

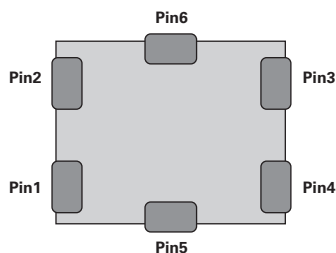
LCFE Series

RoHS



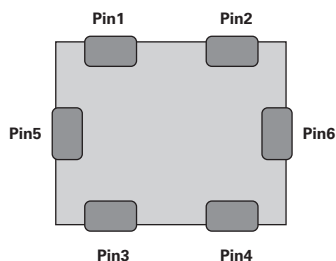
Pinout

0605mm Size



| Item | Description | Source | Equipment |
|-----------------------------|----------------------------------|----------------|------------------|
| R _{dc} | 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 _{R_{CR}} | Pin 1-2 or Pin 3-4 | 5V DC Source | Source Meter |

0806mm Size



| Item | Description | Source | Equipment |
|-----------------------------|----------------------------------|----------------|------------------|
| R _{dc} | 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 _{R_{CR}} | 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.

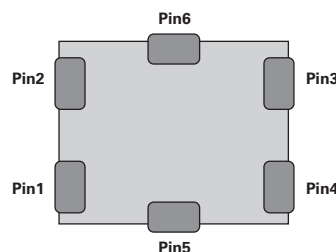
Features

- 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

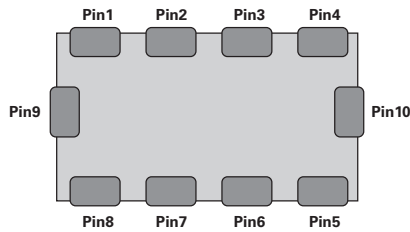
- Mobile Phone and Tablet
- USB 3.1 Gen 1 and 2 (5 and 10Gbps) with Type C
- Display Port 1.2 (5.4Gbps)
- HDMI 2.0 (6.0Gbps)
- MDDI, MIPI, MHL
- Portable/Wearable Devices
- Game console, POS, VR, Dongle
- Consumer Products
- PDP, LCD TV, DVD Player, PC, Audio player, DSC, Set top box, Laptop, SSD, Home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

1210mm Size



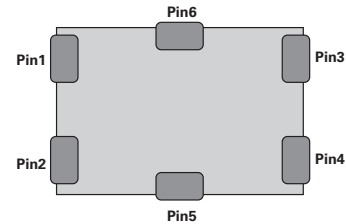
| Item | Description | Source | Equipment |
|-----------------------------|----------------------------------|----------------|------------------|
| R _{dc} | Pin 1-4, 2-3 | 10mA DC Source | Source Meter |
| CM Impedance | Pin 1-2(Short) to Pin 3-4(Short) | 500mV | LCR Meter (3GHz) |
| IL | Pin 5 or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

1608mm Size



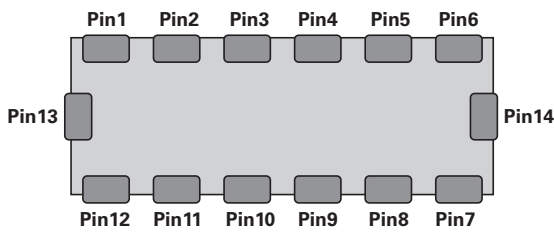
| Item | Description | Source | Equipment |
|--------------|--|----------------|------------------|
| Rdc | Pin 1-8, 2-7, 3-6, 4-5 | 10mA DC Source | Source Meter |
| CM Impedance | Pin 1-2(Short) to Pin 8-7(Short) Pin 3-4(Short) to Pin 6-5(Short) | 500mV | LCR Meter (3GHz) |
| IL | Pin 9 or 10 to Pin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

2012mm Size (LCFE201202A900TG, LCFE201202A121TG)



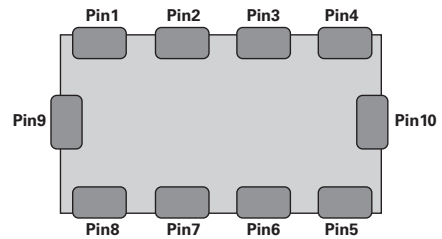
| Item | Description | Source | Equipment |
|------------------|----------------------------------|----------------|------------------|
| Rdc | Pin 1-3, 2-4 | 10mA DC Source | Source Meter |
| CM Impedance | Pin 1-2(Short) to Pin 3-4(Short) | 500mV | LCR Meter (3GHz) |
| IL | Pin 5 or 6 to Pin 1,2,3,4 | 5V DC Source | Source Meter |
| IR _{CR} | 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) Pin 3-4(Short) to Pin 10-9(Short) 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 |

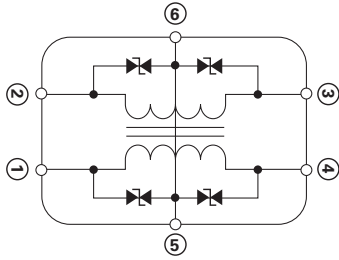
2012mm Size (LCFE201204A101TG)



| 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) 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 |

