

# METAL FILM LOW RESISTANCE CHIP RESISTOR

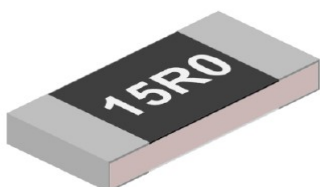
## MFL / MFLP / MFLU Series

### Features

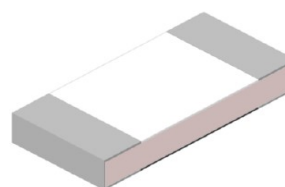
- \* Low TCR/Inductance
- \* Excellent long-term stability
- \* High power capability
- \* Halogen free and lead free
- \* RoHS compliant

### Applications

- \* Consumer electronics
- \* Computer
- \* Telecom
- \* Measuring instrument
- \* Industrial/power supply
- \* Battery management system



Top view



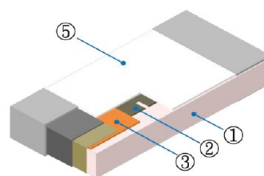
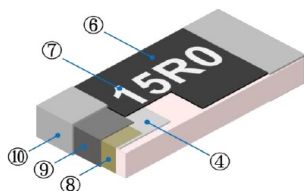
Bottom view

### Dimensions



| Style  |         |         |                    | Dimensions : mm |           |           |            |            |
|--------|---------|---------|--------------------|-----------------|-----------|-----------|------------|------------|
|        |         |         |                    | L               | W         | H         | a          | b          |
| MFL-02 | MFLP-02 | ---     | 0201               | 0.60±0.03       | 0.30±0.03 | 0.26±0.05 | 0.15±0.05  | 0.15±0.05  |
| MFL-04 | MFLP-04 | MFLU-04 | 0402               | 1.00±0.10       | 0.50±0.05 | 0.35±0.05 | 0.20±0.10  | 0.25±0.10  |
| MFL-06 | MFLP-06 | MFLU-06 | 0603               | 1.60±0.10       | 0.80±0.10 | 0.45±0.10 | 0.25±0.15  | 0.30±0.15  |
| MFL-10 | MFLP-10 | MFLU-10 | 0805               | 2.00±0.10       | 1.25±0.10 | 0.55±0.10 | 0.35±0.20  | 0.40±0.20  |
| MFL-18 | MFLP-18 | MFLU-18 | 1206               | 3.10±0.10       | 1.60±0.10 | 0.55±0.10 | 0.40±0.20  | 0.45±0.20  |
|        |         | ---     | 1206<br>(10m~39mΩ) | 3.30±0.20       | 1.70±0.20 | 0.65±0.20 | 0.20±0.15  | 0.68±0.20  |
| MFL-20 | MFLP-20 | ---     | 1210               | 3.10±0.10       | 2.50±0.15 | 0.55±0.10 | 0.50±0.20  | 0.50 ±0.20 |
| MFL-22 | MFLP-22 | ---     | 2010               | 5.00±0.20       | 2.50±0.15 | 0.55±0.10 | 0.60 ±0.25 | 0.60 ±0.25 |
| MFL-24 | MFLP-24 | MFLU-24 | 2512               | 6.30±0.20       | 3.20±0.20 | 0.55±0.10 | 0.65±0.25  | 0.65 ±0.25 |

### Construction



|   |                            |    |                         |
|---|----------------------------|----|-------------------------|
| 1 | Alumina Substrate          | 6  | Top Protective Overcoat |
| 2 | Resistive Layer            | 7  | Marking                 |
| 3 | Bottom Inner Electrode     | 8  | Side Inner Electrode    |
| 4 | Top Inner Electrode        | 9  | Barrier Layer (Ni)      |
| 5 | Bottom Protective Overcoat | 10 | Solder Coating (Sn)     |



