

Features:

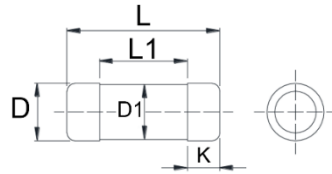
- Thin film technology for precision and stability
- Excellent power to size ratio
- Exhibits good pulse power characteristics
- RoHS compliant, lead free and halogen free



Electrical Specifications									
Type/Code	Package Size	Power Rating (W) @ 70°C	Maximum Working Voltage (V) ⁽¹⁾	Maximum Overload Voltage (V)	TCR (ppm/°C)	Ohmic Range (Ω) and Tolerance			
						0.1%	0.5%	1%	5%
MLF18	0102	0.125	150	300	± 15	100 - 56 K			-
					± 25	100 - 82 K	49.9 - 200 K	49.9 - 390 K	-
					± 50	8.2 - 1 M			-
					± 100	40 - 1 M			-
MLFM15	0102	0.2	200	400	± 15	100 - 56 K			-
					± 25	100 - 82 K	49.9 - 200 K	49.9 - 390 K	-
					± 50	8.2 - 1 M			-
					± 100	40 - 1 M			-
MLF14	0204	0.25	200	400	± 5	10 - 332 K	-		-
					± 10	10 - 20 K			-
					± 15	10 - 300 K			-
					± 25	10 - 1 M		1 - 4.7 M	-
					± 50	10 - 1 M	1 - 1 M	0.2 - 10 M	-
					± 100	-		0.1 - 10 M	-
		Jumper: 2 A			0 Ω (< 15 MΩ)			-	
MLFM25	0204	0.4	200	400	± 5	10 - 332 K	-		-
					± 15	10 - 100 K			-
					± 25	10 - 1 M		1 - 3.4 M	-
					± 50	10 - 1 M	1 - 1 M	0.2 - 1 M	-
					± 100	-		0.1 - 1 M	-
MLF12	0207	0.5	300	600	± 5	10 - 332 K	-		-
					± 10	10 - 20 K			-
					± 15	10 - 300 K			-
					± 25	10 - 1 M		1 - 4.7 M	-
					± 50	10 - 1 M	1 - 1 M	0.2 - 10 M	-
					± 100	-		0.1 - 10 M	-
		Jumper: 4 A			0 Ω (< 15 MΩ)			-	
MLFM1	0207	1	350	700	± 5	10 - 332 K	-		-
					± 15	10 - 100 K			-
					± 25	10 - 1 M		1 - 3.4 M	-
					± 50	10 - 1 M	1 - 1 M	0.2 - 10 M	-
					± 100	-		0.1 - 10 M	-

Note: (1) Lesser of $\sqrt{P \cdot R}$ or maximum working voltage

Mechanical Specifications



Type/Code	Weight (g) (1000 pieces)	L Body Length	L1 (min.) Inner Body Length	D Body Diameter	D1 Middle Body Dia.	K Termination	Unit
MLF18	7.7	0.087 ± 0.004 2.20 ± 0.10	0.043 1.10	0.043 ± 0.004 1.10 ± 0.10	0.043 +0/-0.006 1.10 +0/-0.15	0.018 ± 0.002 0.45 ± 0.05	inches mm
MLFM15	7.7	0.087 ± 0.004 2.20 ± 0.10	0.043 1.10	0.043 ± 0.004 1.10 ± 0.10	0.043 +0/-0.006 1.10 +0/-0.15	0.018 ± 0.002 0.45 ± 0.05	inches mm
MLF14	18.7	0.138 ± 0.008 3.50 ± 0.20	0.067 1.70	0.055 ± 0.006 1.40 ± 0.15	0.055 +0/-0.008 1.40 +0/-0.20	0.031 ± 0.004 0.80 ± 0.10	inches mm
MLFM25	18.7	0.138 ± 0.008 3.50 ± 0.20	0.059 1.50	0.055 ± 0.006 1.40 ± 0.15	0.055 +0/-0.008 1.40 +0/-0.20	0.031 ± 0.004 0.80 ± 0.10	inches mm
MLF12	80.9	0.232 ± 0.008 5.90 ± 0.20	0.114 2.90	0.087 ± 0.008 2.20 ± 0.20	0.087 +0/-0.008 2.20 +0/-0.20	0.051 ± 0.004 1.30 ± 0.10	inches mm
MLFM1	80.9	0.232 ± 0.008 5.90 ± 0.20	0.114 2.90	0.087 ± 0.008 2.20 ± 0.20	0.087 +0/-0.008 2.20 +0/-0.20	0.051 ± 0.004 1.30 ± 0.10	inches mm