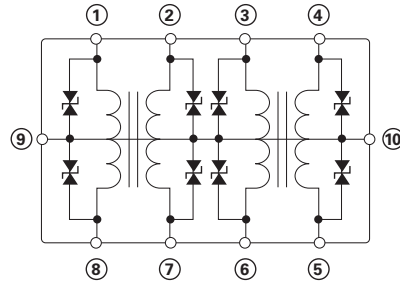
Functional Block Diagram

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



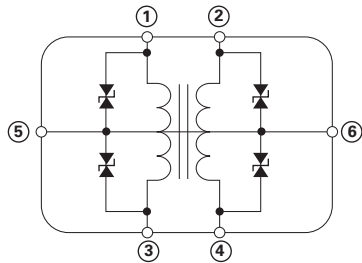
①~④: Data Line; ⑤ and ⑥:Ground

LCFE160804A180TG, LCFE160804A350TG, LCFE160804A550TG,
LCFE160804A750TG, LCFE160804H101TG, LCFE201204A101TG



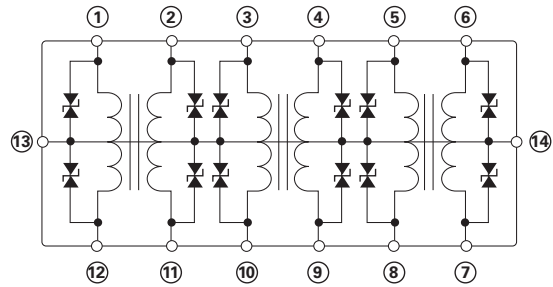
①~⑧: Data Line; ⑨ and ⑩:Ground

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

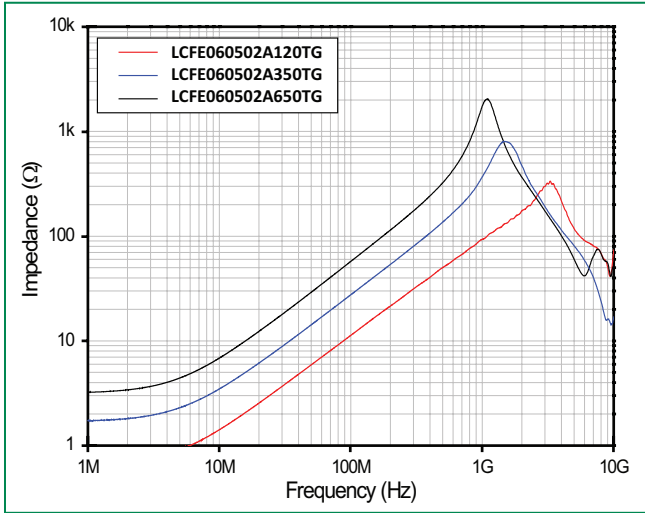
Electrical Characteristics

| 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 (μ A) Max. | Capacitance (pF) | Insulation Resistance (M Ω) Min. | Rated Voltage (V) |
|------------------|-----------|-------------|------------------------------------|-------------------------|-------------------|---------------------------------|-----------------|---------------------------------|------------------|--|-------------------|
| LCFE060502A120TG | 0605 | 0202 | 12(\pm 30%) | 100 | 14.1 | 3.0 | 2 | 1.0 | 1.2 | 10 | 5 |
| LCFE060502A350TG | 0605 | 0202 | 35(\pm 25%) | 50 | 7.09 | 5.5 | 2 | 1.0 | 1.7 | 10 | 5 |
| LCFE060502A650TG | 0605 | 0202 | 65(\pm 25%) | 50 | 4.76 | 8.0 | 2 | 1.0 | 1.7 | 10 | 5 |
| LCFE080602A120TG | 0806 | 0302 | 12(\pm 30%) | 100 | 7.38 | 5.0 | 2 | 1.0 | 1.7 | 10 | 5 |
| LCFE080602A250TG | 0806 | 0302 | 25(\pm 25%) | 100 | 7.97 | 5.0 | 2 | 1.0 | 1.7 | 10 | 5 |
| LCFE080602W500TG | 0806 | 0302 | 50(\pm 25%) | 100 | 3.60 | 7.0 | 2 | 1.0 | 1.7 | 10 | 5 |
| LCFE080602A750TG | 0806 | 0302 | 75(\pm 25%) | 100 | 3.80 | 6.0 | 2 | 1.0 | 1.7 | 10 | 5 |
| LCFE080602A900TG | 0806 | 0302 | 90(\pm 25%) | 100 | 3.80 | 6.0 | 2 | 1.0 | 1.7 | 10 | 5 |
| LCFE080602H900TG | 0806 | 0302 | 90(\pm 25%) | 100 | 3.74 | 8.0 | 2 | 1.0 | 2.0 | 10 | 5 |
| LCFE080602G900TG | 0806 | 0302 | 90(\pm 25%) | 100 | 2.82 | 8.0 | 2 | 1.0 | 2.0 | 10 | 5 |
| LCFE121002A120TG | 1210 | 0504 | 12(\pm 30%) | 100 | 9.02 | 4.0 | 2 | 1.0 | 1.7 | 10 | 5 |
| LCFE121002A350TG | 1210 | 0504 | 35(\pm 25%) | 100 | 6.38 | 4.0 | 2 | 1.0 | 1.7 | 10 | 5 |
| LCFE121002A500TG | 1210 | 0504 | 50(\pm 25%) | 100 | 4.96 | 4.0 | 2 | 1.0 | 1.7 | 10 | 5 |
| LCFE121002A650TG | 1210 | 0504 | 65(\pm 25%) | 100 | 4.30 | 4.0 | 2 | 1.0 | 1.7 | 10 | 5 |
| LCFE121002A900TG | 1210 | 0504 | 90(\pm 25%) | 100 | 4.57 | 4.0 | 2 | 1.0 | 1.7 | 10 | 5 |
| LCFE121002H900TG | 1210 | 0504 | 90(\pm 25%) | 100 | 3.90 | 6.0 | 2 | 1.0 | 1.7 | 10 | 5 |
| LCFE160804A180TG | 1608 | 0603 | 18(\pm 30%) | 100 | 10.35 | 6.0 | 4 | 1.0 | 1.7 | 10 | 5 |
| LCFE160804A350TG | 1608 | 0603 | 35(\pm 30%) | 100 | 7.20 | 6.0 | 4 | 1.0 | 1.7 | 10 | 5 |
| LCFE160804A550TG | 1608 | 0603 | 55(\pm 25%) | 100 | 4.09 | 6.0 | 4 | 1.0 | 2.0 | 10 | 5 |
| LCFE160804A750TG | 1608 | 0603 | 75(\pm 25%) | 100 | 4.91 | 6.0 | 4 | 1.0 | 1.7 | 10 | 5 |
| LCFE160804H101TG | 1608 | 0603 | 100(\pm 25%) | 100 | 3.96 | 8.0 | 4 | 1.0 | 2.0 | 10 | 5 |
| LCFE201202A900TG | 2012 | 0805 | 90(\pm 25%) | 100 | 3.38 | 4.0 | 2 | 1.0 | 1.7 | 10 | 5 |
| LCFE201202A121TG | 2012 | 0805 | 120(\pm 25%) | 100 | 3.62 | 4.0 | 2 | 1.0 | 1.7 | 10 | 5 |
| LCFE201204A101TG | 2012 | 0805 | 100(\pm 25%) | 100 | 4.22 | 4.0 | 4 | 1.0 | 1.7 | 10 | 5 |
| LCFE300806A750TG | 3008 | 1203 | 75(\pm 25%) | 100 | 4.51 | 6.0 | 6 | 1.0 | 2.0 | 10 | 5 |

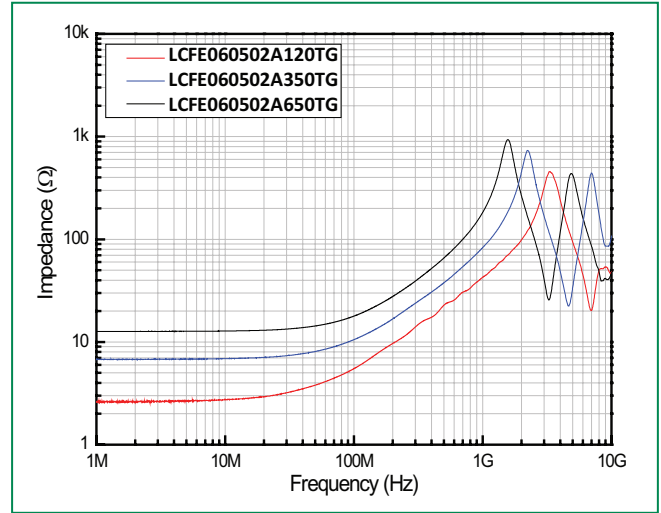
Test Conditions

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

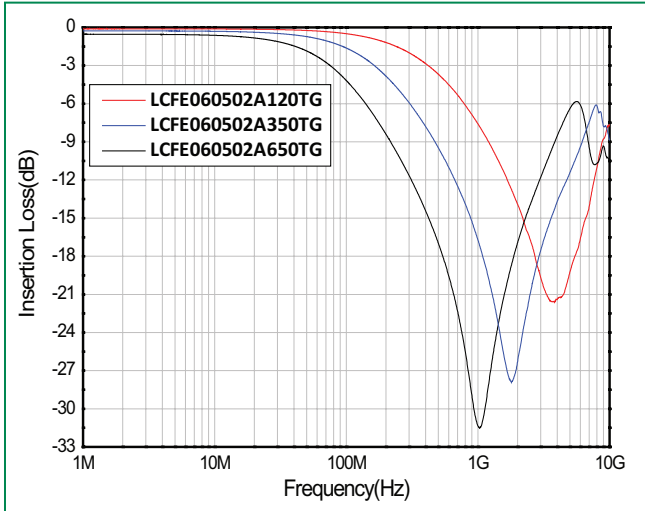
Impedance Curves - 0605mm Size
Common Mode



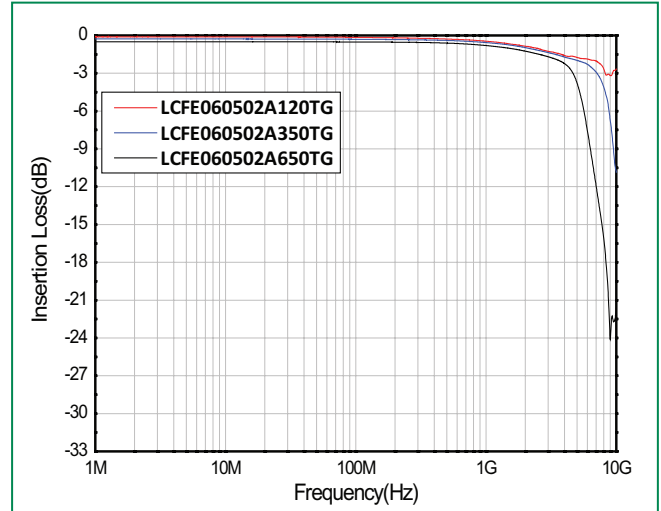
Differential Mode



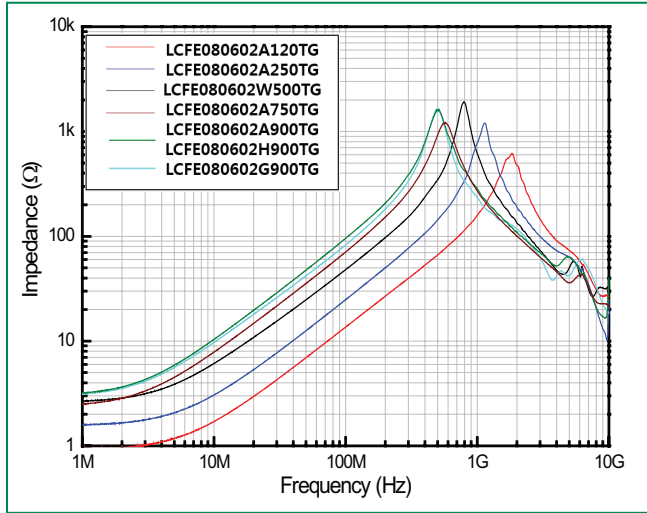
Transmission Characteristics (S-parameter)
Common Mode S21



