

Technical Note TN010: Replacement of Metal Glaze MELFs with Flat Chip Resistors

Introduction

In many applications it is possible to replace the obsolete MELF format metal glaze CHP series, its capped version SMC series, and its high surge version HSF series, with high surge performance thick film chip resistors. In some cases this can be performed without layout changes, but sometimes minor pad redesign will be required. The purpose of this document is to make the replacement process as easy as possible by showing the key parameters of CHP/SMC/HSF and its various chip resistor alternatives side by side.

Electrical Data Comparison

CHP

The following tables show data for the standard range of CHP parts split by footprint size and compared to flat chip alternatives. In the case of 3610 footprint, the largest flat chip size 2512 is used.

1206 Footprint		CHP1/8	PWC1206	HPWC1206	DSC1206	HDSC1206
Power Rating @70°C	W	0.25	0.33	0.33	0.33	0.33
Working Voltage (LEV)	V	200	200	200	200	200
Maximum Voltage (STOL)	V	400	500	500	500	500
Value Range	Ω	1R0 to 1M0	1R0 to 10M	1R0 to 1M0	1R0 to 4M7	1R0 to 1M0
Tolerance	%	1 to 5	0.5 to 5	≥5	0.5 to 5	≥5
TCR	ppm/°C	50 or 100	100	100	100	100
Maximum Operating Temperature	°C	150	155	155	155	155

2010 Footprint		CHP1/2	PWC2010	HPWC2010	DSC2010	HDSC2010
Power Rating @70°C	W	0.5	0.75	0.75	0.75	0.75
Working Voltage (LEV)	V	300	400	400	400	400
Maximum Voltage (STOL)	V	600	1000	1000	1000	1000
Value Range	Ω	1R0 to 348K	1R0 to 10M	1R0 to 1M0	1R0 to 4M7	1R0 to 1M0
Tolerance	%	1 to 5	0.5 to 5	≥5	0.5 to 5	≥5
TCR	ppm/°C	50 or 100	100	100	100	100
Maximum Operating Temperature	°C	150	155	155	155	155

2512 Footprint		CHP1	PWC2512	HPWC2512	DSC2512	HDSC2512
Power Rating @70°C	W	1	1.5	1.5	1.5	1.5
Working Voltage (LEV)	V	350	500	500	500	500
Maximum Voltage (STOL)	V	700	1250	1250	1250	1250
Value Range	Ω	1R0 to 2M21	1R0 to 10M	1R0 to 1M0	1R0 to 4M7	1R0 to 1M0
Tolerance	%	1 to 5	0.5 to 5	≥5	0.5 to 5	≥5
TCR	ppm/°C	50 or 100	100	100	100	100
Maximum Operating Temperature	°C	150	155	155	155	155

3610 Footprint		CHP2	PWC2512	HPWC2512	DSC2512	HDSC2512
Power Rating @70°C	W	1.33	1.5	1.5	1.5	1.5
Working Voltage (LEV)	V	500	500	500	500	500
Maximum Voltage (STOL)	V	1000	1250	1250	1250	1250
Value Range	Ω	1R0 to 2M21	1R0 to 10M	1R0 to 1M0	1R0 to 4M7	1R0 to 1M0
Tolerance	%	1 to 5	0.5 to 5	≥5	0.5 to 5	≥5
TCR	ppm/°C	50 or 100	100	100	100	100
Maximum Operating Temperature	°C	150	155	155	155	155

Meets or exceeds specification
Meets specification partially

SMC

The following tables show data for the SMC parts split by footprint size and compared to flat chip alternatives. In the case of 3610 footprint, the largest flat chip size 2512 is used.