Performance Characteristics

Test	Test Method	Test Condition	Test Specification	
			5% and below	Jumper
Temperature Coefficient of Resistance (T.C.R.)	JIS-C-5201-1 4.8 IEC-60115-1 4.8	At 25°C / - 55°C and 25°C / + 125°C, 25°C is the reference temperature. 5ppm: At 25°C / -10°C and 25°C / +85°C, 25°C is the reference temperature	As specified	
Short Time Overload	JIS-C-5201-1 4.13 IEC-60115-1 4.13	RCWV*2.5 or max. overload voltage whichever is lower for 5 seconds	0204/0207: ± (0.15% + 0.05 Ω) 0102: ± (0.5% + 0.05 Ω) 5ppm: ± (0.05% + 0.01 Ω)	< 15 mΩ
Insulation Resistance	JIS-C-5201-1 4.6 IEC-60115-1 4.6	Max. overload voltage for 1 minute	≥10G	
Endurance	JIS-C-5201-1 4.25 IEC-60115-1 4.25.1	70 ± 2°C, RCWV for 1000 hours with 1.5 hour "ON" and 0.5 hour "OFF"	0204/0207: ± (0.15% + 0.05 Ω) 0102: ± (0.5% + 0.05 Ω) 5ppm: ± (0.25% + 0.01 Ω)	< 15 mΩ
Damp Heat with Load	JIS-C-5201-1 4.24 IEC-60115-1 4.24	40 ± 2°C, 90 ~ 95% R.H., RCWV for 1000 hours with 1.5 hour "ON" and 0.5 hour "OFF"	0204/0207: ± (1% + 0.05 Ω) 0102: ± (0.5% + 0.05 Ω) 5ppm: ± (0.25% + 0.01 Ω)	< 15 mΩ
Dry Heat	JIS-C-5201-1 4.23 IEC-60115-1 4.23.2	At +125°C / +155°C for 1000 hours	0204/0207: ± (1% + 0.05 Ω) 0102: ± (1.5% + 0.05 Ω) 5ppm: ± (0.25% + 0.01 Ω)	< 15 mΩ
Bending Strength	JIS-C-5201-1 4.33 IEC-60115-1 4.33	Bending once for 5 seconds with 2 mm	± (0.5% + 0.05 Ω) 5ppm: ± (0.1% + 0.01 Ω)	< 15 mΩ
Solderability	JIS-C-5201-1 4.17 IEC-60115-1 4.17	245 ± 5°C for 3 seconds	95% min. coverage	
Resistance to Soldering Heat	JIS-C-5201-1 4.18 IEC-60115-1 4.18	260 ± 5°C for 10 seconds	± (0.5% + 0.05 Ω) 5ppm: ± (0.05% + 0.01 Ω)	< 15 mΩ
Voltage Proof	JIS-C-5201-1 4.7 IEC-60115-1 4.7	1.42 times max. operating voltage for 1 minute	No breakdown or flashover	
Leaching	JIS-C-5201-1 4.18 IEC-60068-2-58 8.2.1	260 ± 5°C for 30 seconds	Individual leaching area ≤ 5% Total Leaching area ≤ 10%	
Rapid Change of Temperature	JIS-C-5201-1 4.19 IEC-60115-1 4.19	-55°C to +125°C / +155°C, 5 cycles	± (0.5% + 0.05 Ω) 5ppm: ± (0.2% + 0.01 Ω)	< 15 mΩ

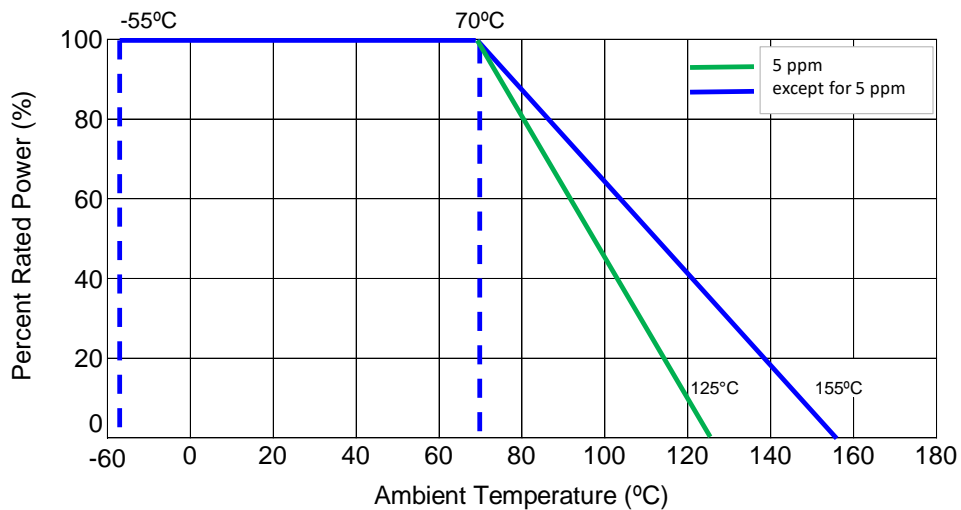
RCWV (rated continuous working voltage) = $\sqrt{P \cdot R}$ or max. operating voltage whichever is lower.

Storage temperature: 25 ± 3°C, humidity < 80% R.H.

Operating temperature range is -55°C to +155°C except for 5 ppm/°C.

Operating temperature range for 5 ppm/°C is -55°C to +125°C.

Power Derating Curve:



Recommended Solder Profile

This information is intended as a reference for solder profiles for Stackpole resistive components. These profiles should be compatible with most soldering processes. These are only recommendations. Actual numbers will depend on board density, geometry, packages used, etc., especially those cells labeled with “*”.

100% Matte Tin / RoHS Compliant Terminations

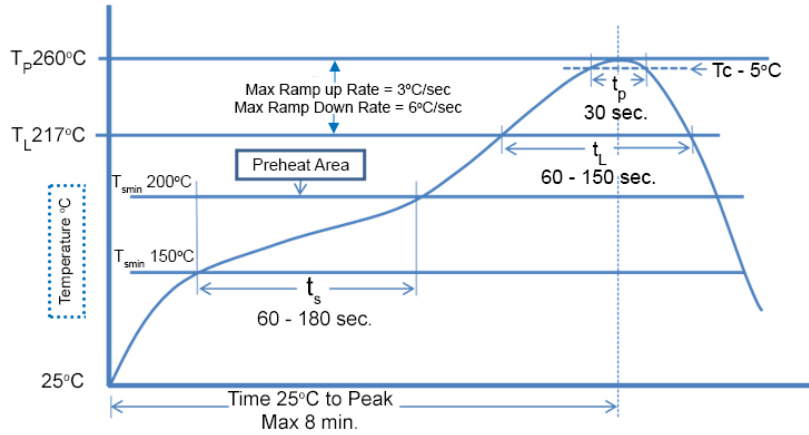
Soldering iron recommended temperatures: 330°C to 350°C with minimum duration.
Maximum number of reflow cycles: 3.