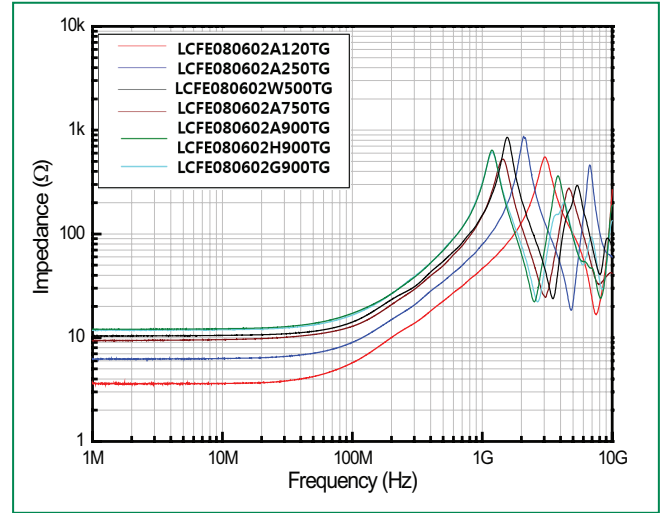
Differential Mode S21



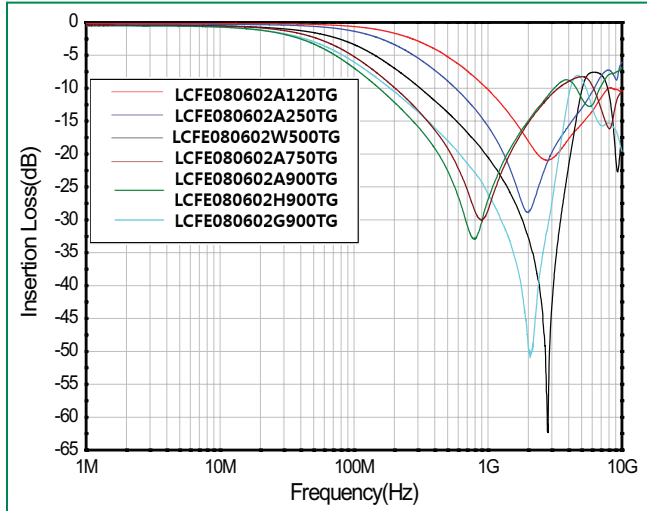
**Impedance Curves - 0806mm Size
Common Mode**



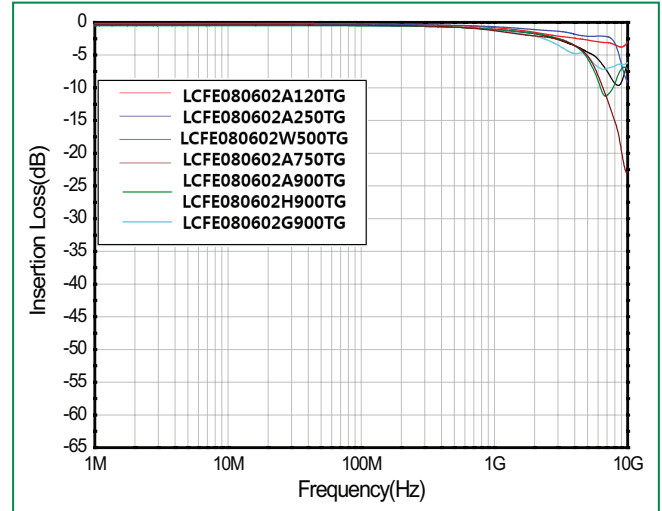
Differential Mode



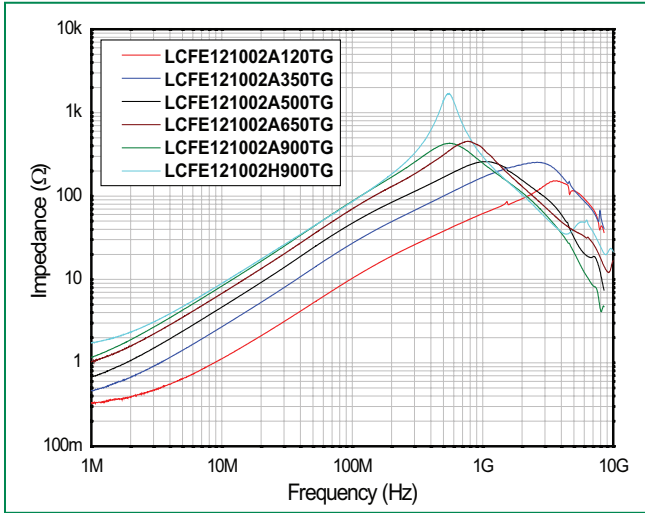
**Transmission Characteristics (S-parameter)
Common Mode S21**



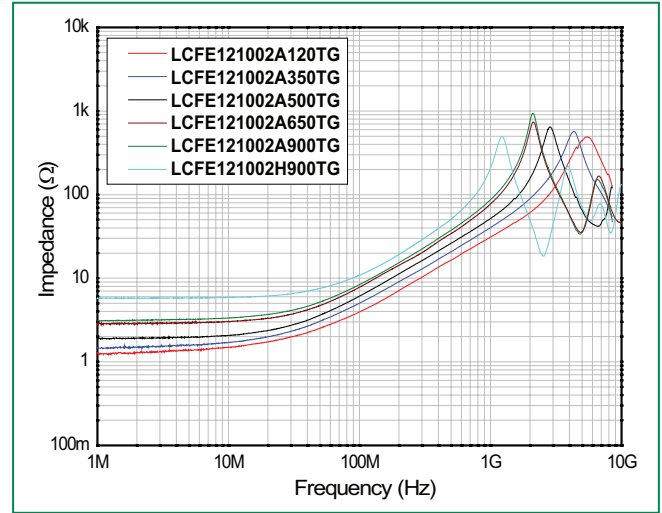
Differential Mode S21



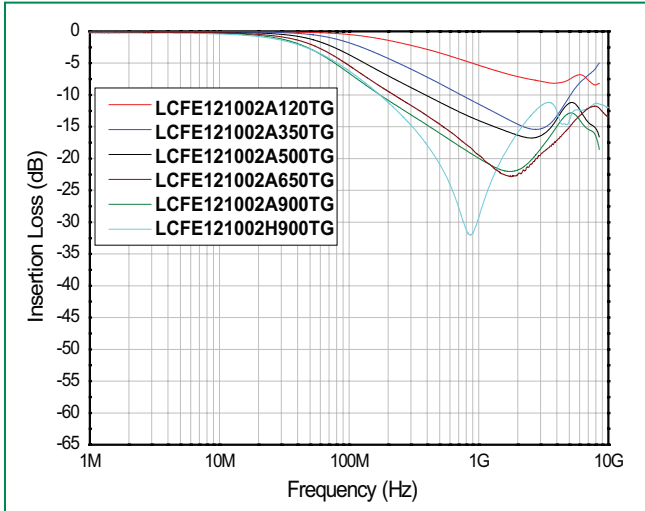
Impedance Curves - 1210mm Size
Common Mode



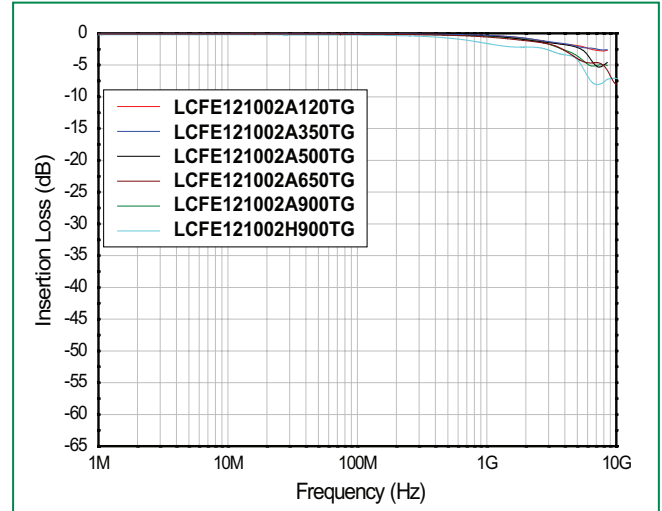
Differential Mode



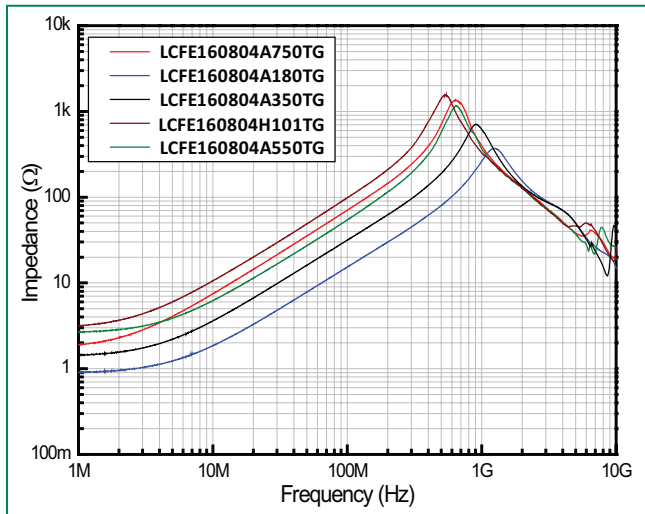
Transmission Characteristics (S-parameter)
Common Mode S21



