Pin 1-2(Short) to Pin 8-7(Short)<br>Pin 3-4(Short) to Pin 6-5(Short) | 500mV          | LCR Meter (3GHz) |
| IL           | Pin 9 or 10 to Pin 1~4 or 5~8  | 5V DC Source   | Source Meter     |

**Functional Block Diagram**

LCFE060502A120TG, LCFE060502A350TG, LCFE060502A650TG,  
LCFE121002A120TG, LCFE121002A350TG, LCFE121002A500TG,  
LCFE121002A650TG, LCFE121002A900TG, LCFE121002H900TG



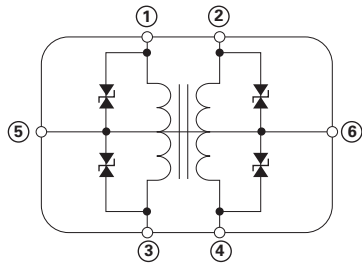
①~④: Data Line; ⑤ and ⑥:Ground

LCFE160804A180TG, LCFE160804A350TG, LCFE160804A550TG,  
LCFE160804A750TG, LCFE160804H101TG, LCFE201204A101TG



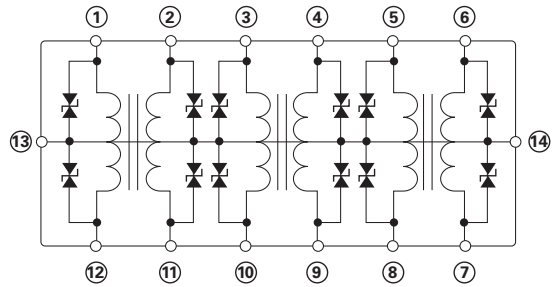
①~⑧: Data Line; ⑨ and ⑩:Ground

LCFE080602A120TG, LCFE080602A250TG, LCFE080602W500TG,  
LCFE080602A750TG, LCFE080602A900TG, LCFE080602H900TG,  
LCFE080602G900TG, LCFE201202A900TG, LCFE201202A121TG



①~④: Data Line; ⑤ and ⑥:Ground

LCFE300806A750TG



①~⑫: Data Line; ⑬ and ⑭: Ground

### Electrical Characteristics

| Part Number      | Size (mm) | Size (inch) | Common Mode Impedance (Ω) | Rated Current (mA) Max. | Cut-off Freq/ GHz | DC Resistance (Ω) Max. | Number of Lines | Leakage Current (μA) Max. | Capacitance (pF) | Insulation Resistance (MΩ) Min. | Rated Voltage (V) |
|------------------|-----------|-------------|---------------------------|-------------------------|-------------------|------------------------|-----------------|---------------------------|------------------|---------------------------------|-------------------|
| LCFE060502A120TG | 0605      | 0202        | 12(±30%)                  | 100                     | 14.1              | 3.0                    | 2               | 1.0                       | 1.2              | 10                              | 5                 |
| LCFE060502A350TG | 0605      | 0202        | 35(±25%)                  | 50                      | 7.09              | 5.5                    | 2               | 1.0                       | 1.7              | 10                              | 5                 |
| LCFE060502A650TG | 0605      | 0202        | 65(±25%)                  | 50                      | 4.76              | 8.0                    | 2               | 1.0                       | 1.7              | 10                              | 5                 |
| LCFE080602A120TG | 0806      | 0302        | 12(±30%)                  | 100                     | 7.38              | 5.0                    | 2               | 1.0                       | 1.7              | 10                              | 5                 |
| LCFE080602A250TG | 0806      | 0302        | 25(±25%)                  | 100                     | 7.97              | 5.0                    | 2               | 1.0                       | 1.7              | 10                              | 5                 |
| LCFE080602W500TG | 0806      | 0302        | 50(±25%)                  | 100                     | 3.60              | 7.0                    | 2               | 1.0                       | 1.7              | 10                              | 5                 |
| LCFE080602A750TG | 0806      | 0302        | 75(±25%)                  | 100                     | 3.80              | 6.0                    | 2               | 1.0                       | 1.7              | 10                              | 5                 |
| LCFE080602A900TG | 0806      | 0302        | 90(±25%)                  | 100                     | 3.80              | 6.0                    | 2               | 1.0                       | 1.7              | 10                              | 5                 |
| LCFE080602H900TG | 0806      | 0302        | 90(±25%)                  | 100                     | 3.74              | 8.0                    | 2               | 1.0                       | 2.0              | 10                              | 5                 |
| LCFE080602G900TG | 0806      | 0302        | 90(±25%)                  | 100                     | 2.82              | 8.0                    | 2               | 1.0                       | 2.0              | 10                              | 5                 |
| LCFE121002A120TG | 1210      | 0504        | 12(±30%)                  | 100                     | 9.02              | 4.0                    | 2               | 1.0                       | 1.7              | 10                              | 5                 |
| LCFE121002A350TG | 1210      | 0504        | 35(±25%)                  | 100                     | 6.38              | 4.0                    | 2               | 1.0                       | 1.7              | 10                              | 5                 |
| LCFE121002A500TG | 1210      | 0504        | 50(±25%)                  | 100                     | 4.96              | 4.0                    | 2               | 1.0                       | 1.7              | 10                              | 5                 |
| LCFE121002A650TG | 1210      | 0504        | 65(±25%)                  | 100                     | 4.30              | 4.0                    | 2               | 1.0                       | 1.7              | 10                              | 5                 |
| LCFE121002A900TG | 1210      | 0504        | 90(±25%)                  | 100                     | 4.57              | 4.0                    | 2               | 1.0                       | 1.7              | 10                              | 5                 |
| LCFE121002H900TG | 1210      | 0504        | 90(±25%)                  | 100                     | 3.90              | 6.0                    | 2               | 1.0                       | 1.7              | 10                              | 5                 |
| LCFE160804A180TG | 1608      | 0603        | 18(±30%)                  | 100                     | 10.35             | 6.0                    | 4               | 1.0                       | 1.7              | 10                              | 5                 |
| LCFE160804A350TG | 1608      | 0603        | 35(±30%)                  | 100                     | 7.20              | 6.0                    | 4               | 1.0                       | 1.7              | 10                              | 5                 |
| LCFE160804A550TG | 1608      | 0603        | 55(±25%)                  | 100                     | 4.09              | 6.0                    | 4               | 1.0                       | 2.0              | 10                              | 5                 |
| LCFE160804A750TG | 1608      | 0603        | 75(±25%)                  | 100                     | 4.91              | 6.0                    | 4               | 1.0                       | 1.7              | 10                              | 5                 |
| LCFE160804H101TG | 1608      | 0603        | 100(±25%)                 | 100                     | 3.96              | 8.0                    | 4               | 1.0                       | 2.0              | 10                              | 5                 |
| LCFE201202A900TG | 2012      | 0805        | 90(±25%)                  | 100                     | 3.38              | 4.0                    | 2               | 1.0                       | 1.7              | 10                              | 5                 |
| LCFE201202A121TG | 2012      | 0805        | 120(±25%)                 | 100                     | 3.62              | 4.0                    | 2               | 1.0                       | 1.7              | 10                              | 5                 |
| LCFE201204A101TG | 2012      | 0805        | 100(±25%)                 | 100                     | 4.22              | 4.0                    | 4               | 1.0                       | 1.7              | 10                              | 5                 |
| LCFE300806A750TG | 3008      | 1203        | 75(±25%)                  | 100                     | 4.51              | 6.0                    | 6               | 1.0                       | 2.0              | 10                              | 5                 |