Wave Soldering			
Description	Maximum	Recommended	Minimum
Preheat Time	80 seconds	70 seconds	60 seconds
Temperature Diff.	140°C	120°C	100°C
Solder Temp.	260°C	250°C	240°C
Dwell Time at Max.	10 seconds	5 seconds	*
Ramp DN (°C/sec)	N/A	N/A	N/A

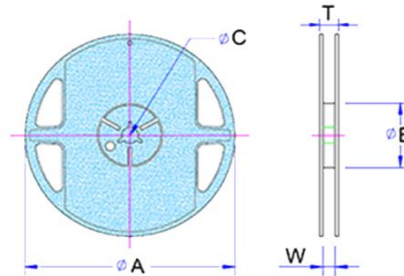
Temperature Diff. = Difference between final preheat stage and soldering stage.

Convection IR Reflow			
Description	Maximum	Recommended	Minimum
Ramp Up (°C/sec)	3°C/sec	2°C/sec	*
Dwell Time > 217°C	150 seconds	90 seconds	60 seconds
Solder Temp.	260°C	245°C	*
Dwell Time at Max.	30 seconds	15 seconds	10 seconds
Ramp DN (°C/sec)	6°C/sec	3°C/sec	*

Recommended Lead Free Resistor Reflow Profile

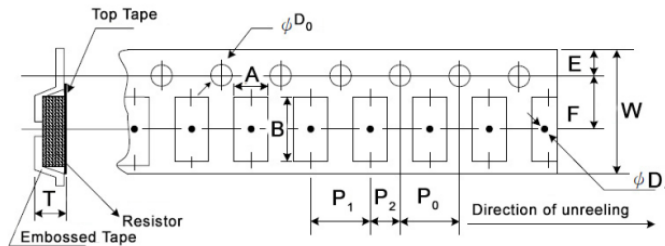


Reel Specifications



Type/Code	ϕA	ϕB	ϕC	W	T	Unit
MLF18	7.028 ± 0.059	2.362 ± 0.039	0.512 ± 0.008	0.354 ± 0.020	0.492 ± 0.020	inches
	178.50 ± 1.50	60.00 ± 1.00	13.00 ± 0.20	9.00 ± 0.50	12.50 ± 0.50	mm
MLFM15	7.028 ± 0.059	2.362 ± 0.039	0.512 ± 0.008	0.354 ± 0.020	0.492 ± 0.020	inches
	178.50 ± 1.50	60.00 ± 1.00	13.00 ± 0.20	9.00 ± 0.50	12.50 ± 0.50	mm
MLF14	7.028 ± 0.059	2.362 ± 0.039	0.512 ± 0.008	0.354 ± 0.020	0.492 ± 0.020	inches
	178.50 ± 1.50	60.00 ± 1.00	13.00 ± 0.20	9.00 ± 0.50	12.50 ± 0.50	mm
MLFM25	7.028 ± 0.059	2.362 ± 0.039	0.512 ± 0.008	0.354 ± 0.020	0.492 ± 0.020	inches
	178.50 ± 1.50	60.00 ± 1.00	13.00 ± 0.20	9.00 ± 0.50	12.50 ± 0.50	mm
MLF12	7.028 ± 0.059	2.362 ± 0.039	0.512 ± 0.020	0.512 ± 0.020	0.610 ± 0.020	inches
	178.50 ± 1.50	60.00 ± 1.00	13.00 ± 0.50	13.00 ± 0.50	15.50 ± 0.50	mm
MLFM1	7.028 ± 0.059	2.362 ± 0.039	0.512 ± 0.020	0.512 ± 0.020	0.610 ± 0.020	inches
	178.50 ± 1.50	60.00 ± 1.00	13.00 ± 0.50	13.00 ± 0.50	15.50 ± 0.50	mm

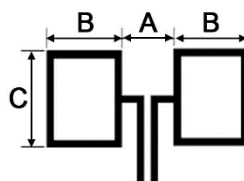
Packaging Specifications - Embossed Plastic Tape



Type/Code	A	B	W	E	F	P0	Unit
MLF18	0.051 ± 0.004	0.094 ± 0.004	0.315 ± 0.004	0.069 ± 0.004	0.138 ± 0.002	0.157 ± 0.004	inches
	1.30 ± 0.10	2.40 ± 0.10	8.00 ± 0.10	1.75 ± 0.10	3.50 ± 0.05	4.00 ± 0.10	mm
MLFM15	0.051 ± 0.004	0.094 ± 0.004	0.315 ± 0.004	0.069 ± 0.004	0.138 ± 0.002	0.157 ± 0.004	inches
	1.30 ± 0.10	2.40 ± 0.10	8.00 ± 0.10	1.75 ± 0.10	3.50 ± 0.05	4.00 ± 0.10	mm
MLF14	0.061 ± 0.004	0.144 ± 0.004	0.315 ± 0.004	0.069 ± 0.004	0.138 ± 0.002	0.157 ± 0.004	inches
	1.55 ± 0.10	3.65 ± 0.10	8.00 ± 0.10	1.75 ± 0.10	3.50 ± 0.05	4.00 ± 0.10	mm
MLFM25	0.061 ± 0.004	0.144 ± 0.004	0.315 ± 0.004	0.069 ± 0.004	0.138 ± 0.002	0.157 ± 0.004	inches
	1.55 ± 0.10	3.65 ± 0.10	8.00 ± 0.10	1.75 ± 0.10	3.50 ± 0.05	4.00 ± 0.10	mm
MLF12	0.094 ± 0.004	0.242 ± 0.004	0.472 ± 0.004	0.069 ± 0.004	0.217 ± 0.002	0.157 ± 0.004	inches
	2.40 ± 0.10	6.15 ± 0.10	12.00 ± 0.10	1.75 ± 0.10	5.50 ± 0.05	4.00 ± 0.10	mm
MLFM1	0.094 ± 0.004	0.242 ± 0.004	0.472 ± 0.004	0.069 ± 0.004	0.217 ± 0.002	0.157 ± 0.004	inches
	2.40 ± 0.10	6.15 ± 0.10	12.00 ± 0.10	1.75 ± 0.10	5.50 ± 0.05	4.00 ± 0.10	mm