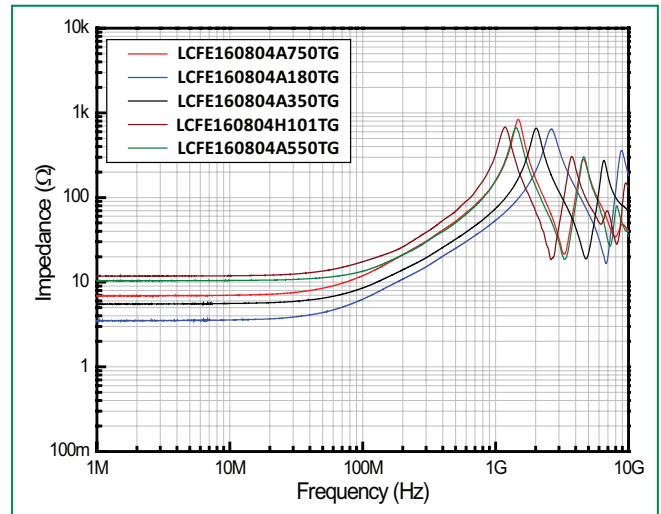
Differential Mode S21



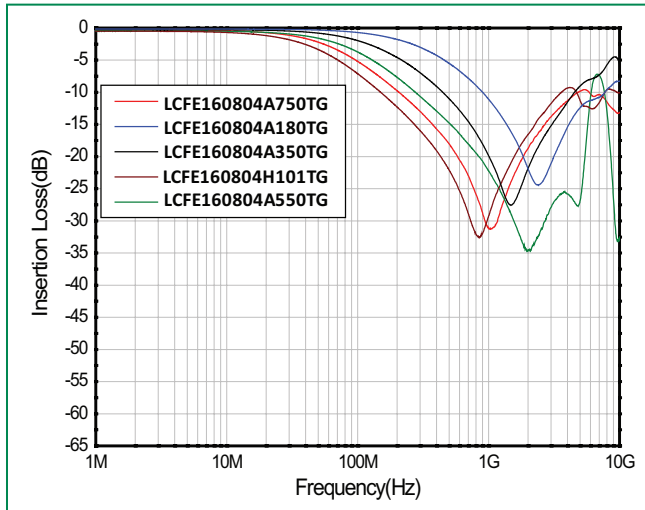
Impedance Curves - 1608mm Size Common Mode



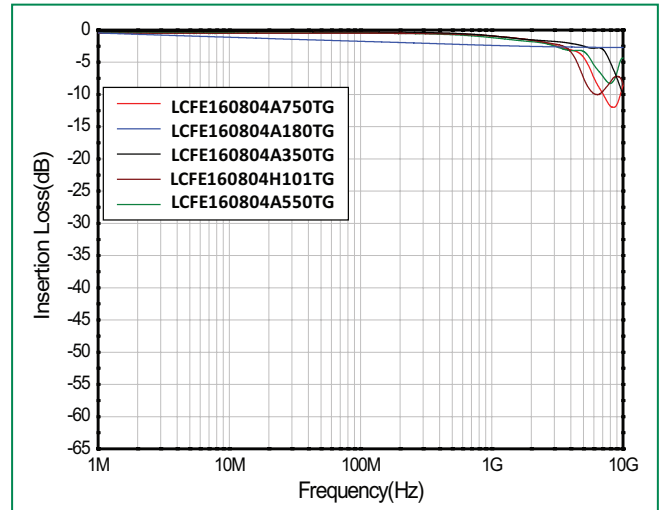
Differential Mode



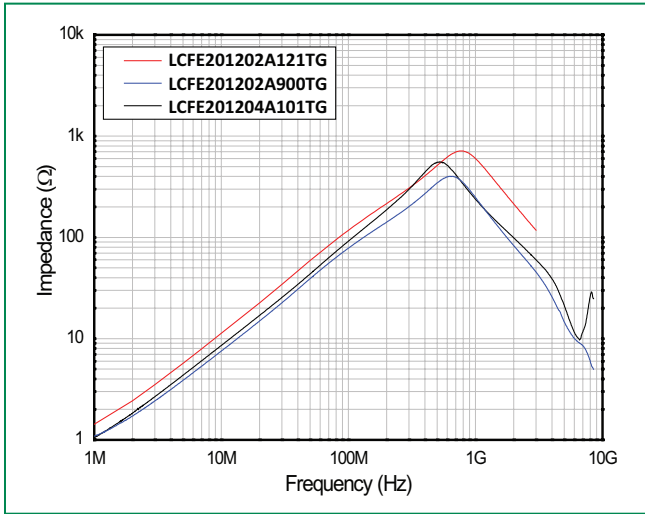
Transmission Characteristics (S-parameter) Common Mode S21



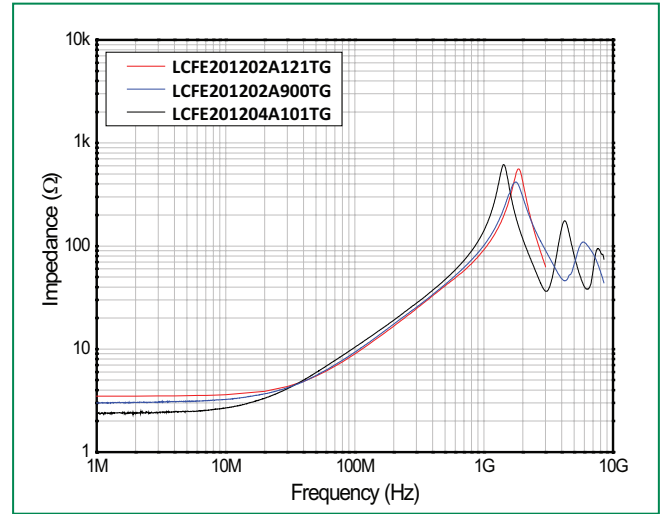
Differential Mode S21



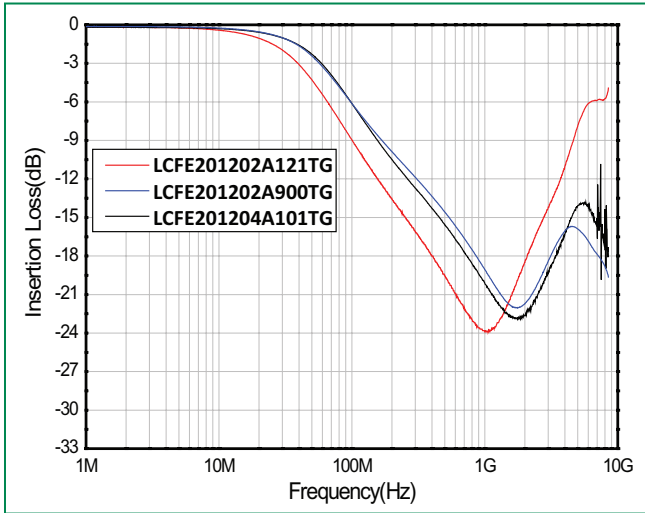
Impedance Curves - 2012mm Size
Common Mode



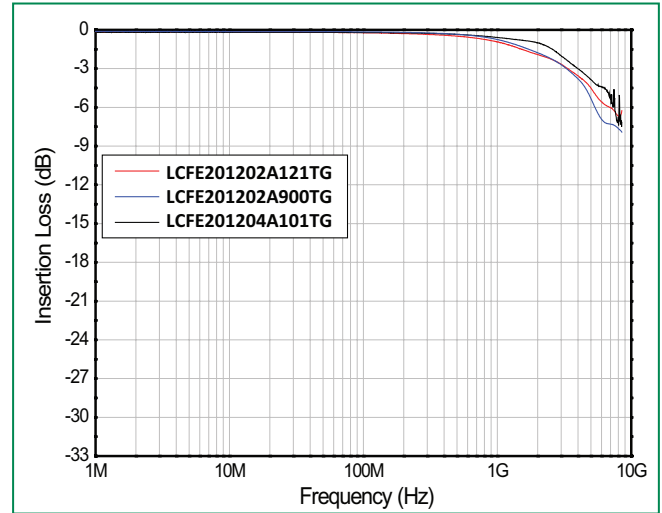
Differential Mode



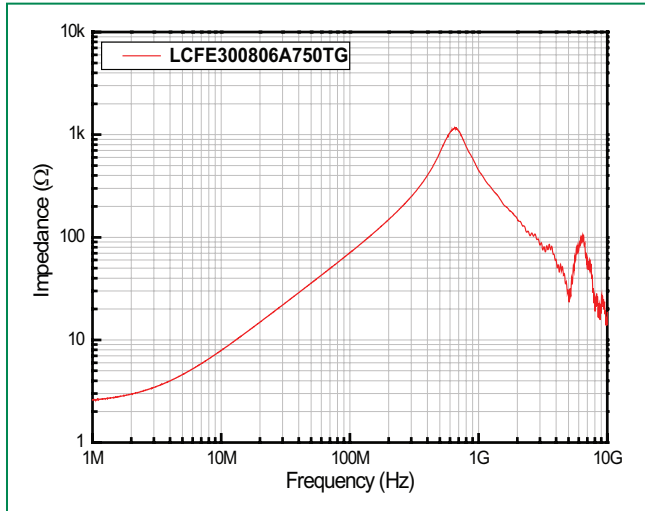
Transmission Characteristics (S-parameter)
Common Mode S21