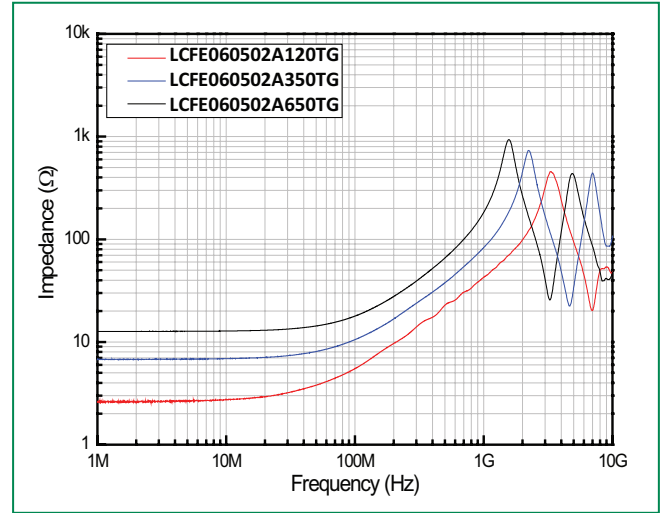
#### Test Conditions

- Common Mode Impedance (Ω): @100MHz
- DC Resistance (Ω): 25°C±2°C
- Leakage Current (μA): 5V
- Capacitance (pF) : 0.5Vrms @1MHz
- Insulation Resistance (Max. MΩ): 5V
- Rated Voltage (V): 25°C±2°C
- Rated Current (mA): 25°C±2°C

**Impedance Curves - 0605mm Size**  
**Common Mode**



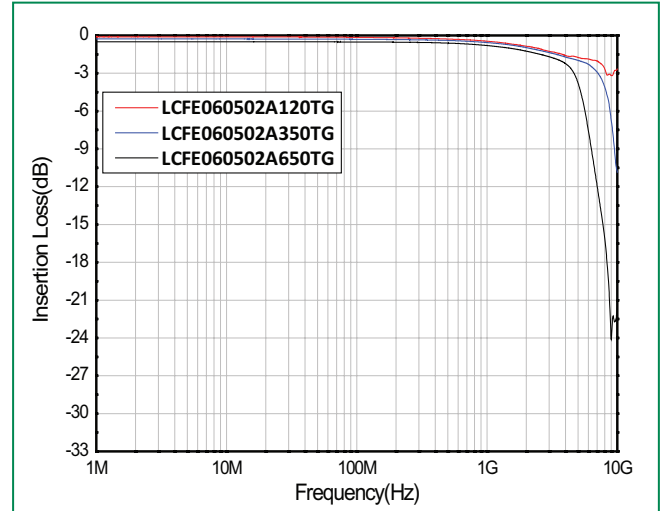
**Differential Mode**



**Transmission Characteristics (S-parameter)**  
**Common Mode S21**



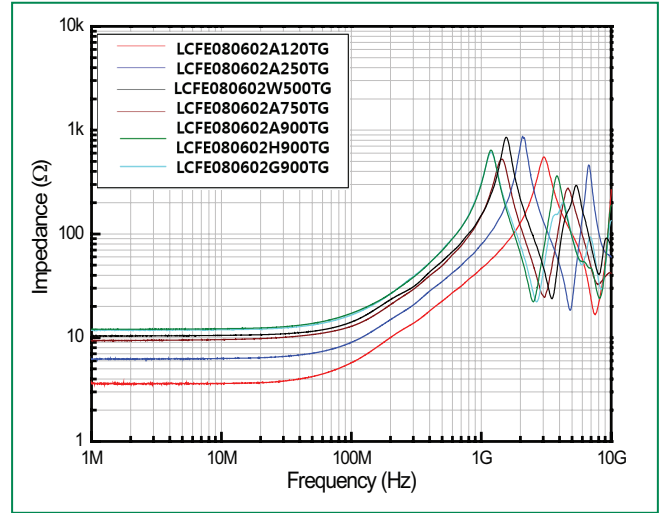
**Differential Mode S21**



**Impedance Curves - 0806mm Size  
Common Mode**



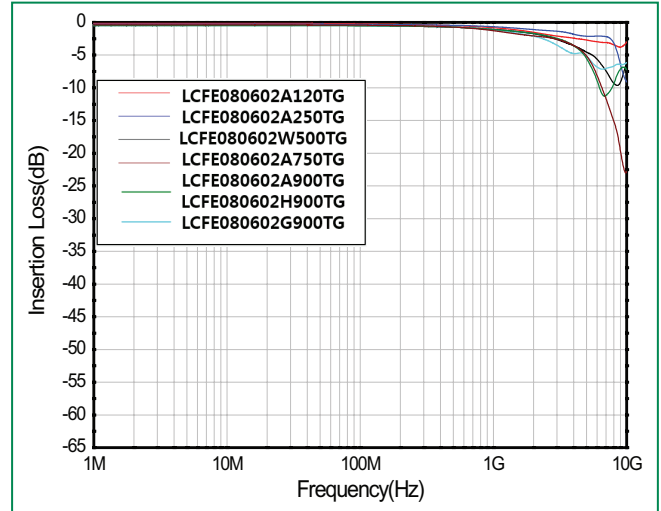
**Differential Mode**



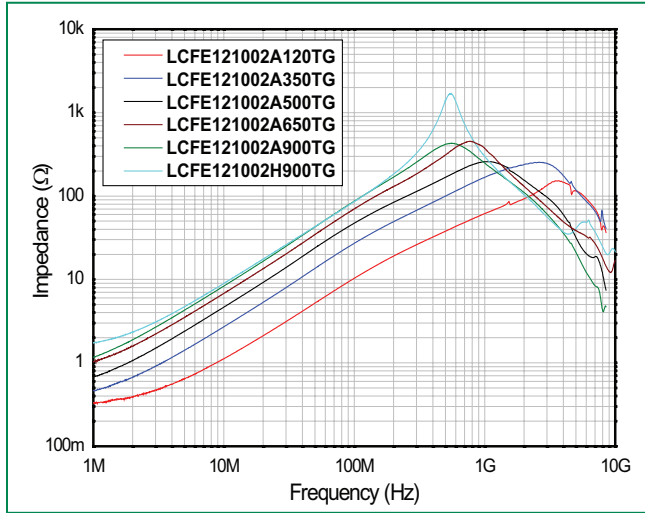
**Transmission Characteristics (S-parameter)  
Common Mode S21**



**Differential Mode S21**



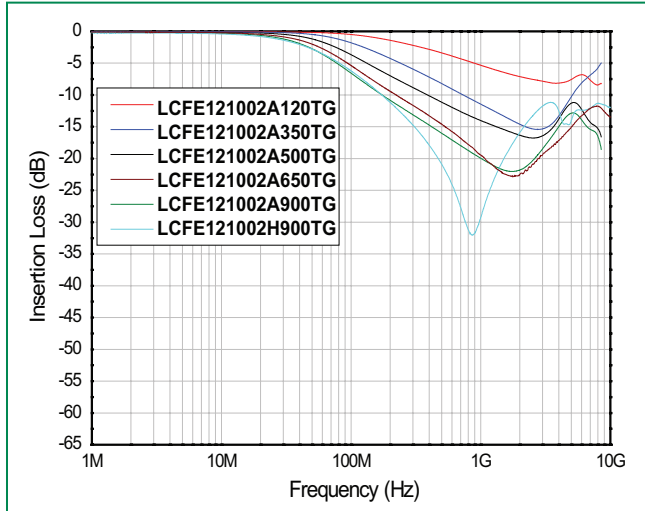
**Impedance Curves - 1210mm Size**  
**Common Mode**