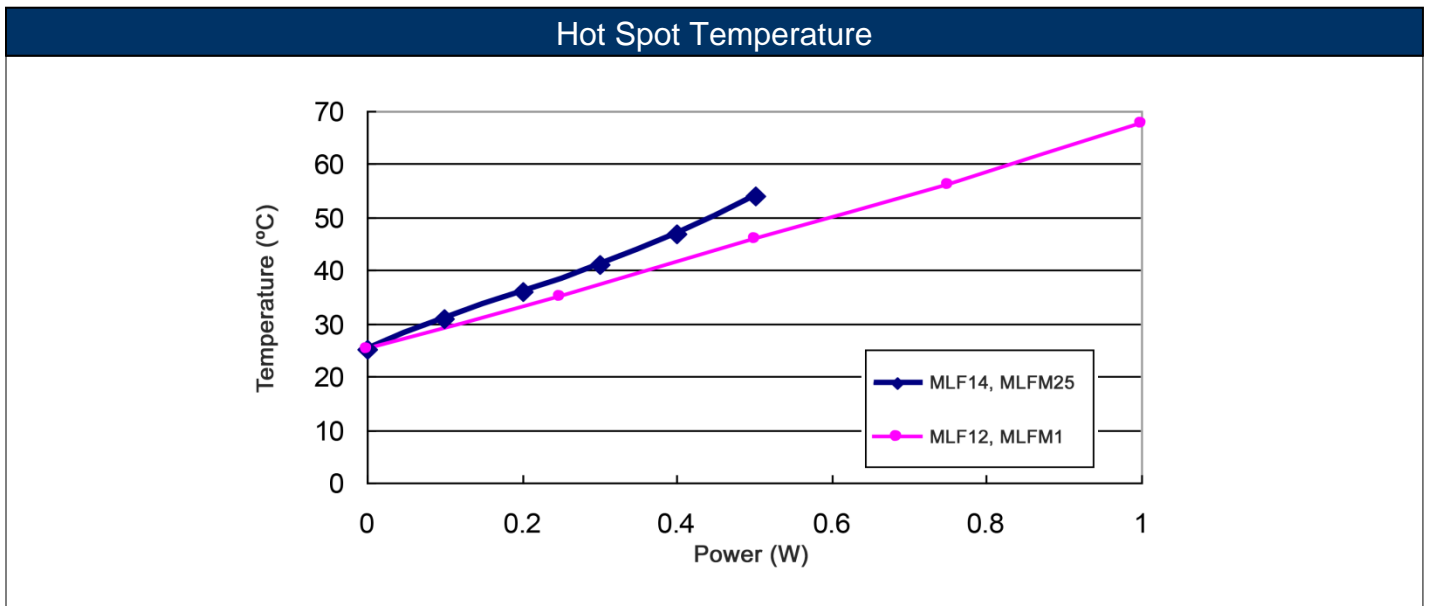
Type/Code	P1	P2	D0	D1	T	Unit
MLF18	0.157 ± 0.004	0.079 ± 0.002	0.059 ± 0.004	0.035 min.	0.059 ± 0.004	inches
	4.00 ± 0.10	2.00 ± 0.05	1.50 ± 0.10	0.90 min.	1.50 ± 0.10	mm
MLFM15	0.157 ± 0.004	0.079 ± 0.002	0.059 ± 0.004	0.035 min.	0.059 ± 0.004	inches
	4.00 ± 0.10	2.00 ± 0.05	1.50 ± 0.10	0.90 min.	1.50 ± 0.10	mm
MLF14	0.157 ± 0.004	0.079 ± 0.002	0.059 ± 0.004	0.035 min.	0.071 ± 0.004	inches
	4.00 ± 0.10	2.00 ± 0.05	1.50 ± 0.10	0.90 min.	1.80 ± 0.10	mm
MLFM25	0.157 ± 0.004	0.079 ± 0.002	0.059 ± 0.004	0.035 min.	0.071 ± 0.004	inches
	4.00 ± 0.10	2.00 ± 0.05	1.50 ± 0.10	0.90 min.	1.80 ± 0.10	mm
MLF12	0.157 ± 0.004	0.079 ± 0.002	0.059 ± 0.004	0.055 min.	0.106 ± 0.004	inches
	4.00 ± 0.10	2.00 ± 0.05	1.50 ± 0.10	1.40 min.	2.70 ± 0.10	mm
MLFM1	0.157 ± 0.004	0.079 ± 0.002	0.059 ± 0.004	0.055 min.	0.106 ± 0.004	inches
	4.00 ± 0.10	2.00 ± 0.05	1.50 ± 0.10	1.40 min.	2.70 ± 0.10	mm