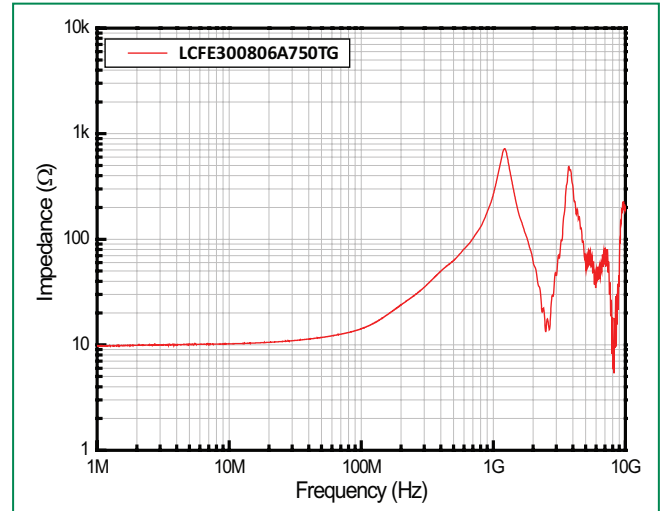
Differential Mode S21



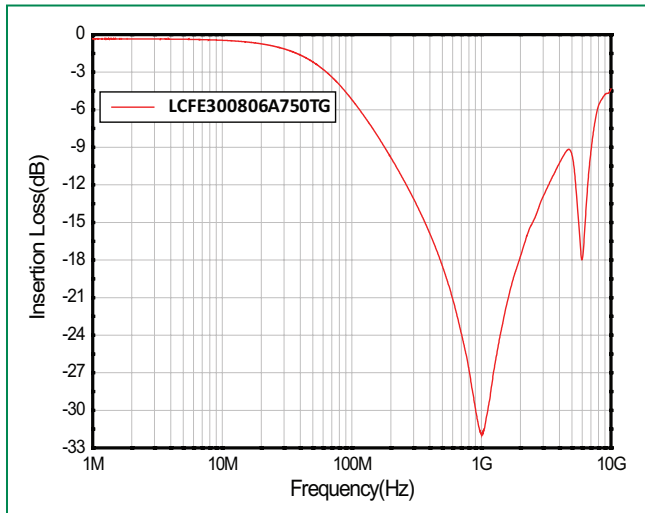
**Impedance Curves - 3008mm Size
Common Mode**



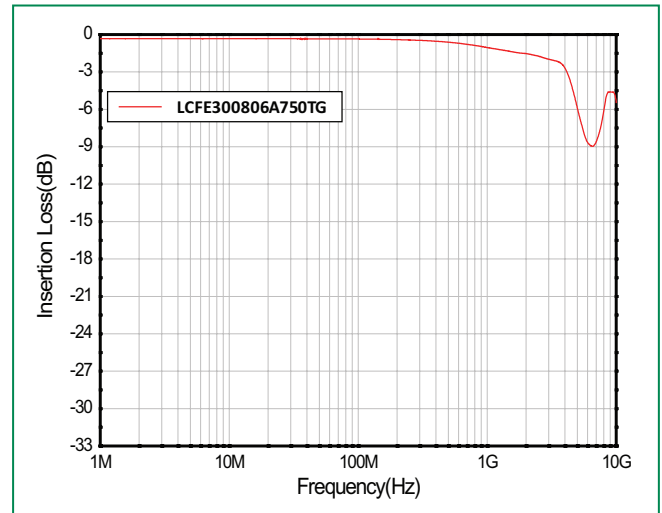
Differential Mode



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

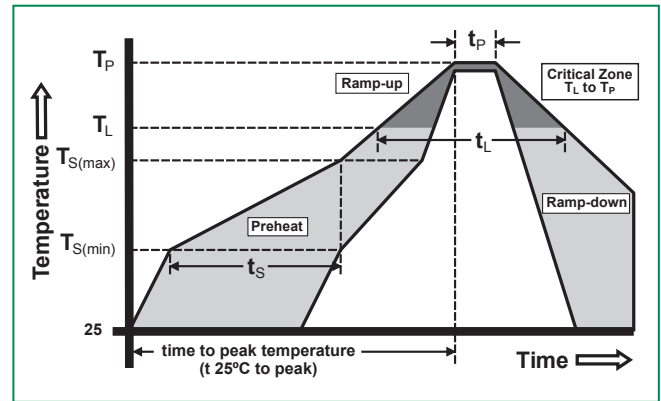


Differential Mode S21



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)

