

## 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     |
| IR <sub>CR</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     |
| IR <sub>CR</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



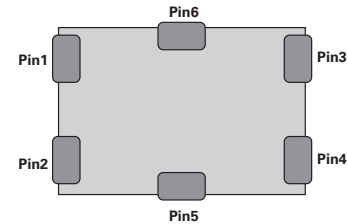
| Item             | Description                      | Source         | Equipment        |
|------------------|----------------------------------|----------------|------------------|
| R <sub>dc</sub>  | Pin 1-4, 2-3                     | 10mA DC Source | Source Meter     |
| CM Impedance     | Pin 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     |
| IR <sub>CR</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     |

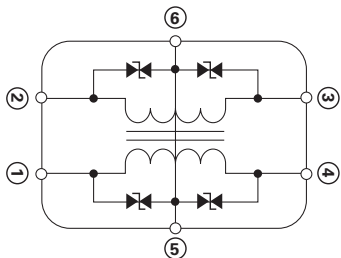
### 2012mm Size (LCFE201204A101TG)



| 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     |

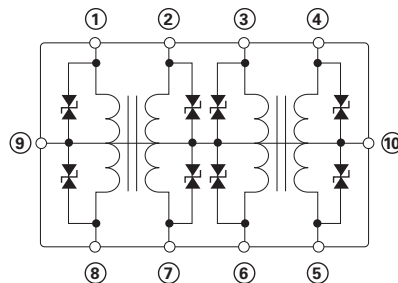
### Functional Block Diagram

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



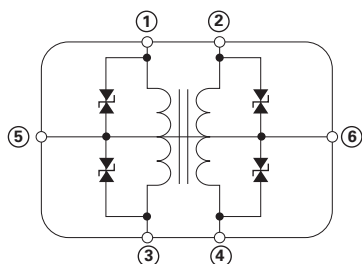
①~④: Data Line; ⑤ and ⑥: Ground

LCFE160804A180TG, LCFE160804A350TG, LCFE160804A550TG,  
LCFE160804A750TG, LCFE160804H101TG, LCFE201204A101TG



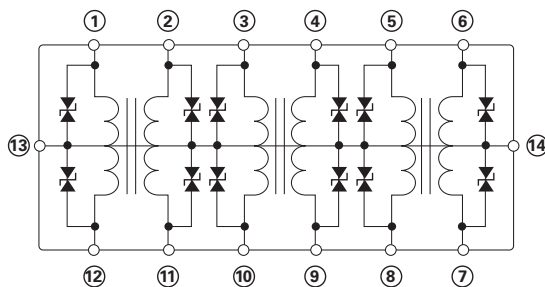
①~⑧: Data Line; ⑨ and ⑩: Ground

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

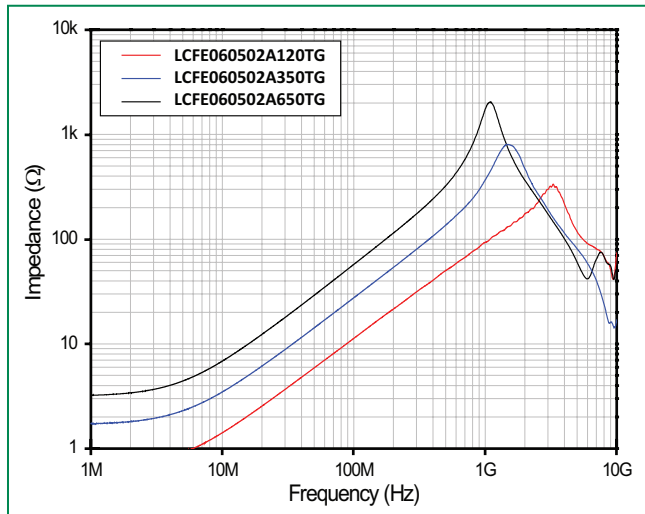
### Electrical Characteristics

| 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                 |

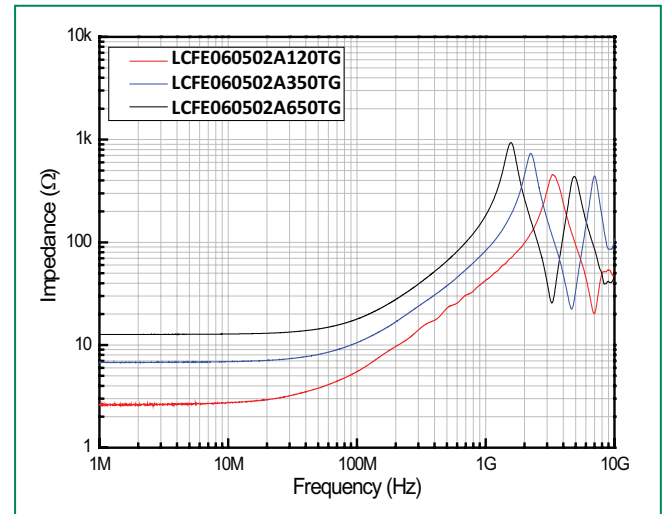
#### Test Conditions

- 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

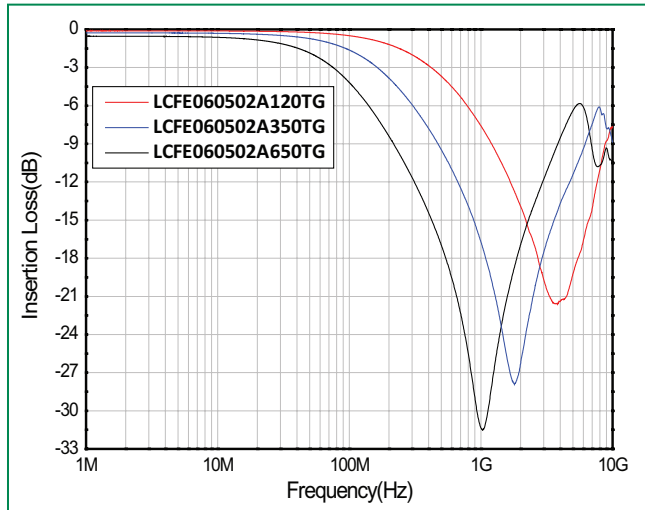
## Impedance Curves - 0605mm Size Common Mode