**Differential Mode**



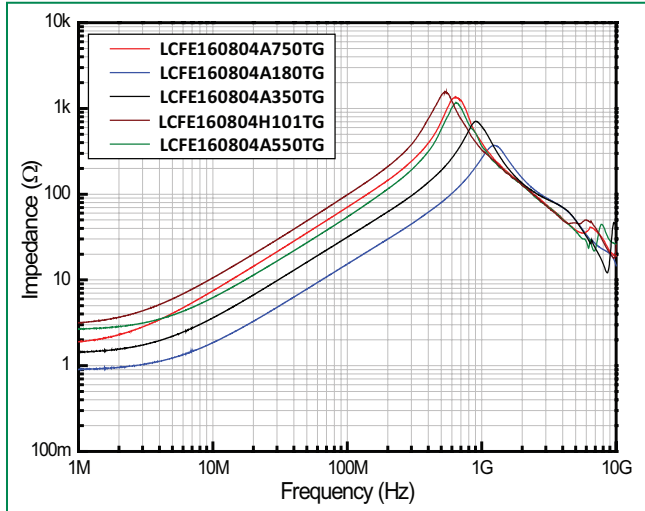
**Transmission Characteristics (S-parameter)**  
**Common Mode S21**



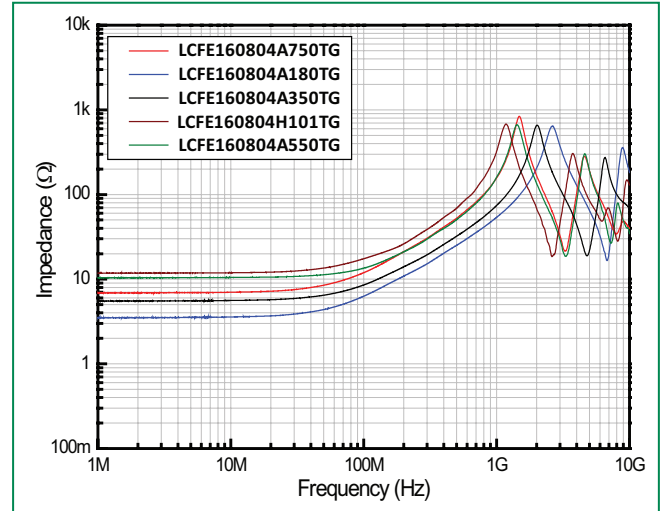
**Differential Mode S21**



## Impedance Curves - 1608mm Size Common Mode



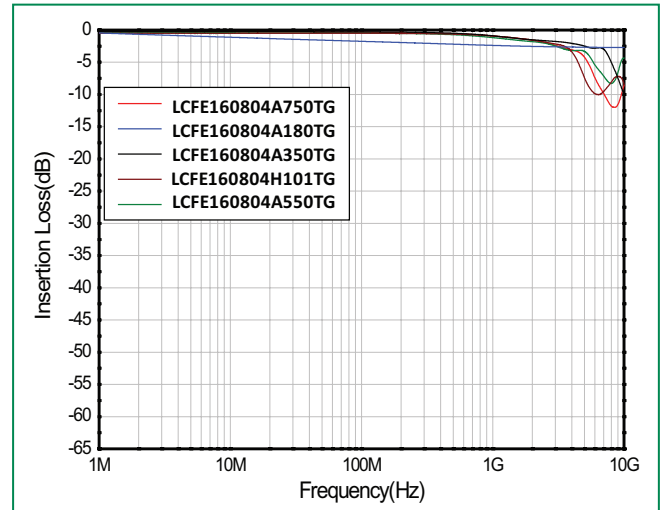
## Differential Mode



## Transmission Characteristics (S-parameter) Common Mode S21

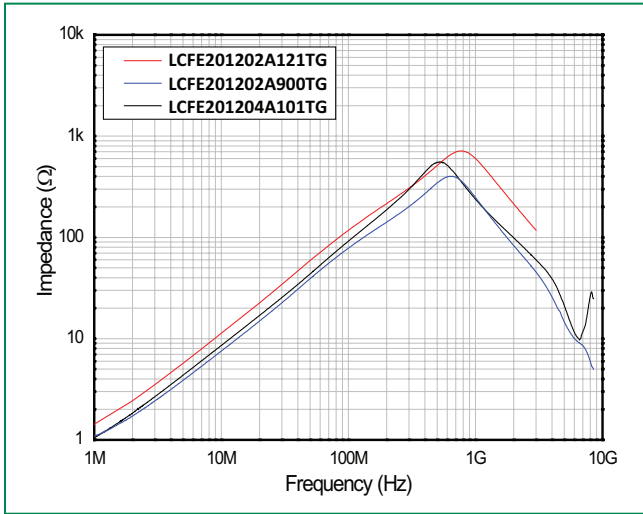


## Differential Mode S21

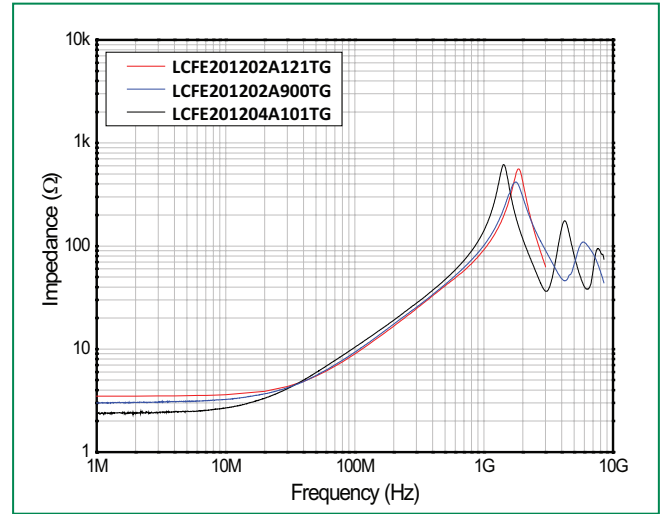




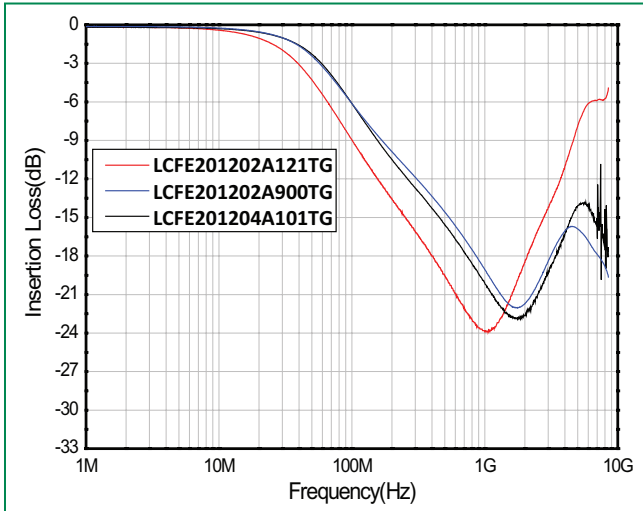
**Impedance Curves - 2012mm Size**  
**Common Mode**