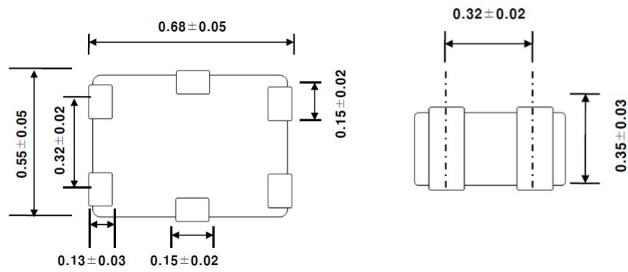
Product Characteristics

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

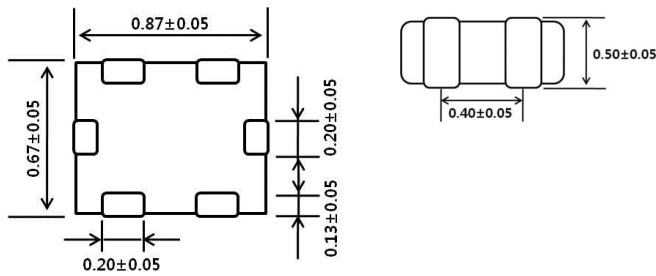
Dimensions

Unit = mm

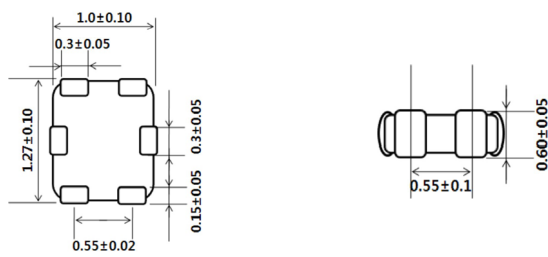
0605mm Size



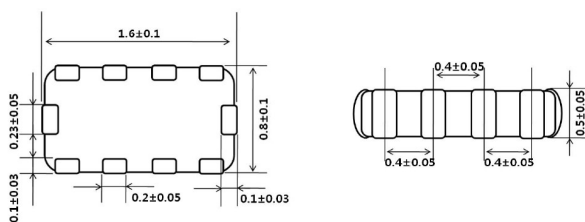
0806mm Size



1210mm Size



1608mm Size

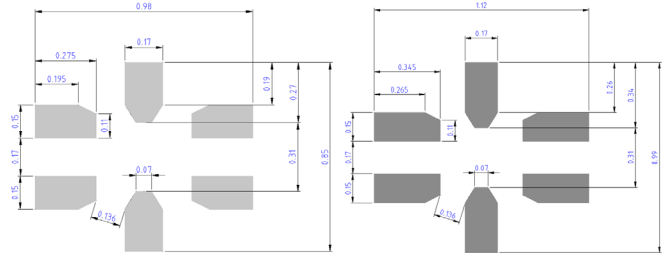


Recommended Footprint and Stencil Mask

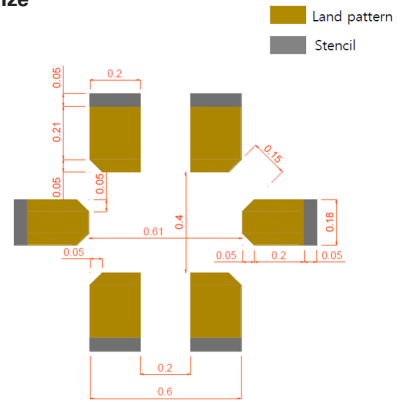
Unit = mm

Stencil Mask T = 0.10mm

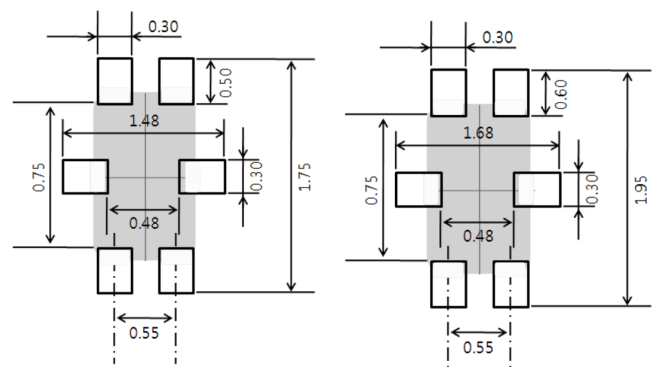
0605mm Size



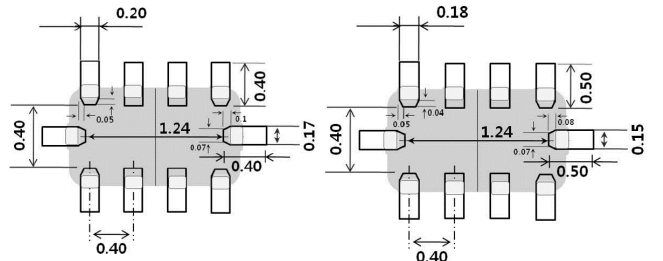
0806mm Size



1210mm Size



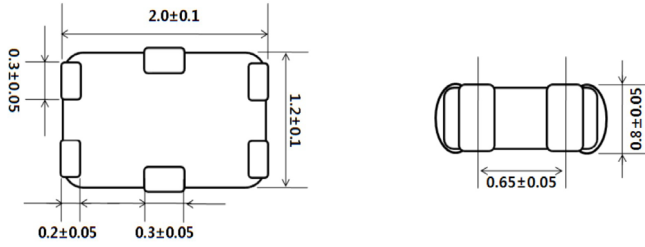
1608mm Size



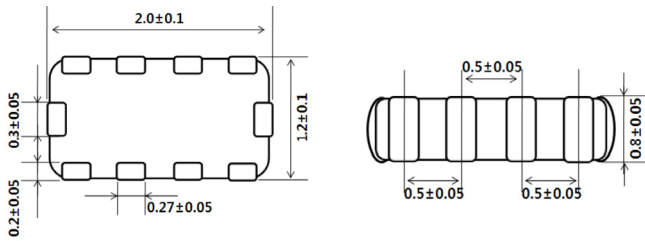
Dimensions

Unit = mm

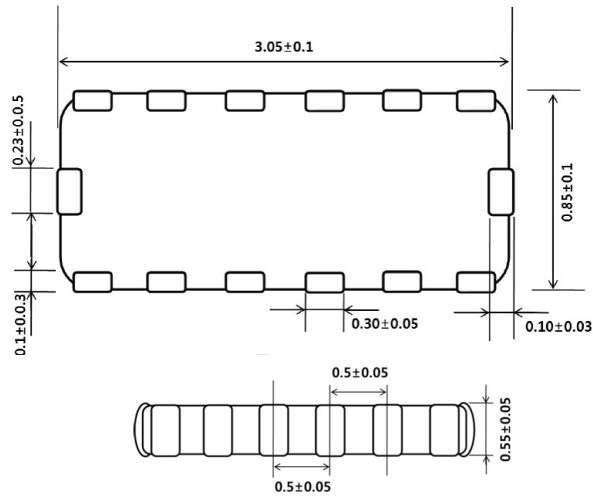
2012mm Size (LCFE201202A900TG, LCFE201202A121TG)



2012mm Size (LCFE201204A101TG)



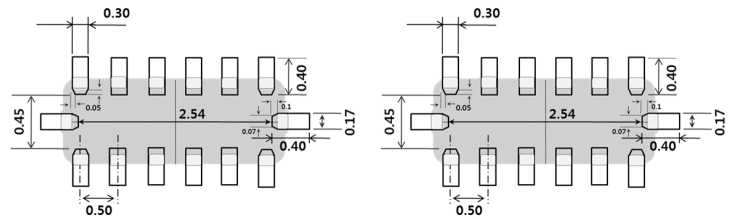
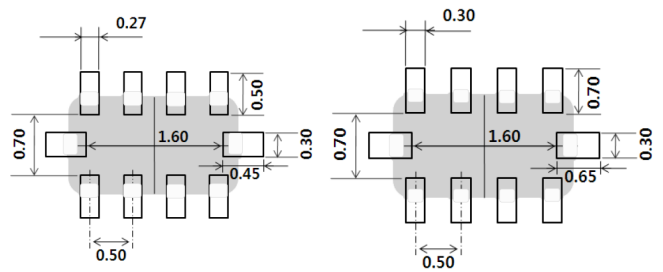
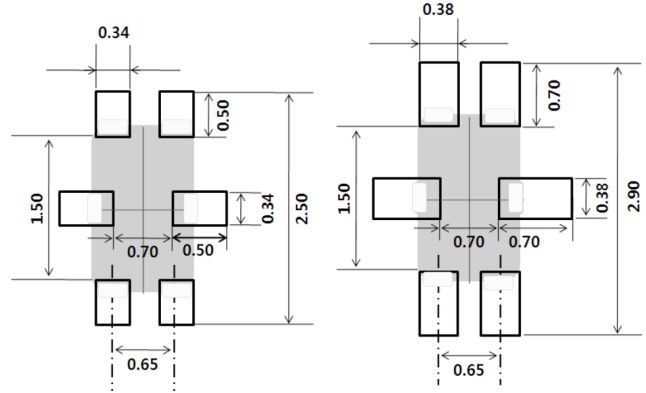
3008mm Size