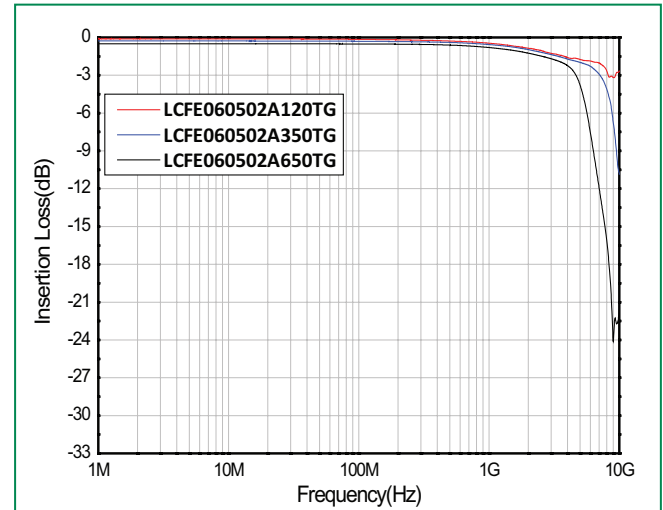
## Differential Mode



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



## Differential Mode S21

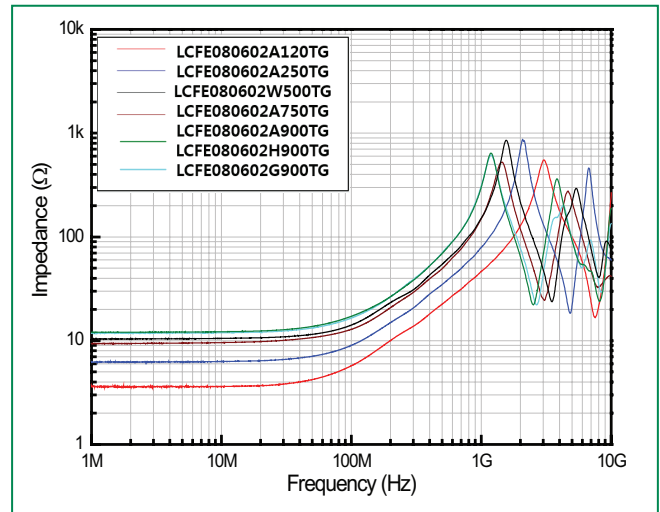


### Impedance Curves - 0806mm Size

#### Common Mode



#### Differential Mode

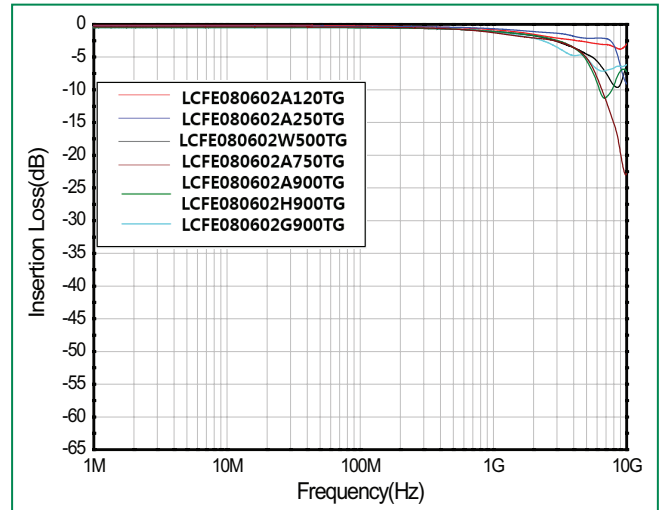


### Transmission Characteristics (S-parameter)

#### Common Mode S21



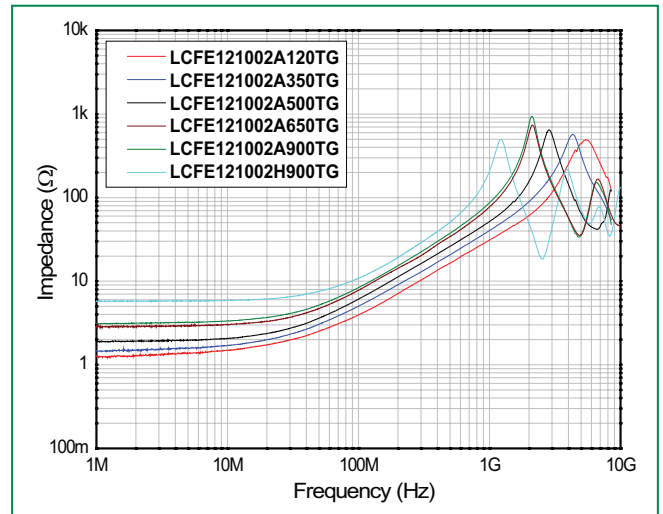
#### Differential Mode S21



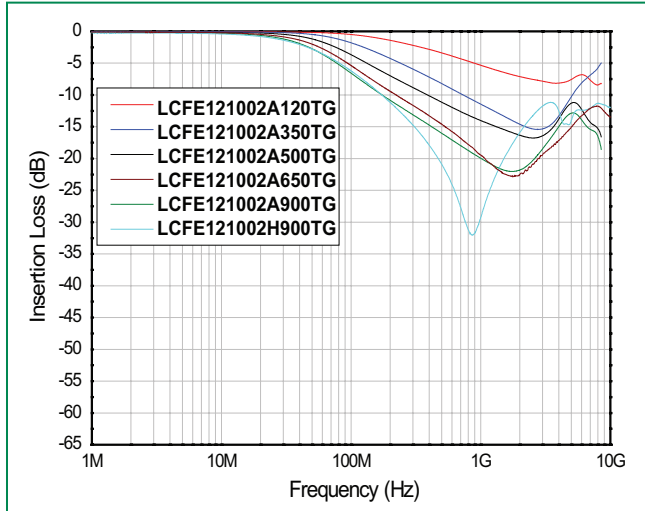