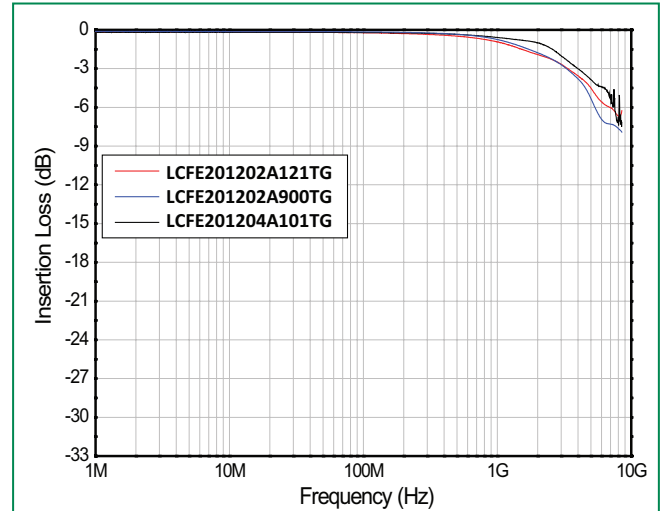
**Differential Mode**



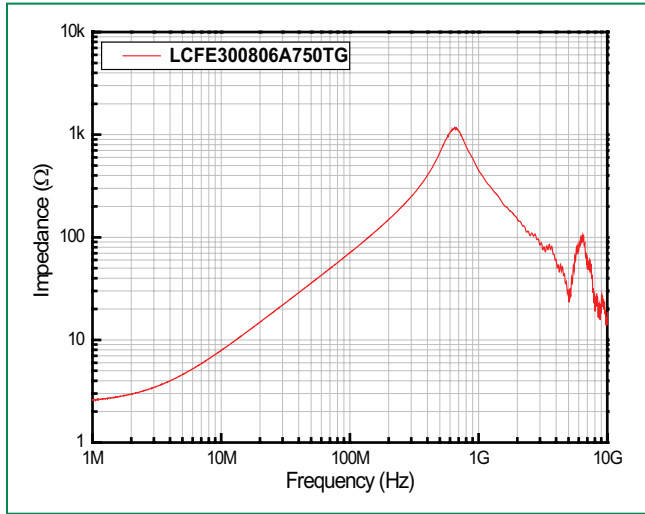
**Transmission Characteristics (S-parameter)**  
**Common Mode S21**



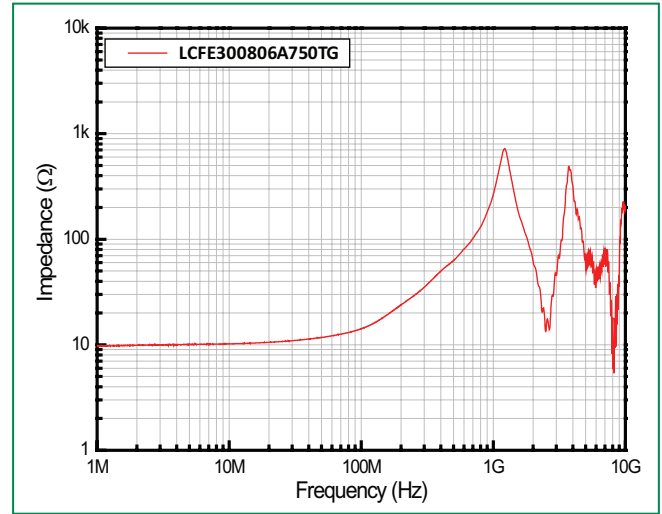
**Differential Mode S21**



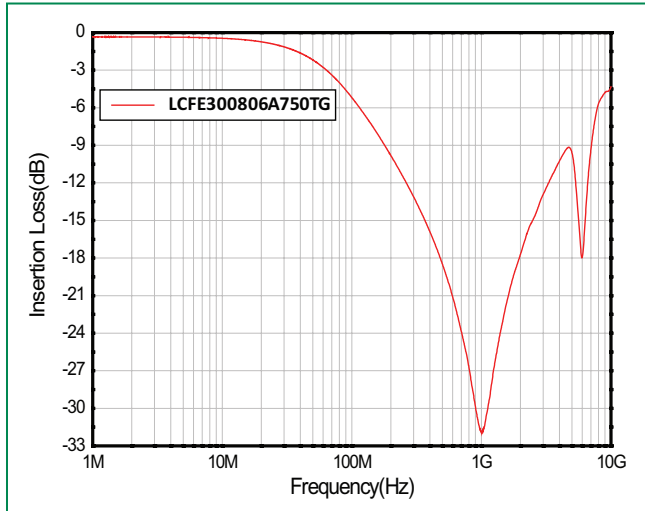
**Impedance Curves - 3008mm Size  
Common Mode**



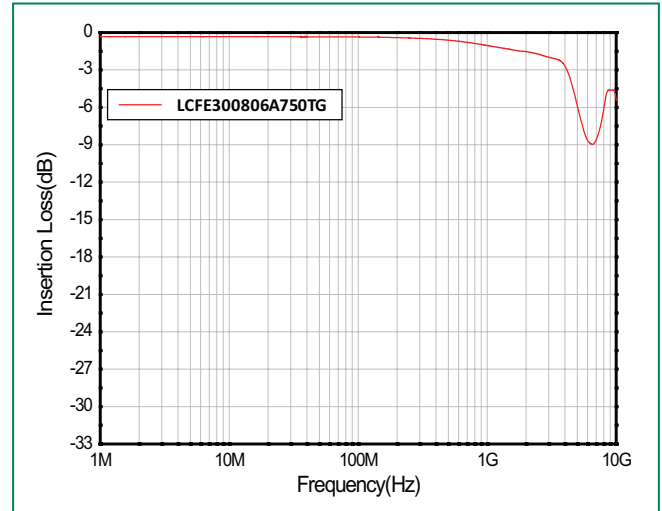
**Differential Mode**



**Transmission Characteristics (S-parameter)  
Common Mode S21**

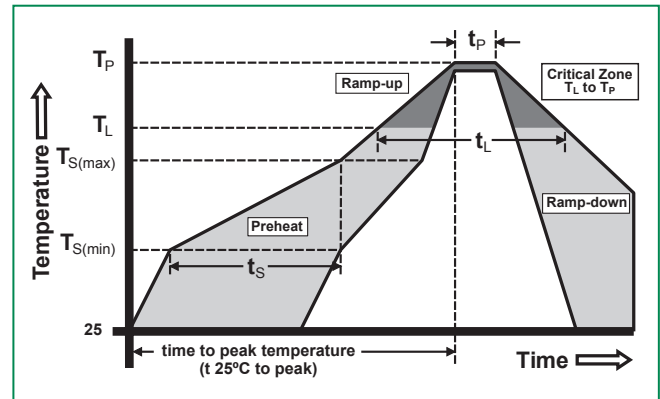


**Differential Mode S21**



### Soldering Parameters

|  |                                    |                    |
|--|------------------------------------|--------------------|
| Reflow Condition                                       |                                    | Pb-free assembly   |
| Pre Heat   | - Temperature Min ( $T_{S(min)}$ ) | 160°C              |
|  | - Temperature Max ( $T_{S(max)}$ ) | 185°C              |
|  | - Time (Min to Max) ( $t_s$ )      | 100 – 120 seconds  |
| Average Ramp-up Rate (Liquidus Temp ( $T_L$ ) to peak) |                                    | 1°C/second max     |
| $T_{S(max)}$ to $T_L$ - Ramp-up Rate                   |                                    | 1°C/second max     |
| Reflow   | - Temperature ( $T_L$ ) (Liquidus) | 220°C              |
|  | - Temperature ( $t_L$ )            | 30 – 50 seconds    |
| Peak Temperature ( $T_P$ )                             |                                    | 260°C              |
| Time within 5°C of actual peak Temperature ( $t_p$ )   |                                    | 5~10 seconds       |
| Ramp-down Rate   |                                    | 2°C/second max     |
| Time 25°C to Peak Temperature ( $T_P$ )                |                                    | 4 minutes max      |
| Do not exceed  |                                    | 260°C              |
| Wave Soldering   |                                    | 260°C, 10 sec. max |