Recommended Pad Layout



Type/Code	A	B	C	Unit
MLF18	0.039	0.031	0.059	inches
	1.00	0.80	1.50	mm
MLFM15	0.039	0.031	0.059	inches
	1.00	0.80	1.50	mm
MLF14	0.063	0.047	0.063	inches
	1.60	1.20	1.60	mm
MLFM25	0.063	0.047	0.063	inches
	1.60	1.20	1.60	mm

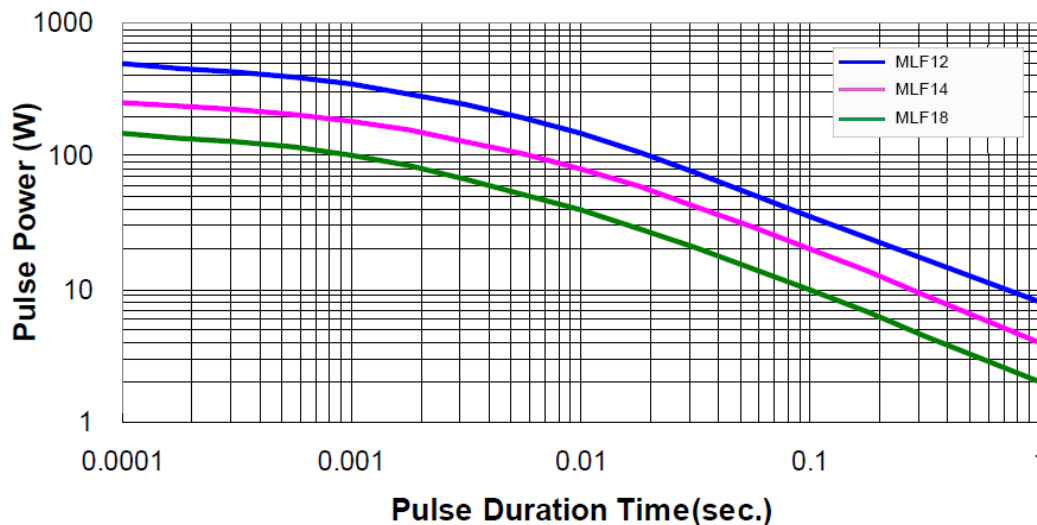
Recommended Pad Layout (cont.)				
Type/Code	A	B	C	Unit
MLF12	0.118	0.067	0.094	inches
	3.00	1.70	2.40	mm
MLFM1	0.118	0.067	0.094	inches
	3.00	1.70	2.40	mm



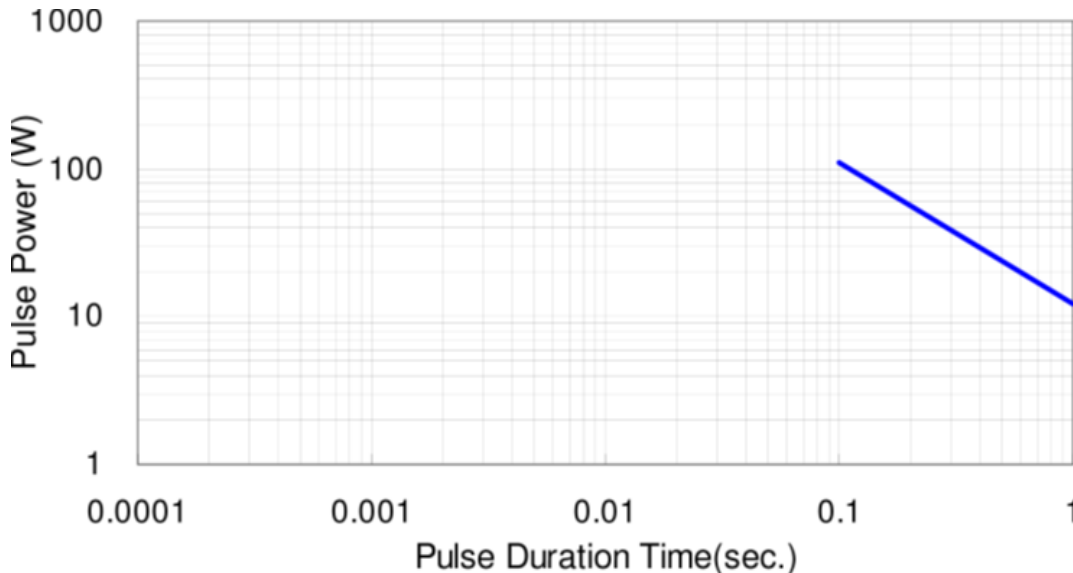
Pulse withstanding capacity

The single impulse graph is the result of 50 impulses of rectangular shape applied at one-minute intervals. The limit of acceptance was a shift in resistance of less than 1% from the initial value. The power applied was subject to the restrictions of the maximum permissible impulse voltage graph shown.