## Impedance Curves - 1210mm Size Common Mode



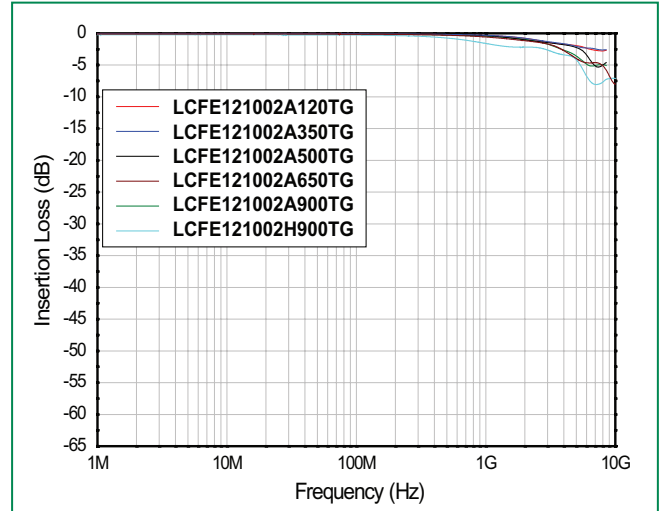
## Differential Mode



## 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

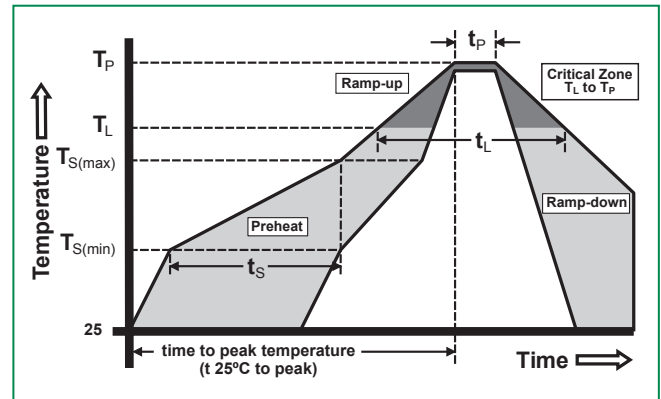


## Soldering Parameters

|                                                        |                                    |                   |
|--------------------------------------------------------|------------------------------------|-------------------|
| 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             |