Recommended Soldering Profile ( Lead free condition)

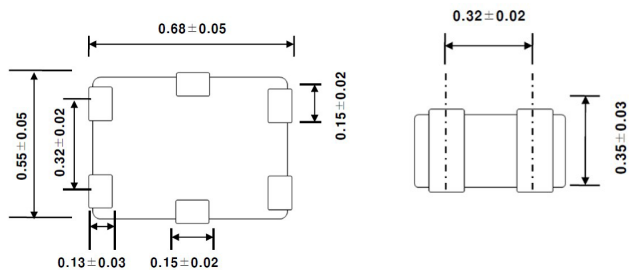
### Product Characteristics

|                                  |   |
|----------------------------------|---|
| <b>Lead Pull Strength</b>        | 5N  |
| <b>Solderability</b>             | 260°C, ≤10s (Reflow),<br>Max 380°C, ≤5s (Soldering iron)        |
| <b>Soldering Heat Resistance</b> | Max 260°C 10sec(Wave), Max<br>Temperature: Max 380°C (Max 5sec) |
| <b>Operating Temperature</b>     | -40°C to +85°C  |
| <b>Climatic Category</b>         | -40°C to +85°C/8 days   |
| <b>Stock Conditions</b>          | -10°C + 40°C RH, ≤ 70%  |
| <b>Vibration Resistance</b>      | 5 g's for 20 minutes, 12 cycles each<br>of 3 orientations       |