## MFL SERIES ( Standard Electrical Specification)

| Type   | Size | Power Rating<br>at 70°C | MAX. Rated<br>Current | Max overload<br>Current | Temperature<br>coefficient<br>TCR; ppm/°C | Resistance Range |                 |
|--------|------|-------------------------|-----------------------|-------------------------|-------------------------------------------|------------------|-----------------|
|        |      |                         |                       |                         |                                           | ±0.5%(D)         | ±5%(J) , ±1%(F) |
| MFL-02 | 0201 | 1/20W                   | 1.00A                 | 2.50A                   | ±100                                      | 50 mΩ ~ 100 mΩ   |                 |
| MFL-04 | 0402 | 1/16W                   | 1.12A                 | 2.80A                   | ±100                                      | 50 mΩ ~ 100 mΩ   |                 |
| MFL-06 | 0603 | 1/10W                   | 1.41A                 | 3.54A                   | ±50                                       | 100 mΩ ~ 10 Ω    |                 |
| MFL-10 | 0805 | 1/8W                    | 1.79A                 | 4.48A                   | ±150                                      | 39 mΩ ~ 50 mΩ    |                 |
|        |      |                         |                       |                         | ±100                                      | 50 mΩ ~ 100 mΩ   |                 |
|        |      |                         |                       |                         | ±50                                       | 100 mΩ ~ 10 Ω    |                 |
| MFL-18 | 1206 | 1/4W                    | 5.00A                 | 12.5A                   | ±200                                      | ---              | 10 mΩ ~ 39 mΩ   |
|        |      |                         | 2.53A                 | 6.33A                   | ±150                                      | 39 mΩ ~ 50 mΩ    |                 |
|        |      |                         |                       |                         | ±100                                      | 50 mΩ ~ 100 mΩ   |                 |
| MFL-20 | 1210 | 1/2W                    | 3.58A                 | 8.95A                   | ±50                                       | 100 mΩ ~ 10 Ω    |                 |
| MFL-22 | 2010 | 3/4W                    | 2.74A                 | 6.85A                   | ±50                                       | 100 mΩ ~ 10 Ω    |                 |
| MFL-24 | 2512 | 1W                      | 3.16A                 | 7.91A                   |                                           | 100 mΩ ~ 10 Ω    |                 |

## MFLP SERIES ( High Power Rating Electrical Specification)

| Type    | Size | Power Rating<br>at 70°C | MAX. Rated<br>Current | Max overload<br>Current | Temperature<br>coefficient<br>TCR; ppm/°C | Resistance Range |                 |
|---------|------|-------------------------|-----------------------|-------------------------|-------------------------------------------|------------------|-----------------|
|         |      |                         |                       |                         |                                           | ±0.5%(D)         | ±5%(J) , ±1%(F) |
| MFLP-02 | 0201 | 1/10W                   | 1.41A                 | 3.16A                   | ±100                                      | 50 mΩ ~ 100 mΩ   |                 |
| MFLP-04 | 0402 | 1/8W                    | 1.58A                 | 3.54A                   | ±100                                      | 50 mΩ ~ 100 mΩ   |                 |
| MFLP-06 | 0603 | 1/5W                    | 2.00A                 | 4.47A                   | ±50                                       | 100 mΩ ~ 10 Ω    |                 |
| MFLP-10 | 0805 | 1/4W                    | 2.53A                 | 5.66A                   | ±150                                      | 39 mΩ ~ 50 mΩ    |                 |
|         |      |                         |                       |                         | ±100                                      | 50 mΩ ~ 100 mΩ   |                 |
|         |      |                         |                       |                         | ±50                                       | 100 mΩ ~ 10 Ω    |                 |
| MFLP-18 | 1206 | 1/2W                    | 7.00A                 | 15.81A                  | ±200                                      | ---              | 10 mΩ ~ 39 mΩ   |
|         |      |                         | 3.58A                 | 8.00A                   | ±150                                      | 39 mΩ ~ 50 mΩ    |                 |
|         |      |                         |                       |                         | ±100                                      | 50 mΩ ~ 100 mΩ   |                 |
| MFLP-20 | 1210 | 1W                      | 5.06A                 | 11.32A                  | ±50                                       | 100 mΩ ~ 10 Ω    |                 |
| MFLP-22 | 2010 | 1.5W                    | 8.87A                 | 8.66A                   | ±50                                       | 100 mΩ ~ 10 Ω    |                 |
| MFLP-24 | 2512 | 2W                      | 4.47A                 | 10.00A                  |                                           | 100 mΩ ~ 10 Ω    |                 |