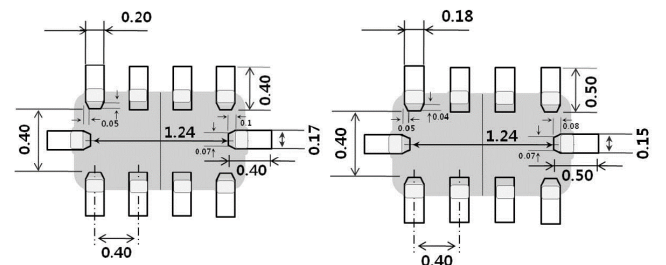
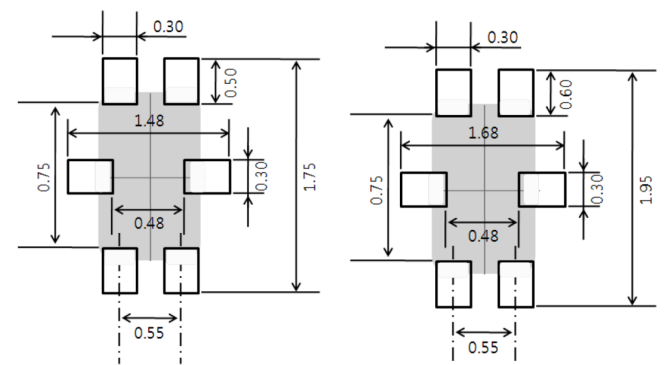
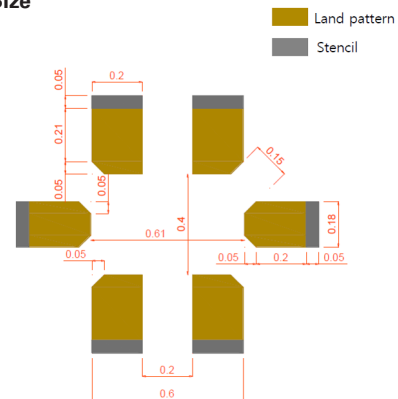
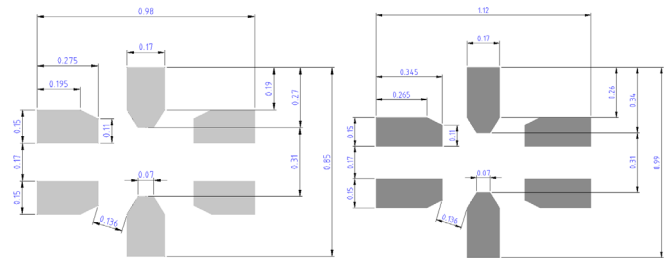
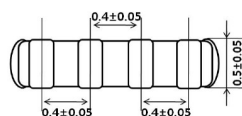
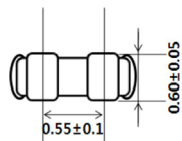
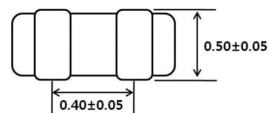
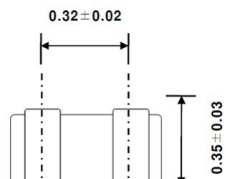
|                |                    |
|----------------|--------------------|
| Wave Soldering | 260°C, 10 sec. max |
|----------------|--------------------|



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

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



#### 2012mm Size (LCFE201204A101TG)



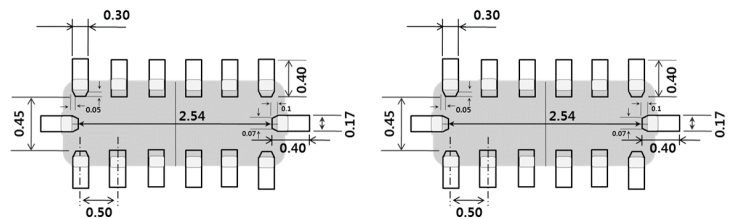
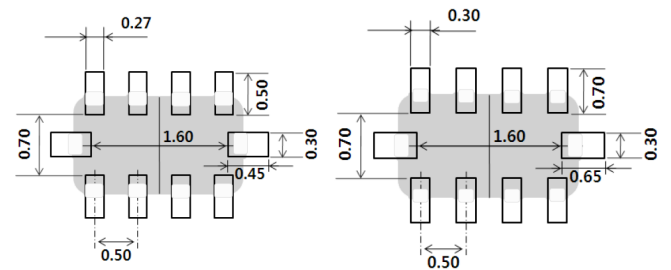
#### 3008mm Size