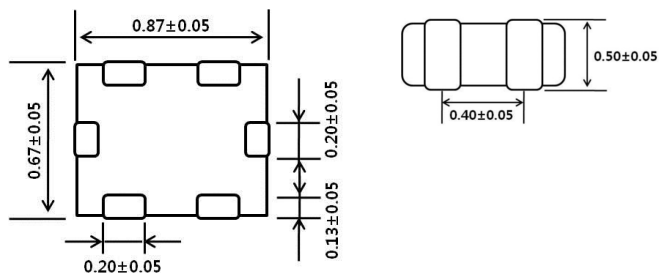
## Dimensions

Unit = mm

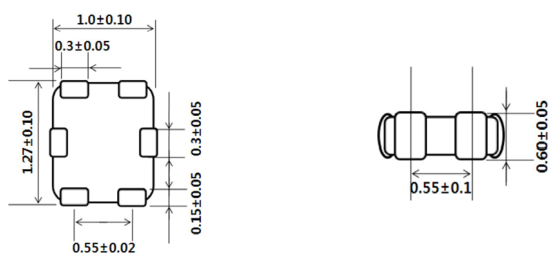
### 0605mm Size



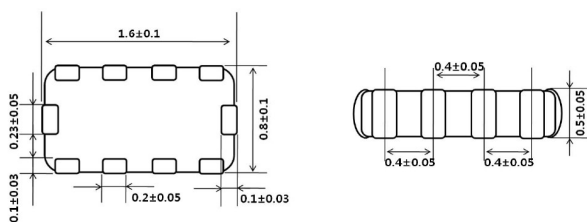
### 0806mm Size



### 1210mm Size



### 1608mm Size

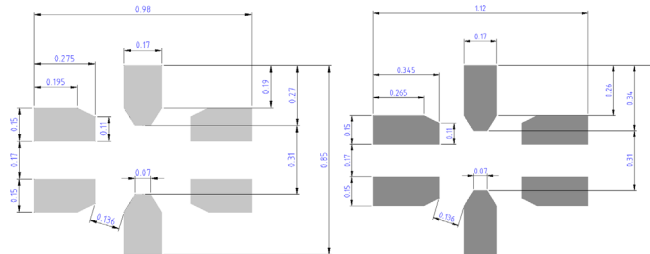


## Recommended Footprint and Stencil Mask

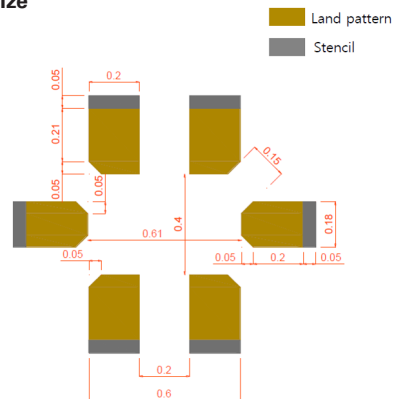
Unit = mm

Stencil Mask T = 0.10mm

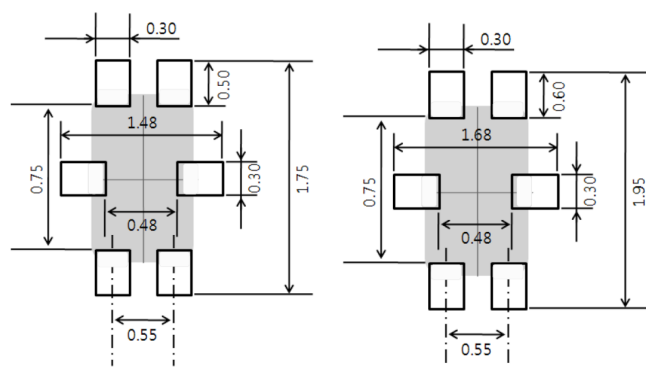
### 0605mm Size



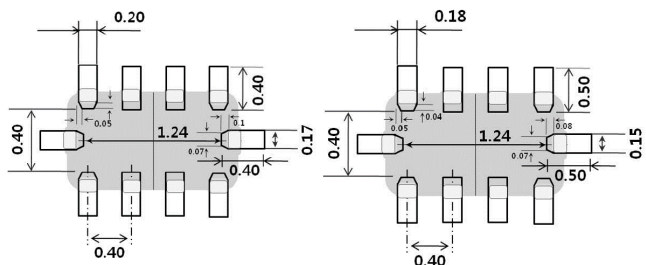
### 0806mm Size



### 1210mm Size



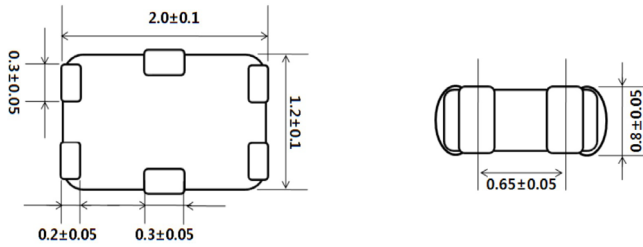
### 1608mm Size



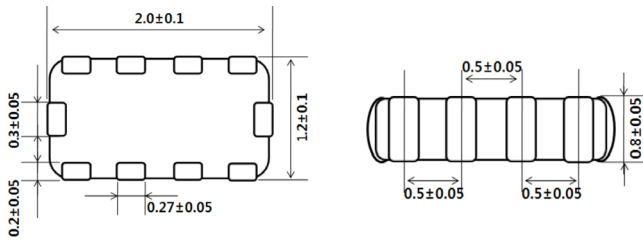
**Dimensions**

Unit = mm

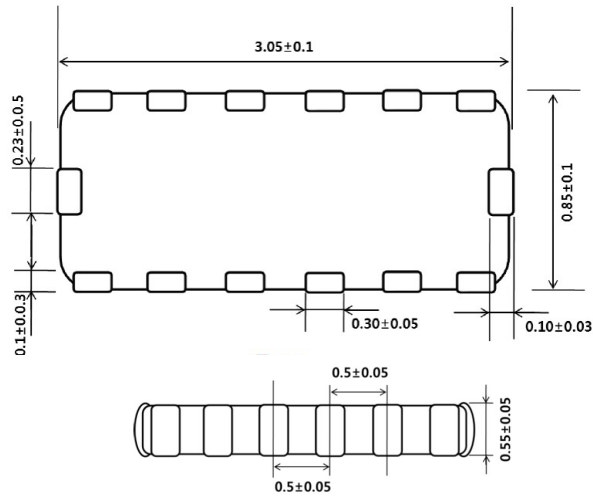
**2012mm Size (LCFE201202A900TG, LCFE201202A121TG)**



**2012mm Size (LCFE201204A101TG)**



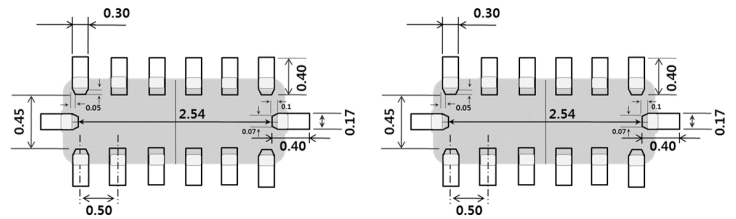
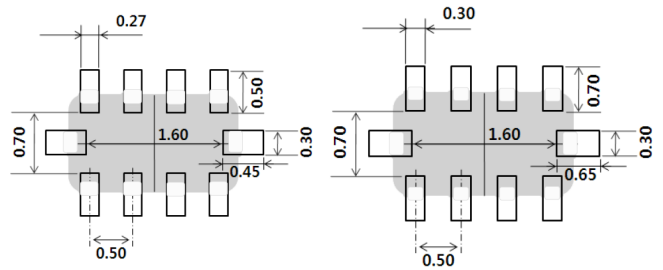
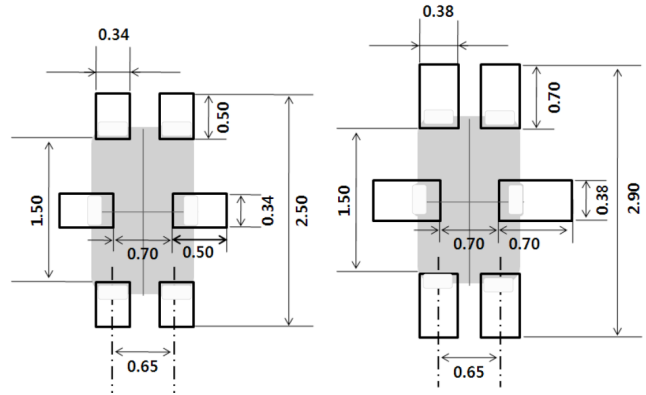
**3008mm Size**



**Recommended Footprint and Stencil Mask**

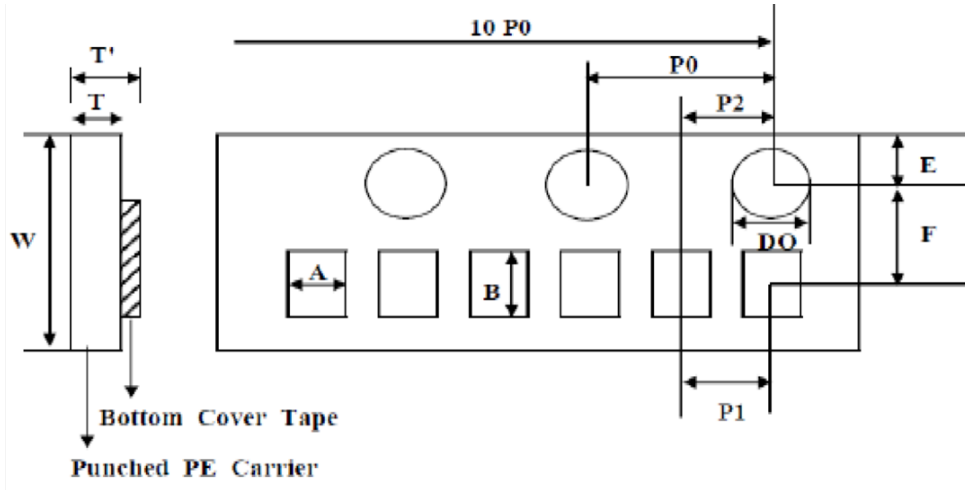
Unit = mm

Stencil Mask T = 0.10mm



### Carrie Tape Dimensions

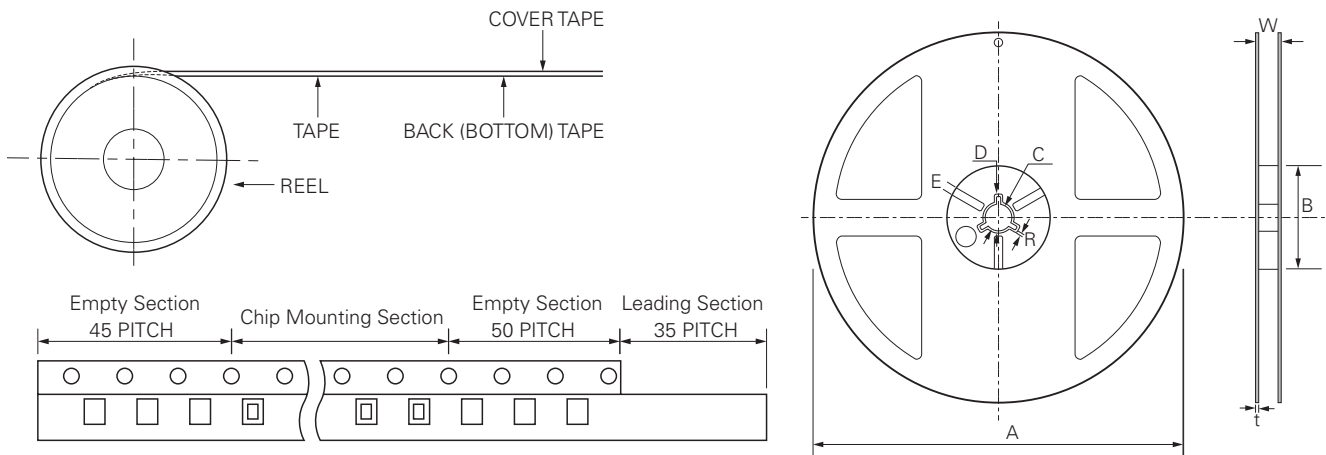
0605mm size



| Symbol | Dimensions  |
|--------|-------------|
|        | Millimeters |
| A      | 0.62±0.03   |
| B      | 0.78±0.03   |
| E      | 1.75±0.05   |
| F      | 3.50±0.05   |
| D0     | 1.55±0.03   |
| P1     | 2.00±0.05   |
| P2     | 2.00±0.05   |
| P0     | 4.00±0.05   |
| 10P0   | 40.00±0.10  |
| W      | 8.00±0.10   |
| T      | 0.40±0.02   |
| T'     | 0.43±0.05   |