Recommended Footprint and Stencil Mask

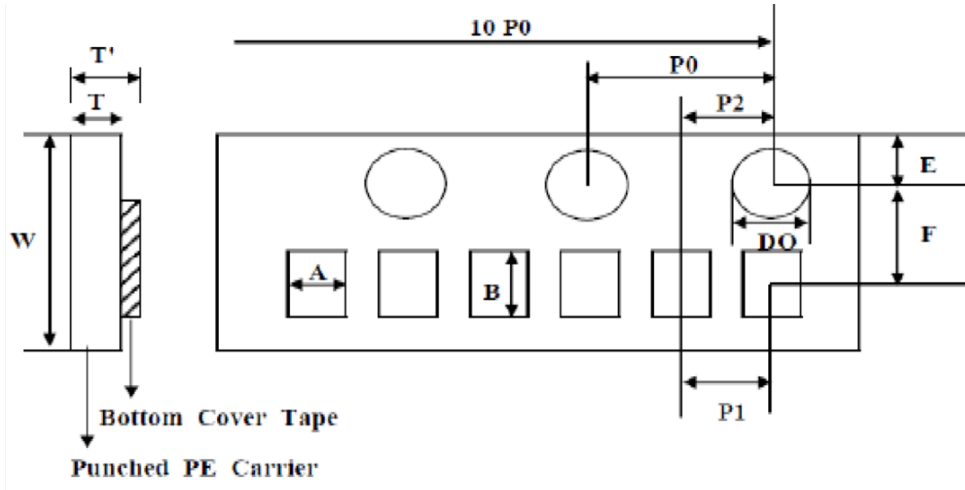
Unit = mm

Stencil Mask T = 0.10mm



Carrie Tape Dimensions

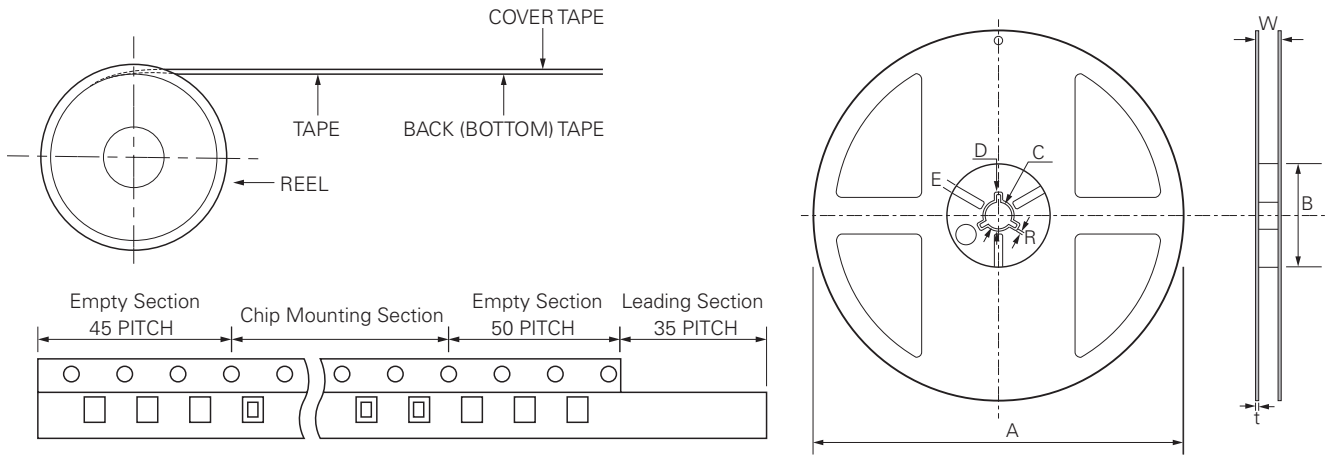
0605mm size



| 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

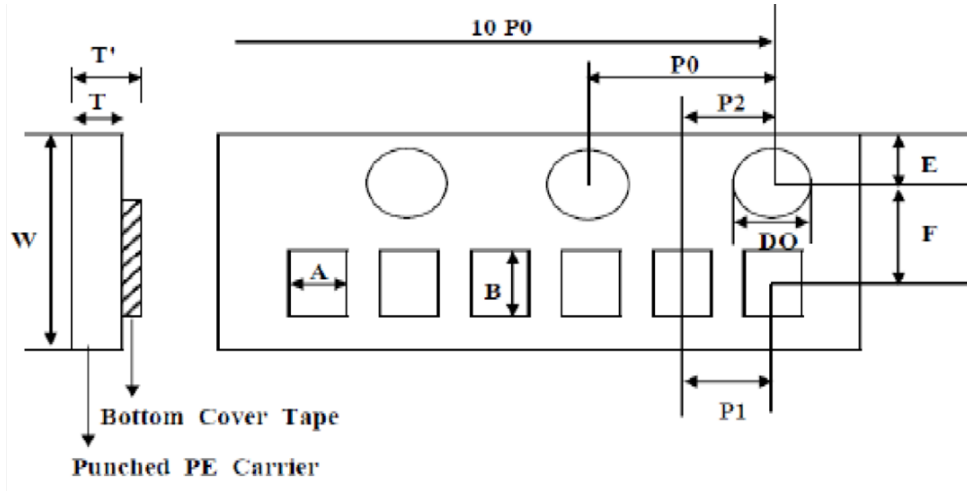


- (1) Reel Materials: Polystyrene (2) Label (3) Taping
 - Standard Packing Quantity per Reel (Ø178)
 - PE Tape: 10,000pcs

| 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

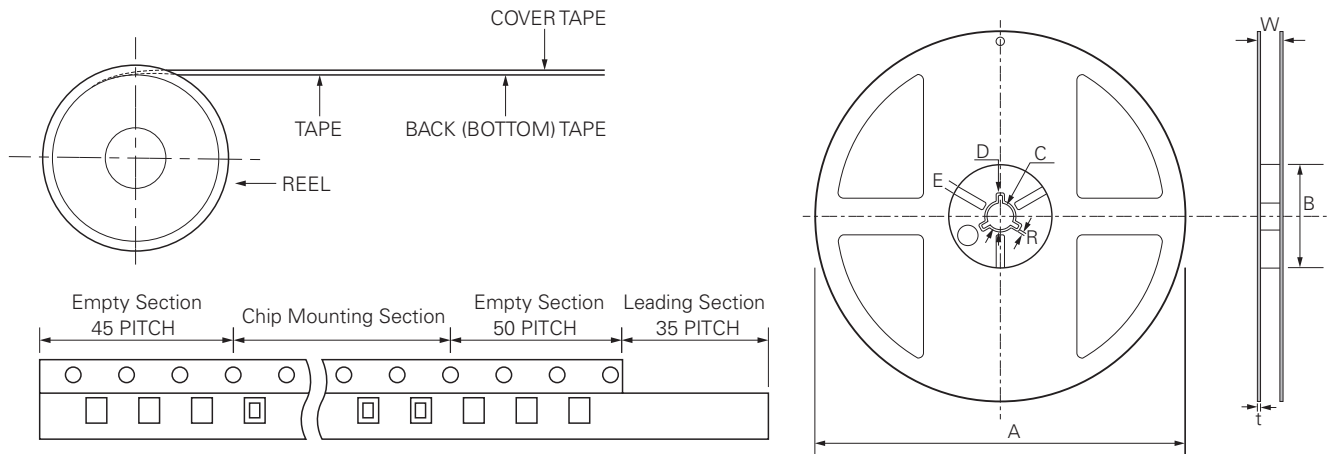
0806mm size



| 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

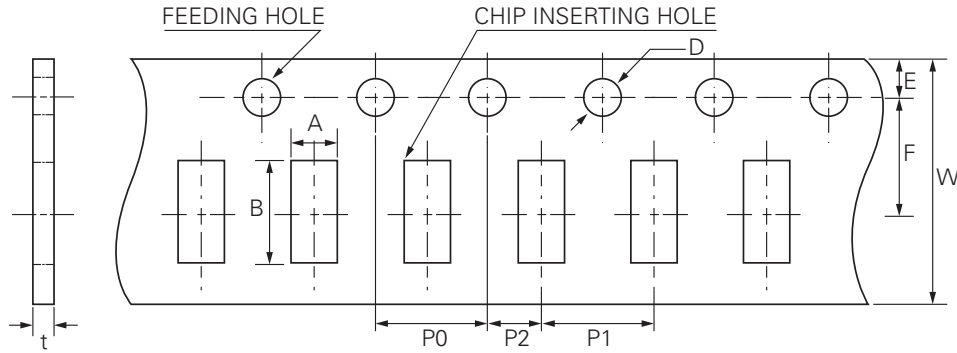


- (1) Reel Materials: Polystyrene (2) Label (3) Taping
- Standard Packing Quantity per Reel (Ø178)
- PE Tape: 10,000pcs

| 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

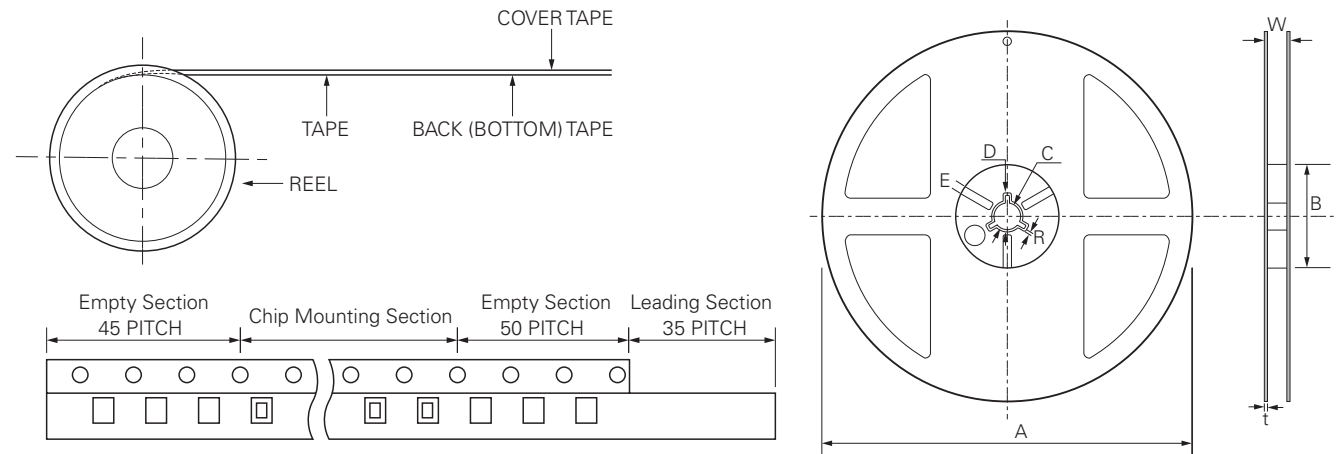
1210mm size



| 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

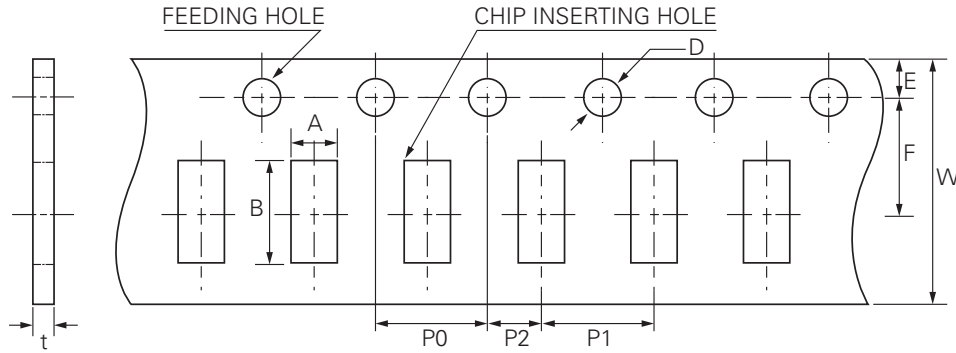


- (1) Reel Materials: Polystyrene (2) Label (3) Taping
 - Standard Packing Quantity per Reel (Ø178)
 - PE Tape: 4,000pcs