Single Pulse



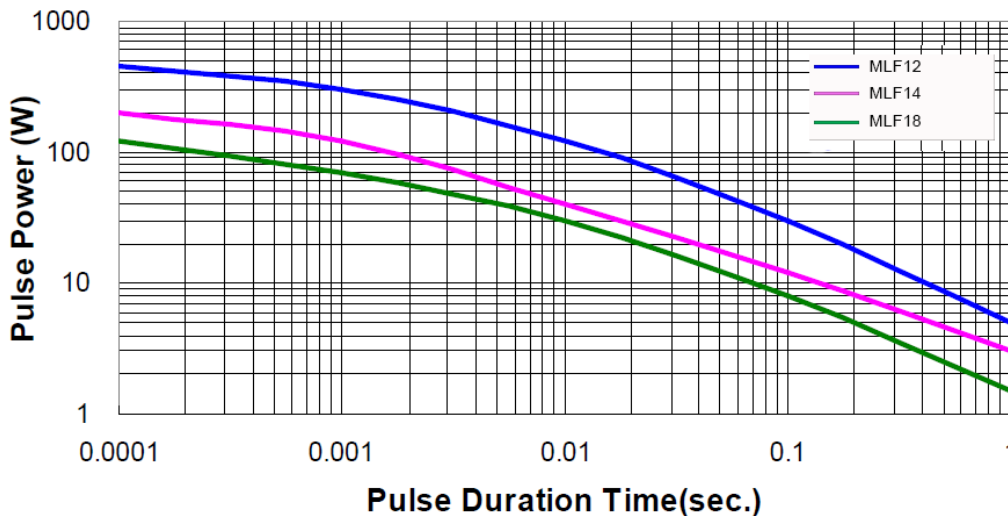
MLFM1 Single Pulse (1 Kohm)



Continuous Pulse

The continuous load graph was obtained by applying repetitive rectangular pulses where the pulse period was adjusted so that the average power dissipated in the resistor was equal to its rated power at 70°C. Again the limit of acceptance was a shift in resistance of less than 1% from the initial value.

Continuous Pulse

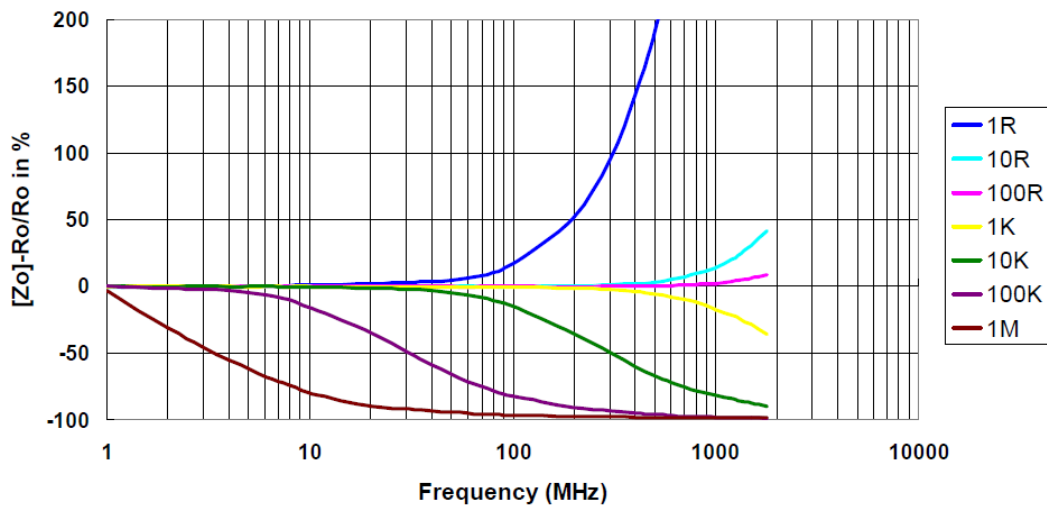


Frequency behavior

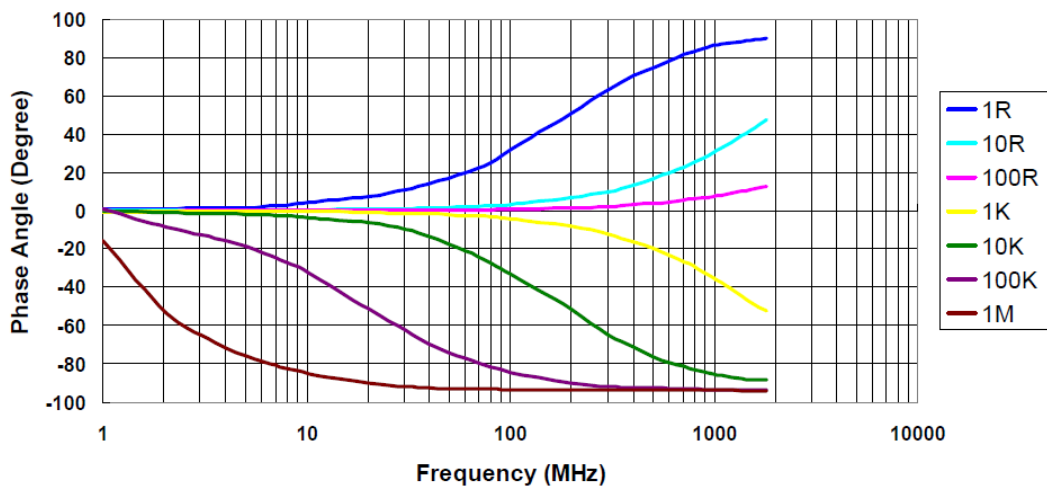
Resistors are designed to function according to Ohmic laws. This is basically true of resistors for frequencies up to 100 kHz. At higher frequencies, there is an additional contribution to the impedance by an ideal resistor switched in series with a coil and both switched parallel to a capacitor. The values of the capacitance and inductance are mainly determined by the dimensions of the terminations and the conductive path length.

The environment surrounding components has a large influence on the behavior of the component on the printed-circuit board.