### Tape and Reel Dimension

0605mm size



- (1) Reel Materials: Polystyrene (2) Label (3) Taping
- Standard Packing Quantity per Reel (Ø178)
- PE Tape: 10,000pcs

| Code      | A      | B        | C       | D       | E       | W      | T       | R   |
|-----------|--------|----------|---------|---------|---------|--------|---------|-----|
| Dimension | Ø178±2 | Min. Ø50 | Ø13±0.5 | Ø21±0.8 | 2.0±0.5 | 10±1.5 | 0.8±0.2 | 1.0 |

### Carrie Tape Dimensions

0806mm size



| Symbol | Dimensions  |
|--------|-------------|
|        | Millimeters |
| A      | 0.80±0.03   |
| B      | 1.02±0.03   |
| E      | 1.75±0.05   |
| F      | 3.50±0.05   |
| D0     | 1.55±0.03   |
| P1     | 2.00±0.05   |
| P2     | 2.00±0.05   |
| P0     | 4.00±0.05   |
| 10P0   | 40.00±0.10  |
| W      | 8.00±0.10   |
| T      | 0.60±0.02   |
| T'     | 0.63±0.05   |

### Tape and Reel Dimension

0806mm size

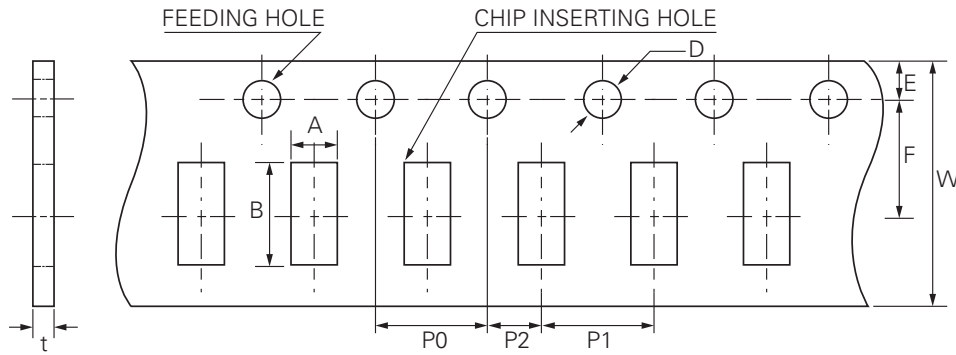


- (1) Reel Materials: Polystyrene (2) Label (3) Taping
- Standard Packing Quantity per Reel (Ø178)
- PE Tape: 10,000pcs

| Code      | A      | B        | C       | D       | E       | W      | T       | R   |
|-----------|--------|----------|---------|---------|---------|--------|---------|-----|
| Dimension | Ø178±2 | Min. Ø50 | Ø13±0.5 | Ø21±0.8 | 2.0±0.5 | 10±1.5 | 0.8±0.2 | 1.0 |

### Carrie Tape Dimensions

1210mm size



| Symbol | Dimensions     |
|--------|----------------|
|        | Millimeters    |
| A      | 1.15±0.05      |
| B      | 1.50±0.05      |
| W      | 8.00+0.30-0.10 |
| F      | 3.50±0.05      |
| E      | 1.75±0.05      |
| P1     | 4.00±0.10      |
| P2     | 2.00±0.05      |
| P0     | 4.00±0.05      |
| D      | 1.55±0.03      |
| T      | 0.75±0.05      |

### Tape and Reel Dimension

1210mm size



- (1) Reel Materials: Polystyrene (2) Label (3) Taping  
 - Standard Packing Quantity per Reel (Ø178)  
 - PE Tape: 4,000pcs

| Code      | A      | B        | C       | D       | E       | W      | T       | R   |
|-----------|--------|----------|---------|---------|---------|--------|---------|-----|
| Dimension | Ø178±2 | Min. Ø50 | Ø13±0.5 | Ø21±0.8 | 2.0±0.5 | 10±1.5 | 0.8±0.2 | 1.0 |



### Carrie Tape Dimensions

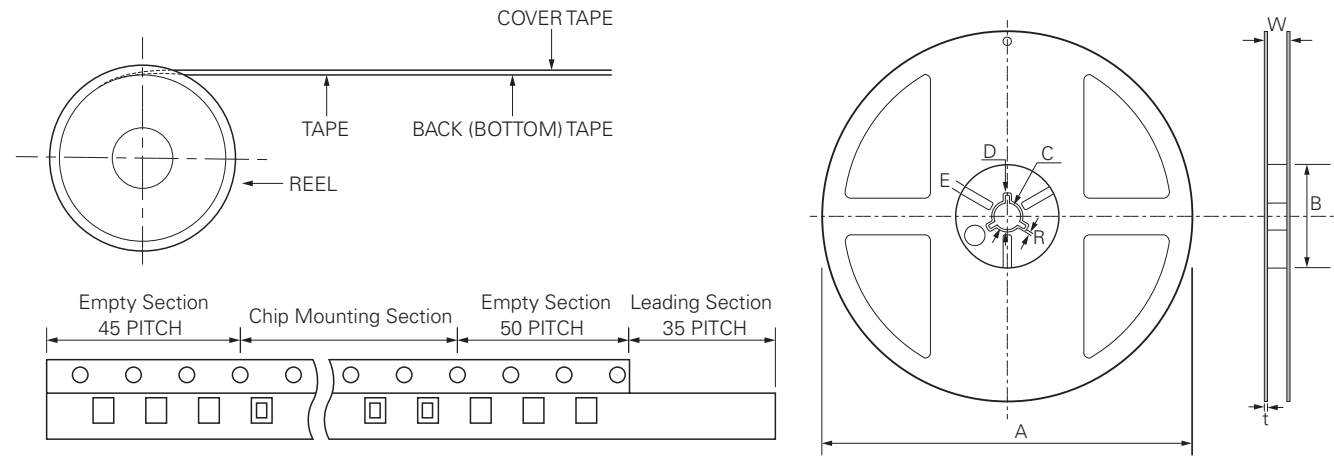
1608mm size



| Symbol | Dimensions  |
|--------|-------------|
|        | Millimeters |
| A      | 0.97±0.03   |
| B      | 1.80±0.03   |
| W      | 8.00±0.10   |
| F      | 3.50±0.05   |
| E      | 1.75±0.05   |
| P1     | 4.00±0.10   |
| P2     | 2.00±0.05   |
| P0     | 4.00±0.05   |
| D      | 1.55±0.03   |
| T      | 0.58±0.03   |