| 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

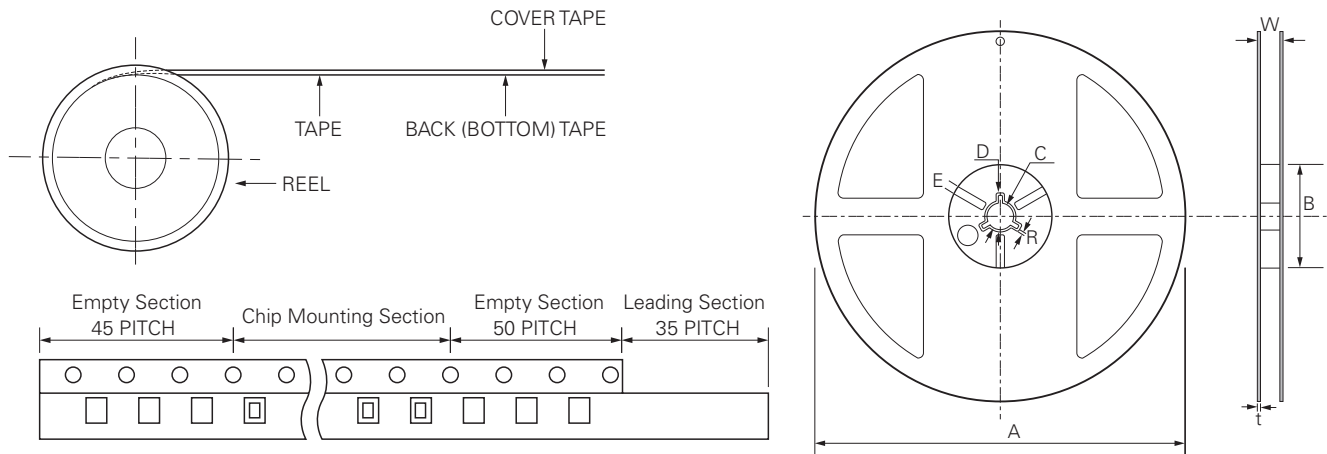
1608mm size



| 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

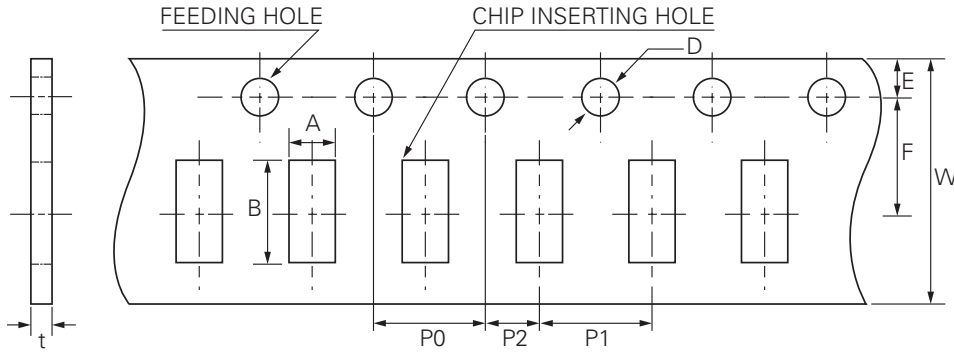


- (1) Reel Materials: Polystyrene (2) Label (3) Taping
 - Standard Packing Quantity per Reel (Ø178)
 - PE Tape: 4,000pcs

| 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

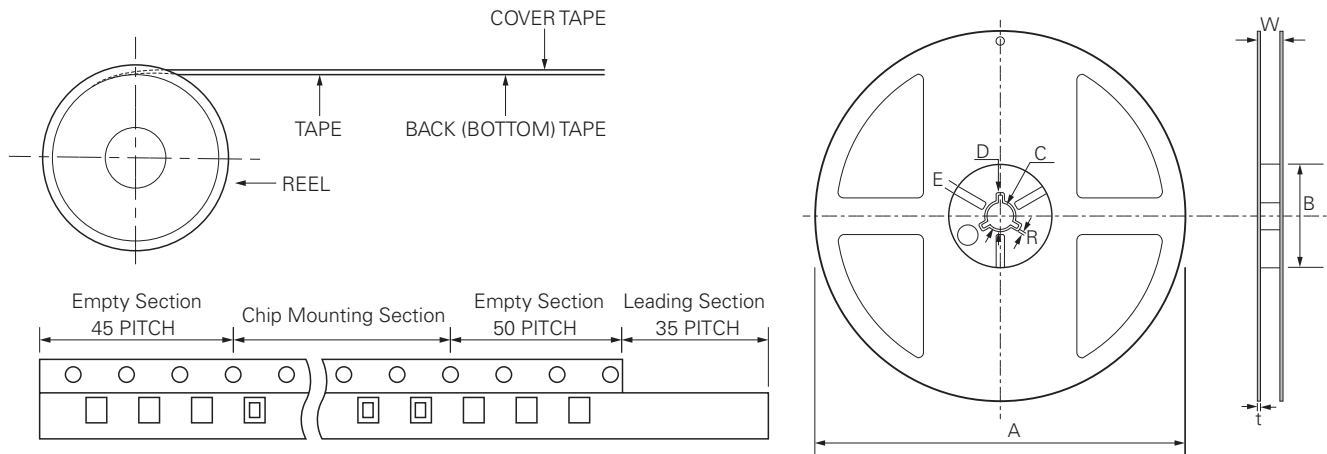
2012mm size



| Symbol | Dimensions |
|--------|-------------|
| | 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

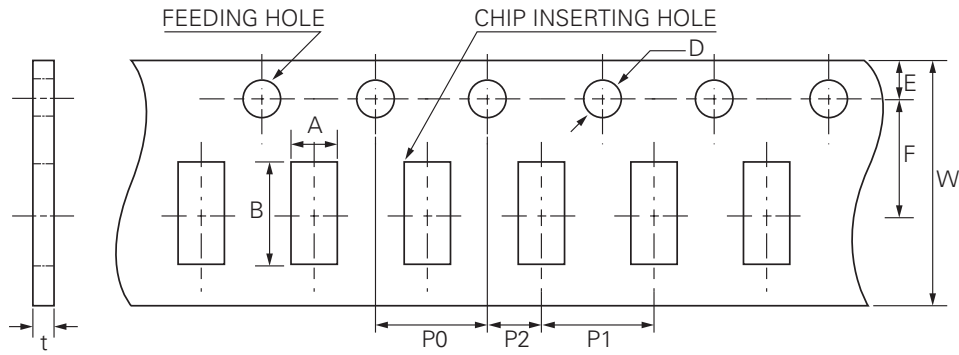


- (1) Reel Materials: Polystyrene (2) Label (3) Taping
 - Standard Packing Quantity per Reel (Ø178)
 - PE Tape: 4,000pcs

| 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

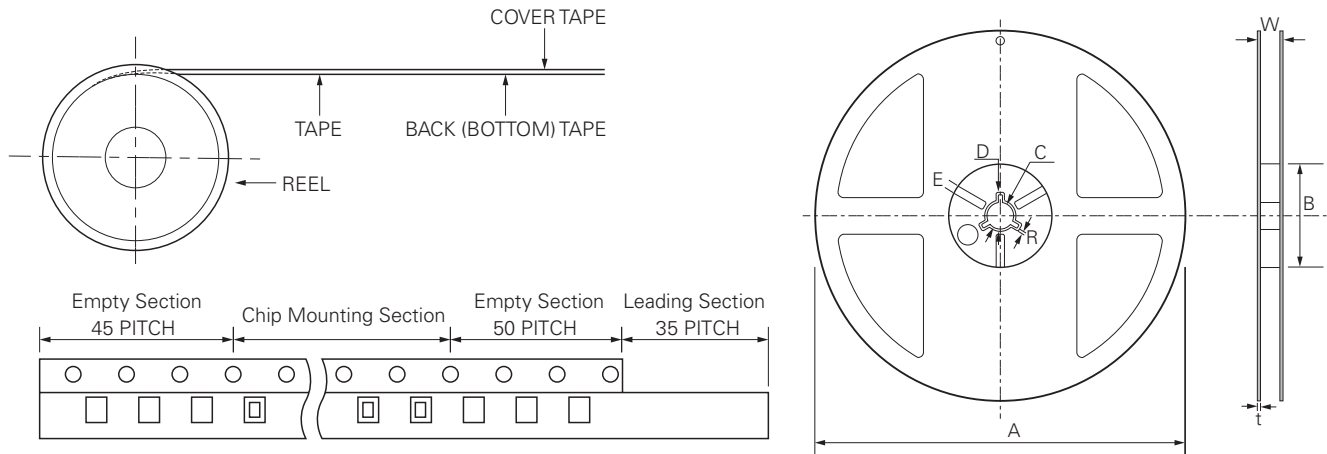
3008mm size



| 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

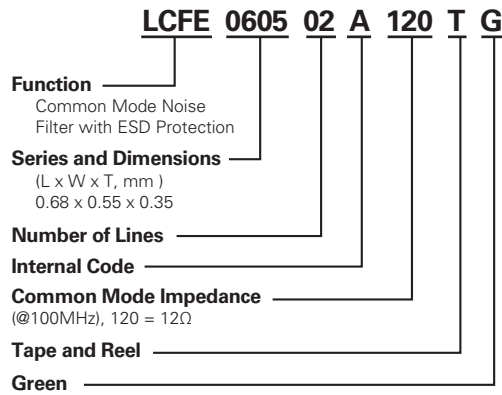
3008mm size



- (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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