### Recommended Footprint and Stencil Mask

Unit = mm

Stencil Mask T = 0.10mm



### Carrie Tape Dimensions

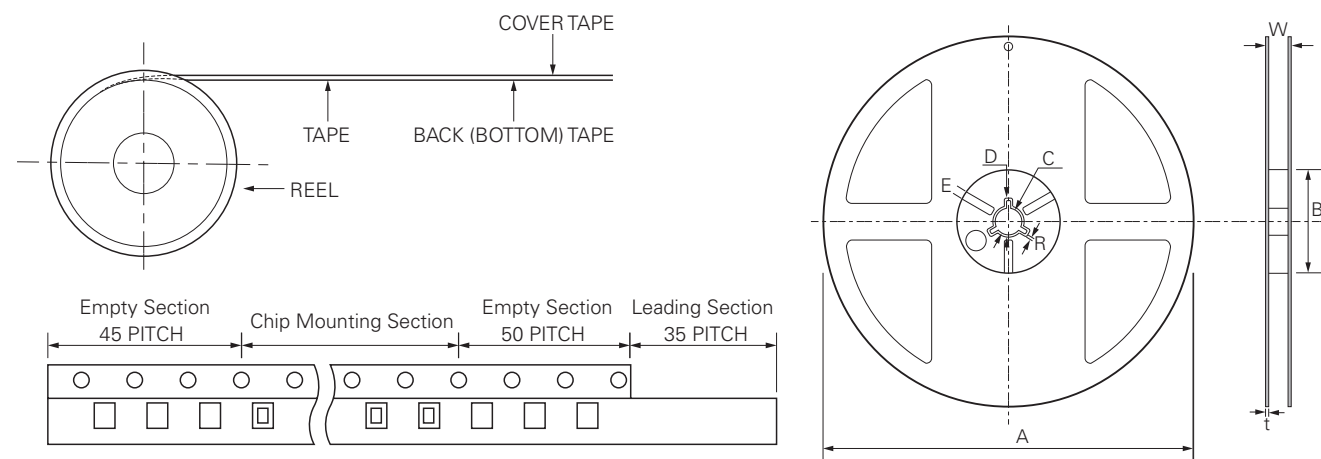
0605mm size



| 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

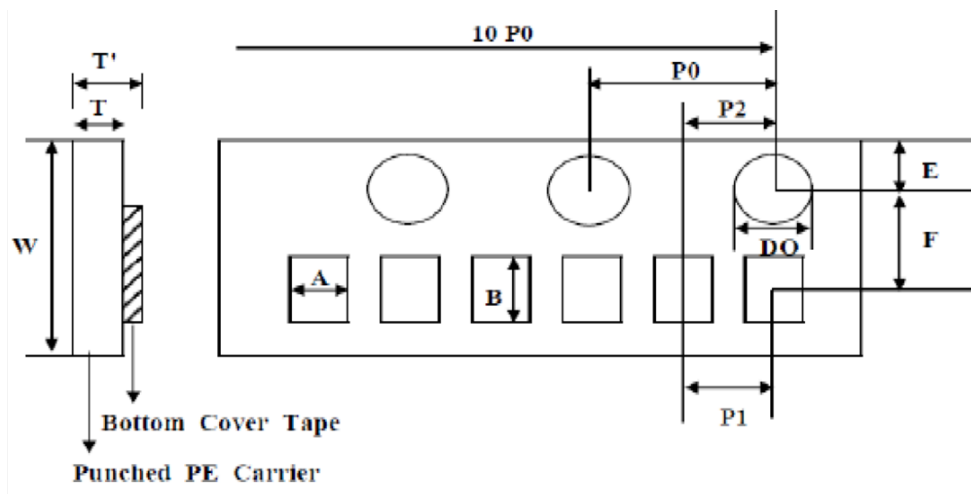


- (1) Reel Materials: Polystyrene (2) Label (3) Taping  
 - Standard Packing Quantity per Reel (Ø178)  
 - PE Tape: 10,000pcs