## MFLU SERIES ( Ultra High Power Rating Electrical Specification)

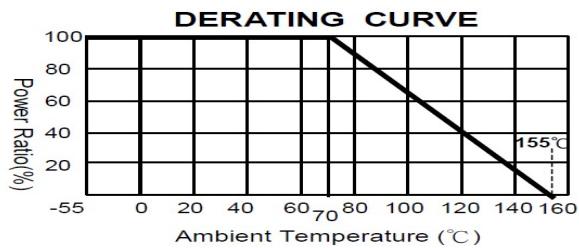
| Type    | Size | Power Rating<br>at 70°C | MAX. Rated<br>Current | Max overload<br>Current | Temperature<br>coefficient<br>TCR; ppm/°C | Resistance Range |                 |
|---------|------|-------------------------|-----------------------|-------------------------|-------------------------------------------|------------------|-----------------|
|         |      |                         |                       |                         |                                           | ±0.5%(D)         | ±5%(J) , ±1%(F) |
| MFLU-04 | 0402 | 1/4W                    | 2.24A                 | 5.00A                   | ±100                                      | 50 mΩ ~ 100 mΩ   |                 |
| MFLU-06 | 0603 | 2/5W                    | 2.83A                 | 6.32A                   | ±50                                       | 100 mΩ ~ 10 Ω    |                 |
| MFLU-10 | 0805 | 1/2W                    | 3.58A                 | 8.00A                   | ±150                                      | 39 mΩ ~ 50 mΩ    |                 |
|         |      |                         |                       |                         | ±100                                      | 50 mΩ ~ 100 mΩ   |                 |
|         |      |                         |                       |                         | ±50                                       | 100 mΩ ~ 10 Ω    |                 |
| MFLU-18 | 1206 | 1W                      | 5.06A                 | 11.32A                  | ±150                                      | 39 mΩ ~ 50 mΩ    |                 |
|         |      |                         |                       |                         | ±100                                      | 50 mΩ ~ 100 mΩ   |                 |
|         |      |                         |                       |                         | ±50                                       | 100 mΩ ~ 10 Ω    |                 |
| MFLU-24 | 2512 | 3W                      | 5.48A                 | 12.25A                  | ±50                                       | 100 mΩ ~ 10 Ω    |                 |

\* For non-standard parts, please contact our sales dept.

\* Operating Temperature Range : -55°C~+155°C.



## Derating Curve



The Operating Temperature Range:  $-55^{\circ}\text{C} \sim +155^{\circ}\text{C}$   
 Power Rating is in the case based on continuous full-load at ambient temperature of  $70^{\circ}\text{C}$ . For operation at ambient temperature in excess of  $70^{\circ}\text{C}$ , the load should be derated in accordance with figure of derating curve.

### \* Rated voltage

Resistance range:  $\geq 1\Omega$

Rated voltage: The resistor shall have a DC continuous working voltage or a RMS AC(ms) continuous working voltage at commercial - line frequency and wave form corresponding to the power rating, as determined formula as following:

$$V = \sqrt{P \times R}$$

$V$  = Rated voltage (V)  
 $P$  = Rated power (W)  
 $R$  = Nominal resistance ( $\Omega$ )

### \* Rated Current

Resistance range:  $< 1\Omega$

Rated Current: The resistor shall have a DC continuous working current of a AC(ms) continuous working current at commercial - line frequency and wave form corresponding to the power rating, as determined formula as following:

$$I = \sqrt{P/R}$$

$I$  = Rated current (A)  
 $P$  = Rated Power (W)  
 $R$  = Resistance( $\Omega$ )

## Marking

### \* m $\Omega$ Resistance Codes



0201 ~ 0402  
no marking



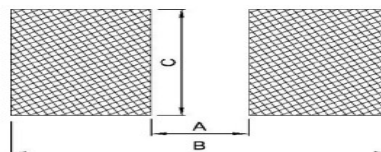
0603  
3 digits code



0805 ~ 2512 1%  
4 digits code

| Value                         | Code |      | Example           |                    |
|-------------------------------|------|------|-------------------|--------------------|
|                               | 5%   | 1%   | 5%                | 1%                 |
| 50m $\Omega$ ~ 99m $\Omega$   | R05  | R050 | R05=50m $\Omega$  | R050=50m $\Omega$  |
| 100m $\Omega$ ~ 990m $\Omega$ | R10  | 0R10 | R10=100m $\Omega$ | R100=100m $\Omega$ |
| 1 $\Omega$ ~ 9.9 $\Omega$     | 1R0  | 1R00 | 1R0=1 $\Omega$    | 1R00=1 $\Omega$    |
| 10 $\Omega$                   | 100  | 10R0 | 100=10 $\Omega$   | 10R0=10 $\Omega$   |