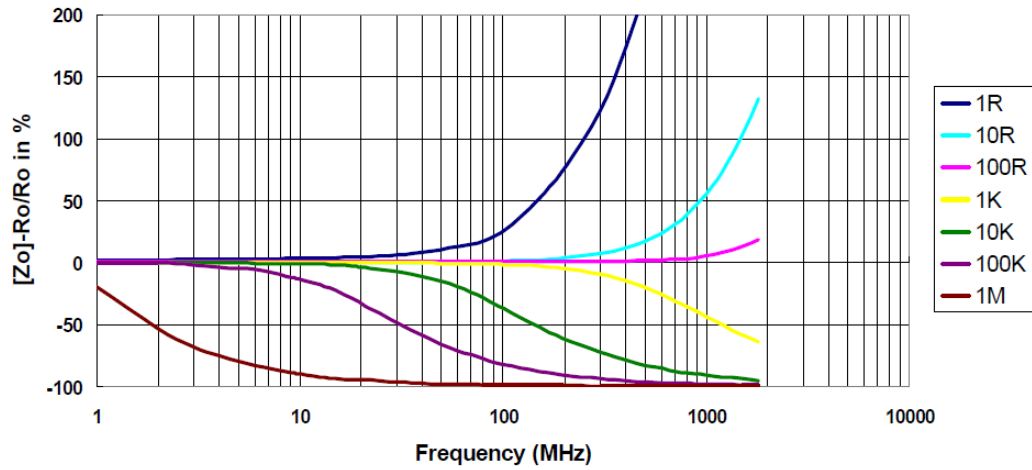
Frequency vs. Impedance
MLF14



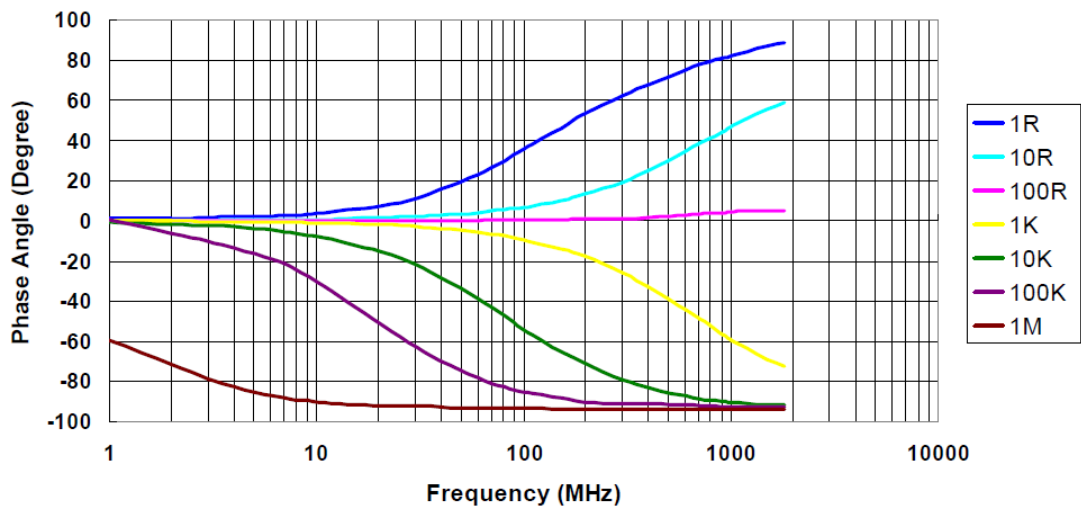
Frequency vs. Phase Angle
MLF14



Frequency vs. Impedance
MLF12



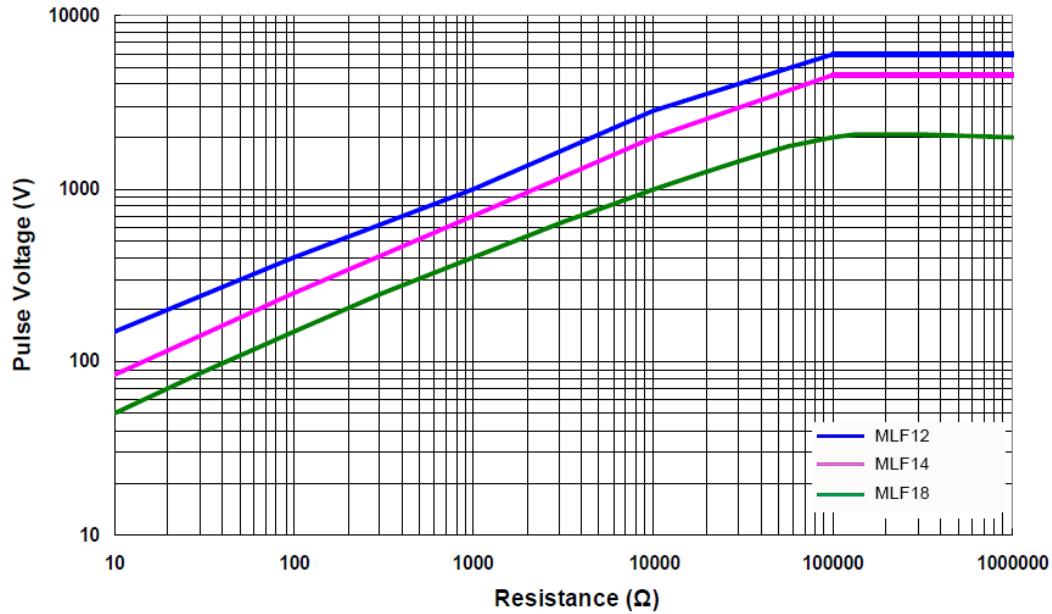
Frequency vs. Phase Angle
MLF12



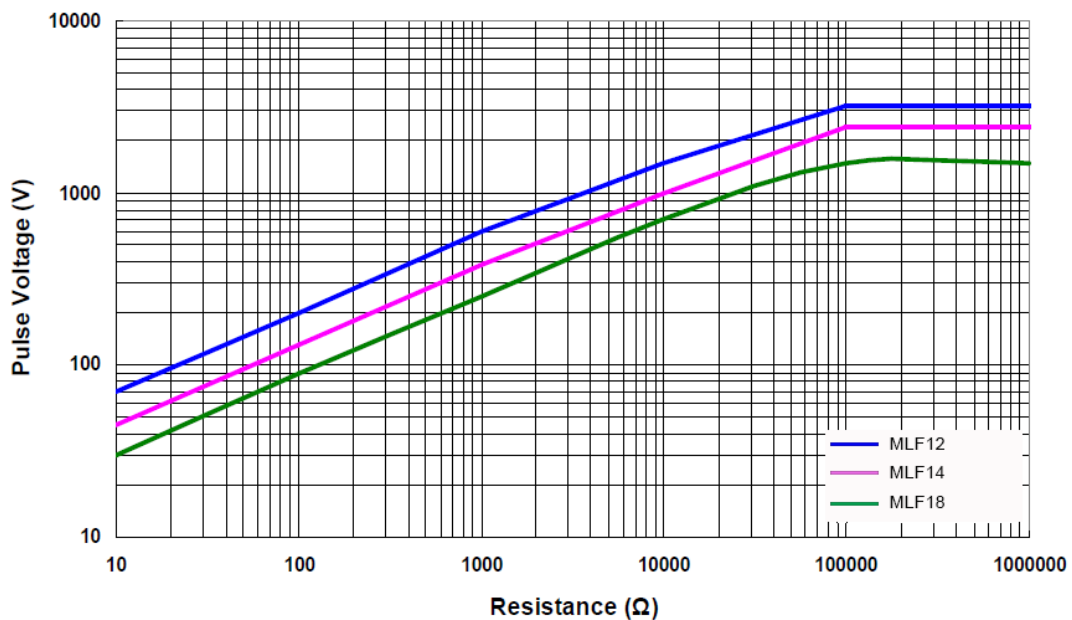
Lightning Surge

Resistors are tested in accordance with IEC 60 115-1 using both 1.2/50 μ s and 10/700 μ s pulse shapes. The limit of acceptance is a shift in resistance of less than 0.5% from the initial value.

1.2/50 μ s Lightning Surge



10/700 μ s Lightning Surge



RoHS Compliance

Stackpole Electronics has joined the worldwide effort to reduce the amount of lead in electronic components and to meet the various regulatory requirements now prevalent, such as the European Union’s directive regarding “Restrictions on Hazardous Substances” (RoHS 3). As part of this ongoing program, we periodically update this document with the status regarding the availability of our compliant components. All our standard part numbers are compliant to EU Directive 2011/65/EU of the European Parliament as amended by Directive (EU) 2015/863/EU as regards the list of restricted substances.

RoHS Compliance Status						
Standard Product Series	Description	Package / Termination Type	Standard Series RoHS Compliant	Lead-Free Termination Composition	Lead-Free Mfg. Effective Date (Std Product Series)	Lead-Free Effective Date Code (YY/WW)
MLF	Precision Metal Film Melf Resistor	SMD	YES	100% Matte Sn	Always	Always
MLFM	Precision Metal Film Mini Melf Resistor	SMD	YES	100% Matte Sn	Always	Always

“Conflict Metals” Commitment