| 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

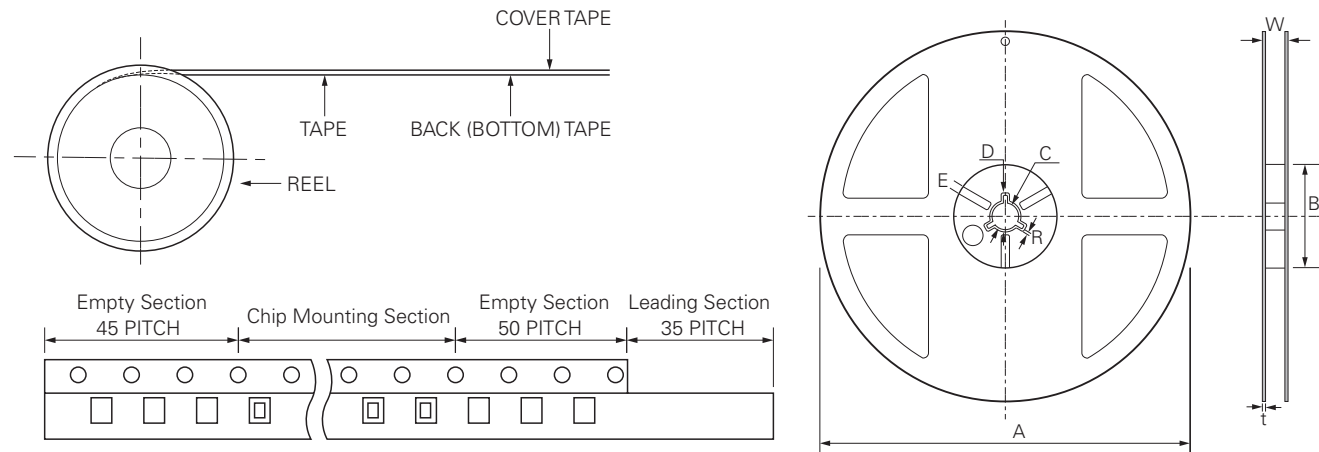
0806mm size



| 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

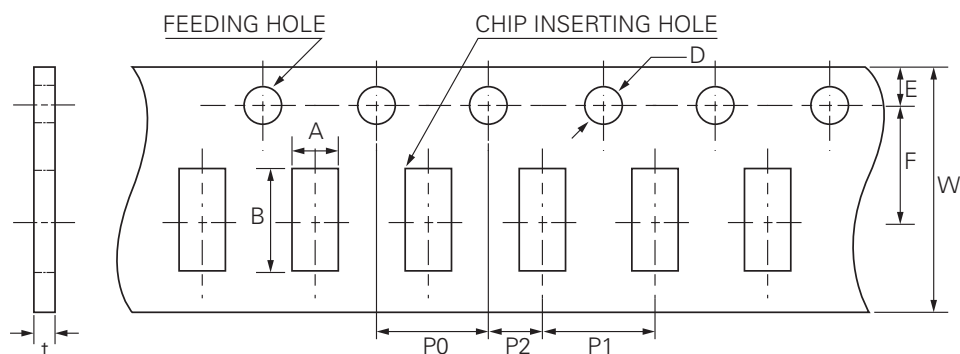


- (1) Reel Materials: Polystyrene (2) Label (3) Taping  
- Standard Packing Quantity per Reel (Ø178)  
- PE Tape: 10,000pcs