2512 Footprint		SMC1	PWC2512	HPWC2512	DSC2512	HDSC2512
Power Rating @70°C	W	1	1.5	1.5	1.5	1.5
Working Voltage (LEV)	V	350	500	500	500	500
Maximum Voltage (STOL)	V	700	1250	1250	1250	1250
Value Range	Ω	1R0 to 1M0	1R0 to 10M	1R0 to 1M0	1R0 to 4M7	1R0 to 1M0
Tolerance	%	1 to 5	0.5 to 5	≥5	0.5 to 5	≥5
TCR	ppm/°C	100 or 200	100	100	100	100
Maximum Operating Temperature	°C	150	155	155	155	155

3610 Footprint		SMC2	PWC2512	HPWC2512	DSC2512	HDSC2512
Power Rating @70°C	W	1.33	1.5	1.5	1.5	1.5
Working Voltage (LEV)	V	500	500	500	500	500
Maximum Voltage (STOL)	V	1000	1250	1250	1250	1250
Value Range	Ω	1R0 to 1M0	1R0 to 10M	1R0 to 1M0	1R0 to 4M7	1R0 to 1M0
Tolerance	%	1 to 5	0.5 to 5	≥5	0.5 to 5	≥5
TCR	ppm/°C	100 or 200	100	100	100	100
Maximum Operating Temperature	°C	150	155	155	155	155

Meets or exceeds specification
Meets specification partially

HSF

The following tables show data for the HSF parts split by footprint size and compared to flat chip alternatives. In the case of 3610 footprint, the largest flat chip size 2512 is used.

2512 Footprint		HSF1	PWC2512	HPWC2512	DSC2512	HDSC2512
Power Rating @70°C	W	1	1.5	1.5	1.5	1.5
Working Voltage (LEV)	V	350	500	500	500	500
Value Range	Ω	5R9 to 270R	1R0 to 10M	1R0 to 1M0	1R0 to 4M7	1R0 to 1M0
Tolerance	%	10	0.5 to 5	≥5	0.5 to 5	≥5
TCR	ppm/°C	200	100	100	100	100
Maximum Operating Temperature	°C	150	155	155	155	155

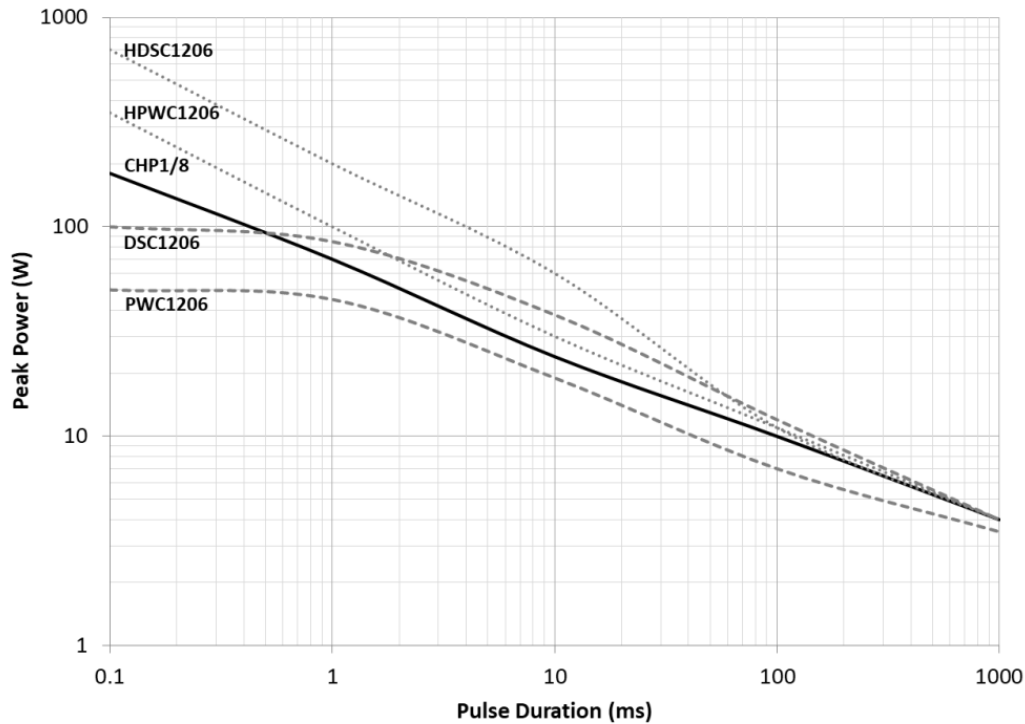
3610 Footprint		HSF2	PWC2512	HPWC2512	DSC2512	HDSC2512
Power Rating	W	2@25°C	1.5@70°C	1.5@70°C	1.5@70°C	1.5@70°C
Working Voltage (LEV)	V	500	500	500	500	500
Value Range	Ω	8R2 to 300R	1R0 to 10M	1R0 to 1M0	1R0 to 4M7	1R0 to 1M0
Tolerance	%	10	0.5 to 5	≥5	0.5 to 5	≥5
TCR	ppm/°C	200	100	100	100	100
Maximum Operating Temperature	°C	150	155	155	155	155