### \* Recommend Land Pattern Design



| Type | 0201 | 0402 | 0603 | 0805 | 1206<br>10m~39m $\Omega$ | 1206 | 1210 | 2010 | 2512 |
|------|------|------|------|------|--------------------------|------|------|------|------|
| A    | 0.25 | 0.50 | 0.80 | 1.30 | 1.2                      | 2.20 | 2.00 | 3.80 | 4.90 |
| B    | 0.85 | 1.60 | 2.40 | 2.90 | 4.8                      | 4.20 | 4.40 | 6.60 | 8.10 |
| C    | 0.35 | 0.70 | 1.00 | 1.45 | 1.84                     | 1.80 | 2.70 | 2.70 | 3.40 |

## Reliability Test and Requirement

| Test Item                                      | Test Method                                 | Procedure                                                                                                                                                               | Requirements                                 |
|------------------------------------------------|---------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------|
| Temperature Coefficient of Resistance (T.C.R.) | JIS- C- 5201-1 4.8<br>IEC-60115-1 4.8       | TCR +125°C, 25°C is the reference temperature                                                                                                                           | Refer to Standard Electrical Spec            |
| Short Time Overload                            | JIS- C- 5201-1 4.13<br>IEC-60115-1 4.13     | Standard power : 6.25 times rated power whichever is less for 5 seconds.<br>High power (2X/4X) and wide terminal type: 5 times rated power whichever is less for 5 sec. | $\pm(1.0\%+0.001\Omega)$                     |
| Insulation Resistance                          | JIS- C- 5201-1 4.6<br>IEC-60115-1 4.6       | 100V for 1minute                                                                                                                                                        | $\geq 10G\Omega$                             |
| Solderability                                  | JIS- C- 5201-1 4.17<br>IEC-60115-1 4.17     | 245 $\pm$ 5°C for 3 $\pm$ 0.5 secs.                                                                                                                                     | > 95% Coverage<br>No Visual damage           |
| Resistance to Soldering Heat                   | JIS -C- 5201-1 4.18<br>IEC-60115-1 4.18     | 260 $\pm$ 5°C for 10 seconds.                                                                                                                                           | $\pm(1.0\%+0.001\Omega)$<br>No Visual damage |
| Leaching                                       | JIS- C- 5201-1 4.18<br>IEC-60068-2-58 8.2.1 | 260 $\pm$ 5°C for 30 seconds                                                                                                                                            | >95% Coverage<br>No Visual damage            |
| Temperature Cycling                            | JIS- C- 5201-1 4.19<br>IEC-60115-1 4.19     | -55°C to +155°C, 300cycles                                                                                                                                              | $\pm(1.0\%+0.001\Omega)$<br>No Visual damage |
| High Temperature Exposure                      | JIS C 5201-1 4.25<br>IEC-60068-2-2          | 155 $\pm$ 5°C for 1000 hours                                                                                                                                            | $\pm(1.0\%+0.001\Omega)$                     |
| Resistance to Solvent                          | JIS -C- 5201-1 4.29                         | The tested resistor be immersed into isopropyl alcohol of 20-25°C for 60 secs. Then the resistor is left in the room for 48 hrs.                                        | $\pm(1.0\%+0.001\Omega)$<br>No Visual damage |
| Damp Heat with Load                            | JIS- C- 5201-1 4.24<br>IEC-60115-1 4.24     | 40 $\pm$ 2°C, 90~95% R.H. ,Rated power or Max. working current whichever is less for 1000hrs with 1.5hrs "ON" and 0.5hr "OFF"                                           | $\pm(1.0\%+0.001\Omega)$                     |
| Load Life (Endurance)                          | JIS -C- 5201-1 4.25<br>IEC-60115-1 4.25.1   | 70 $\pm$ 2°C, Rated power or Max. working current whichever is less for 1000hrs with 1.5hrs "ON" and 0.5hr "OFF"                                                        | $\pm(1.0\%+0.001\Omega)$                     |
| Terminal Strength                              | JIS-C-5201-1 4.32<br>AEC Q200-006           | Pressurizing force for 10 seconds<br>0201, 0402, 0603: 8N<br>0805 and above: 17.7N                                                                                      | No broken                                    |
| Bending Strength                               | JIS -C- 5201-1 4.33<br>IEC-60115-1 4.33     | Bending once for 5 seconds<br>D: 0402 、 0603 、 0805=5mm<br>1206 、 1210 = 3mm<br>2010 、 2512 = 2mm                                                                       | $\pm(1.0\%+0.001\Omega)$<br>No Visual damage |