### Tape and Reel Dimension

1608mm size

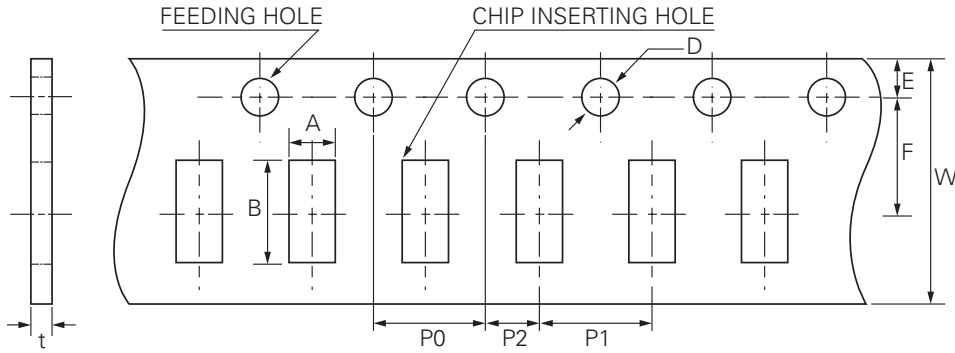


- (1) Reel Materials: Polystyrene (2) Label (3) Taping
- Standard Packing Quantity per Reel (Ø178)
- PE Tape: 4,000pcs

| Code      | A      | B        | C       | D       | E       | W      | T       | R   |
|-----------|--------|----------|---------|---------|---------|--------|---------|-----|
| Dimension | Ø178±2 | Min. Ø50 | Ø13±0.5 | Ø21±0.8 | 2.0±0.5 | 10±1.5 | 0.8±0.2 | 1.0 |

### Carrie Tape Dimensions

2012mm size



| Symbol | Dimensions<br>Millimeters |
|--------|---------------------------|
| A      | 1.55±0.05                 |
| B      | 2.30±0.05                 |
| W      | 8.00±0.10                 |
| F      | 3.50±0.05                 |
| E      | 1.75±0.05                 |
| P1     | 4.00±0.10                 |
| P2     | 2.00±0.05                 |
| P0     | 4.00±0.10                 |
| D      | 1.55±0.03                 |
| T      | 0.95±0.05                 |

### Tape and Reel Dimension

2012mm size

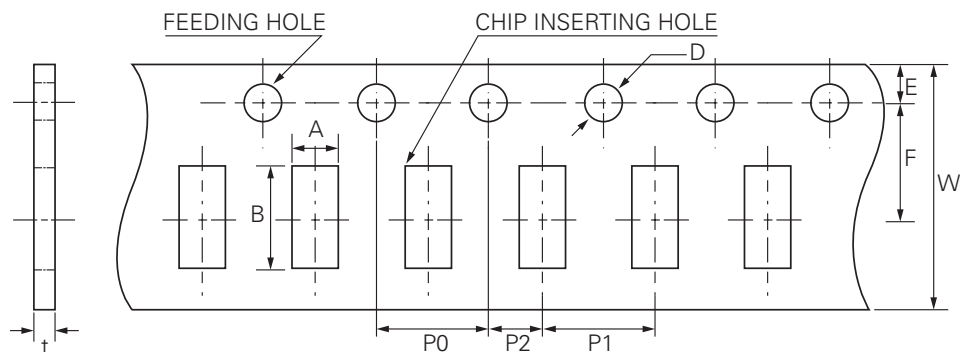


- (1) Reel Materials: Polystyrene (2) Label (3) Taping  
 - Standard Packing Quantity per Reel (Ø178)  
 - PE Tape: 4,000pcs

| Code      | A      | B        | C       | D       | E       | W      | T       | R   |
|-----------|--------|----------|---------|---------|---------|--------|---------|-----|
| Dimension | Ø178±2 | Min. Ø50 | Ø13±0.5 | Ø21±0.8 | 2.0±0.5 | 10±1.5 | 0.8±0.2 | 1.0 |

### Carrie Tape Dimensions

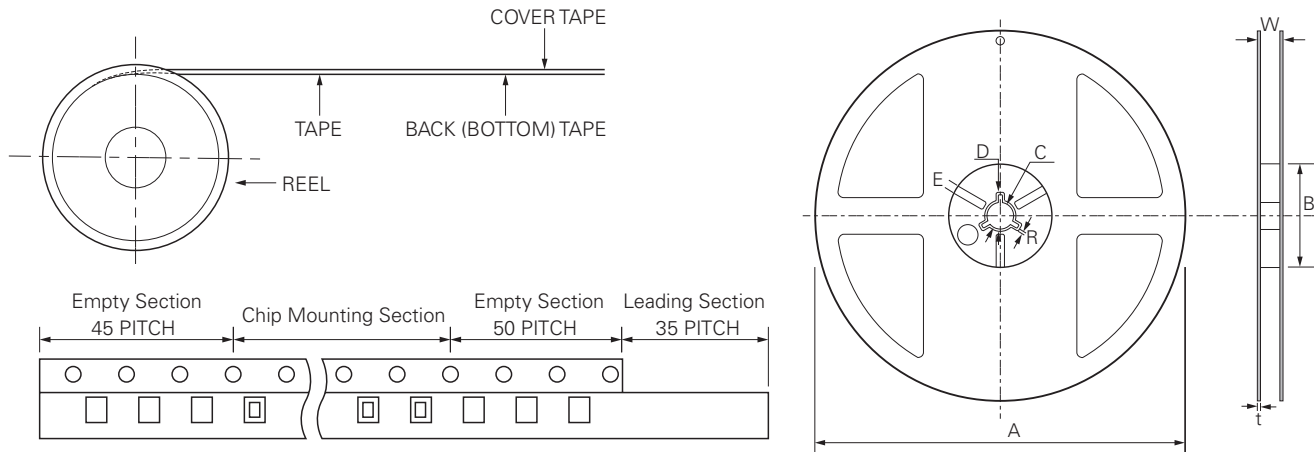
3008mm size



| Symbol | Dimensions  |
|--------|-------------|
|        | Millimeters |
| A      | 1.05±0.05   |
| B      | 3.30±0.05   |
| W      | 8.00±0.10   |
| F      | 3.50±0.05   |
| E      | 1.75±0.05   |
| P1     | 4.00±0.10   |
| P2     | 2.00±0.05   |
| P0     | 4.00±0.10   |
| D      | 1.55±0.03   |
| T      | 0.60±0.05   |

### Tape and Reel Dimension

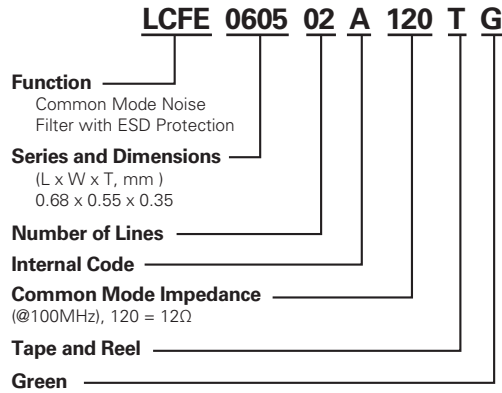
3008mm size



- (1) Reel Materials: Polystyrene (2) Label (3) Taping
- Standard Packing Quantity per Reel (Ø178)
- PE Tape: 4,000pcs

| Code      | A      | B        | C       | D       | E       | W      | T       | R       |
|-----------|--------|----------|---------|---------|---------|--------|---------|---------|
| Dimension | Ø178±2 | Min. Ø50 | Ø13±0.5 | Ø21±0.8 | 3.0±0.5 | 10±1.5 | 1.3±0.2 | 1.0±0.2 |

### Part Numbering System



### Ordering Information

| Part Number                     | Reel Quantity |
|---------------------------------|---------------|
| LCFE0605xxxxxxx/LCFE0806xxxxxxx | 10,000        |
| LCFE1608xxxxxxx/LCFE1210xxxxxxx | 4,000         |
| LCFE2012xxxxxxx/LCFE3008xxxxxxx | 4,000         |

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