| 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

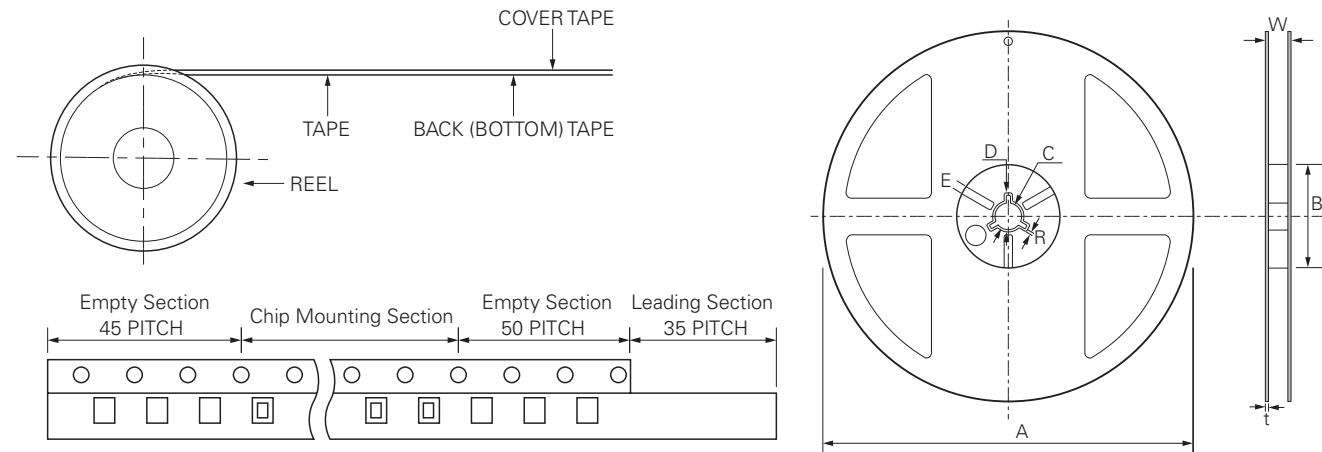
1210mm size



| Symbol | Dimensions<br>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

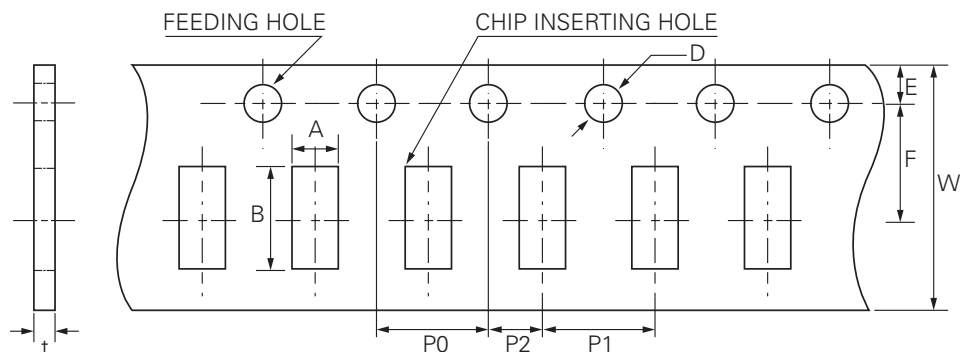


- (1) Reel Materials: Polystyrene (2) Label (3) Taping  
- Standard Packing Quantity per Reel (Ø178)  
- PE Tape: 4,000pcs