\* Temperature Coefficient of Resistance test to -55°C is available on request

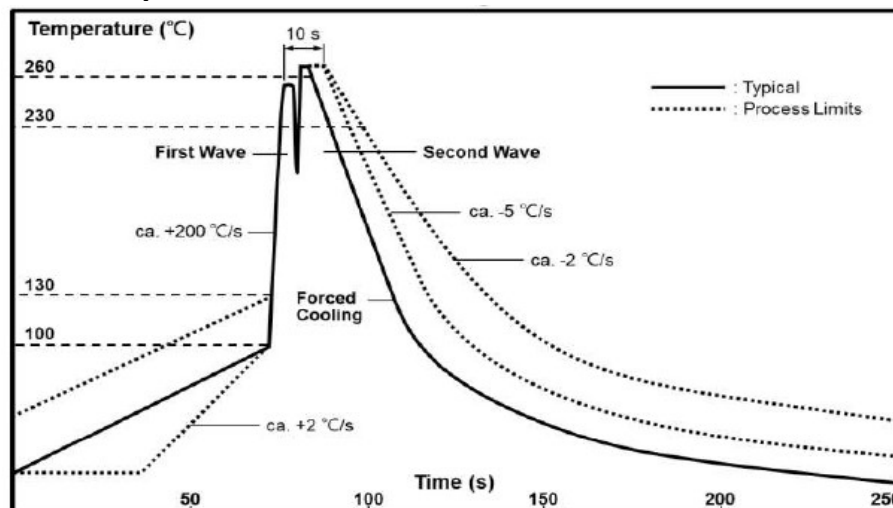


## Parts Number System

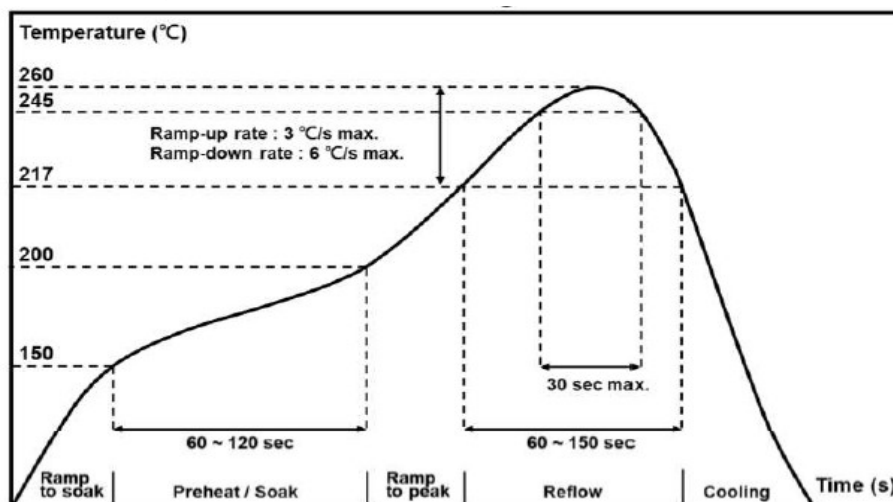
| MFL -                                                      | 10 -                                                                                 | R050                                                                                                                        | F                               | R                                                     |
|------------------------------------------------------------|--------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------|---------------------------------|-------------------------------------------------------|
| <b>Type</b>                                                | <b>Size</b>                                                                          | <b>Resistance</b>                                                                                                           | <b>Tolerance</b>                | <b>Standard Packing</b>                               |
| <b>MFL</b> - Metal Film<br>Low Resistance<br>Chip Resistor | 02=0201<br>04=0402<br>06=0603<br>10=0805<br>18=1206<br>20=1210<br>22=2010<br>24=2512 | <b>3 Digits for 5%</b><br>R10=10mΩ<br>R01=1 mΩ<br><b>4 Digits for 1%</b><br>R050=50mΩ<br>R100=100mΩ<br>1R00=1 Ω<br>10R0=10Ω | D = ±0.5%<br>F = ±1%<br>J = ±5% | R=Paper tape reel<br><br>K=Embossed plastic tape reel |

## Recommended Customer Soldering Parameters

### \* Wave Solder Temperature Condition



### \* Solder Reflow Temperature Condition



\* Rework Temperature (hot air equipment) : 350°C, 3~5seconds