We at Stackpole Electronics, Inc. are joined with our industry in opposing the use of metals mined in the “conflict region” of the eastern Democratic Republic of the Congo (DRC) in our products. Recognizing that the supply chain for metals used in the electronics industry is very complex, we work closely with our own suppliers to verify to the extent possible that the materials and products we supply do not contain metals sourced from this conflict region. As such, we are in compliance with the requirements of Dodd-Frank Act regarding Conflict Minerals.

Compliance to “REACH”

We certify that all passive components supplied by Stackpole Electronics, Inc. are SVHC (Substances of Very High Concern) free and compliant with the requirements of EU Directive 1907/2006/EC, “The Registration, Evaluation, Authorization and Restriction of Chemicals”, otherwise referred to as REACH. Contact us for complete list of REACH Substance Candidate List.

Environmental Policy

It is the policy of Stackpole Electronics, Inc. (SEI) to protect the environment in all localities in which we operate. We continually strive to improve our effect on the environment. We observe all applicable laws and regulations regarding the protection of our environment and all requests related to the environment to which we have agreed. We are committed to the prevention of all forms of pollution.

How to Order

1	2	3	4	5	6	7	8	9	10	11	12
M	L	F	1	2	D	T	E	4	K	7	5

Product Series		Power Rating			Tolerance			Packaging				TCR		Resistance Value
Code	Description	Code	Size	W	Code	Tol	Value	Code	Description	Product Code	Quantity	Code	ppm	
MLF	Standard	18	0102	0.125	B	0.1%	E96, E24	T	7" Reel Plastic Tape	MLF18, MLF14, MLFM15, MLFM25	3000	Z	jumper	Four characters with the multiplier used as the decimal holder. 10 ohm = 10R0 100 ohm = 100R 1 Kohm = 1K00 560 Kohm = 560K zero ohm jumper = 0R00
MLFM	Mini	15	0102	0.2	D	0.5%				S	15			
		14	0204	0.25	F	1%	T			10				
		25	0204	0.4	J	5%	E			25				
		12	0207	0.5	Z	jumper	C	50						
		1	0207	1			D	100						