| 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

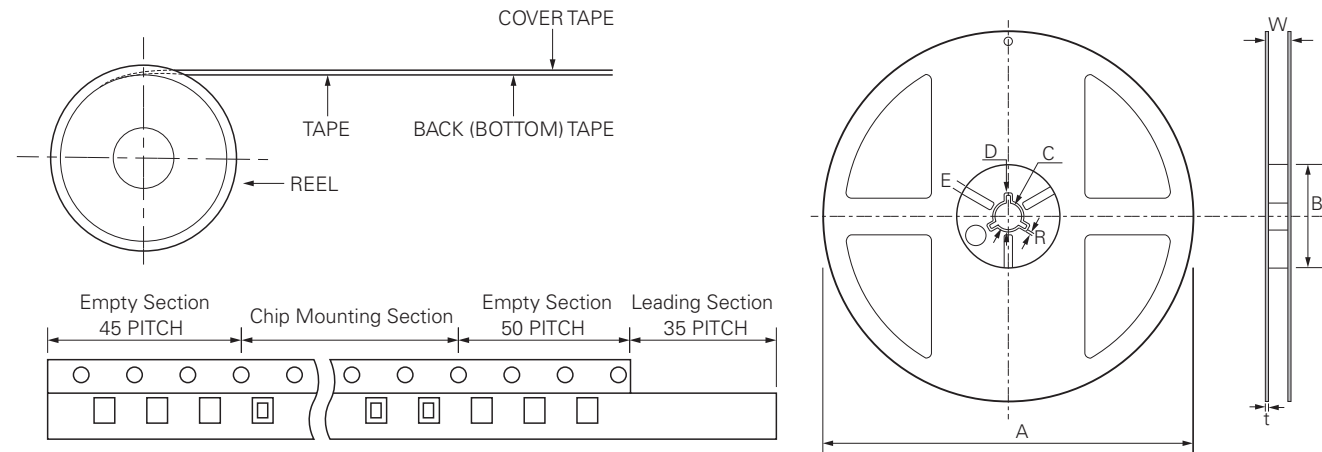
1608mm size



| Symbol | Dimensions<br>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

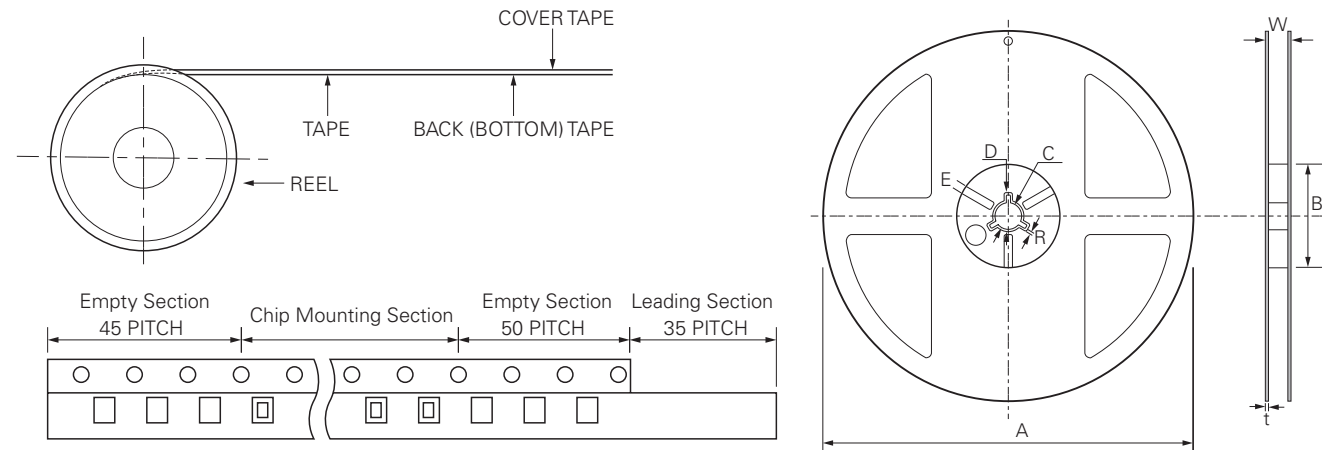
2012mm size



| 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

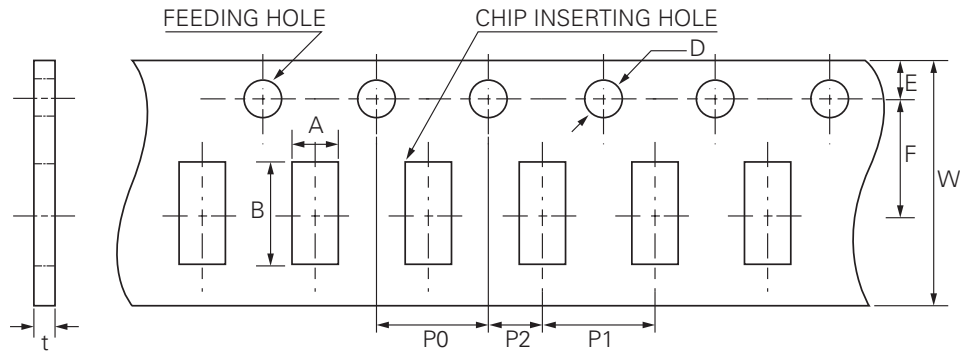


- (1) Reel Materials: Polystyrene (2) Label (3) Taping  
- Standard Packing Quantity per Reel (Ø178)  
- PE Tape: 4,000pcs

| 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

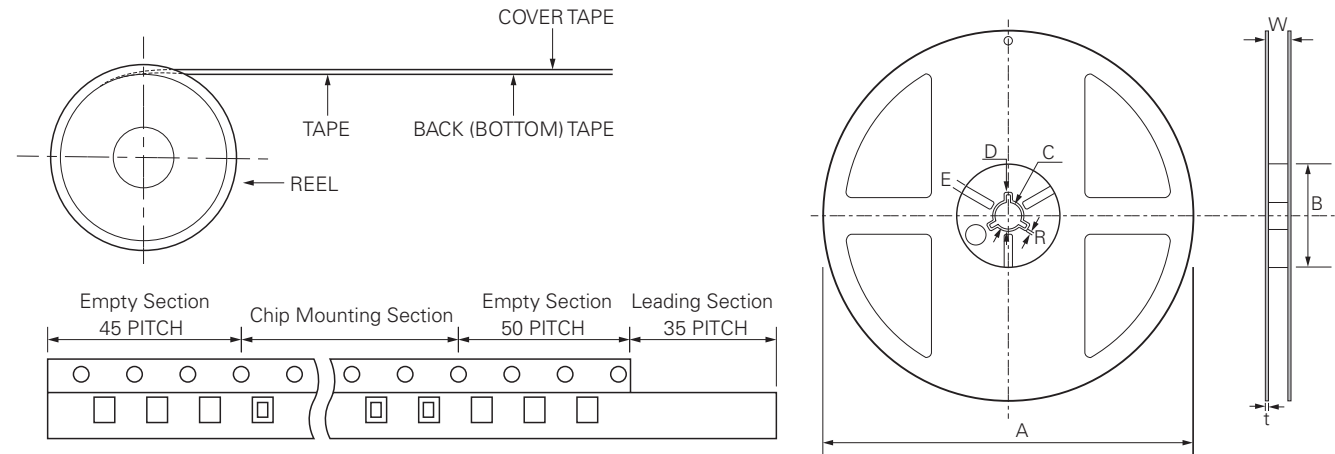
3008mm size



| Symbol | Dimensions<br>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 |
|-----------------------------------|---------------|
| LCFE0605xxxxxxxx/LCFE0806xxxxxxxx | 10,000        |
| LCFE1608xxxxxxxx/LCFE1210xxxxxxxx | 4,000         |
| LCFE2012xxxxxxxx/LCFE3008xxxxxxxx | 4,000         |

**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 [www.littelfuse.com/disclaimer-electronics](http://www.littelfuse.com/disclaimer-electronics).