Meets or exceeds specification
Meets specification partially

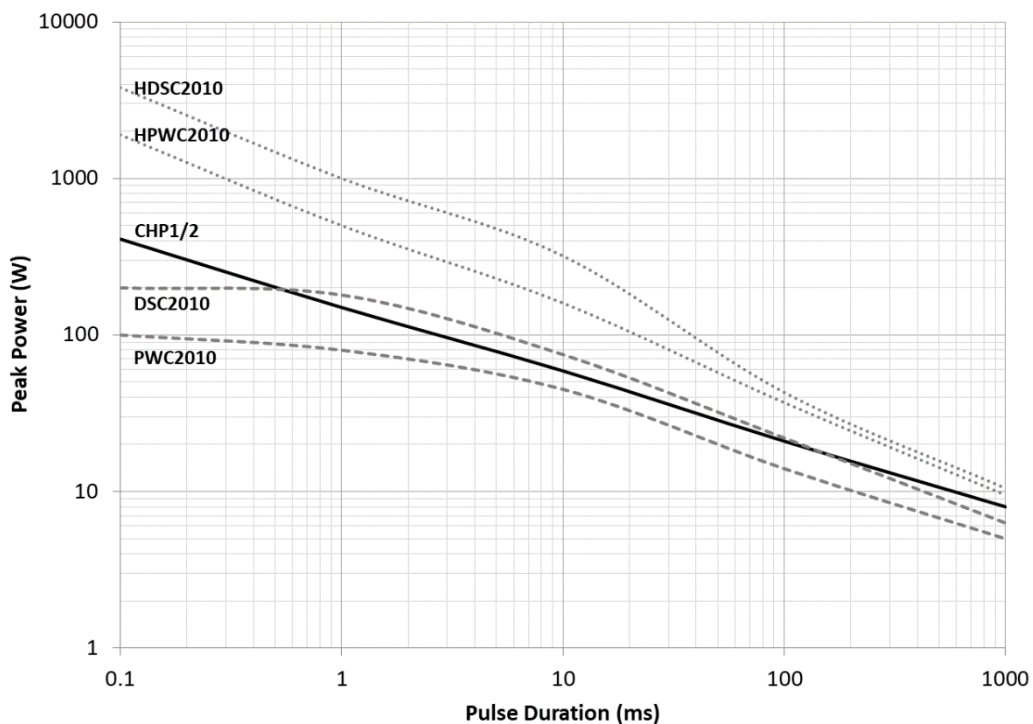
Surge Performance Comparison

In applications where surge performance is required, the graphs below should be used to select the most appropriate flat chip replacement. In some cases this will depend on the range of pulse durations and any restrictions on value tolerance. Note that continuous pulse peak power limits for all these products are around 50% of those shown for single pulse. The test conditions used were 50 pulses with no cumulative heating and $\Delta R < 1\%$.

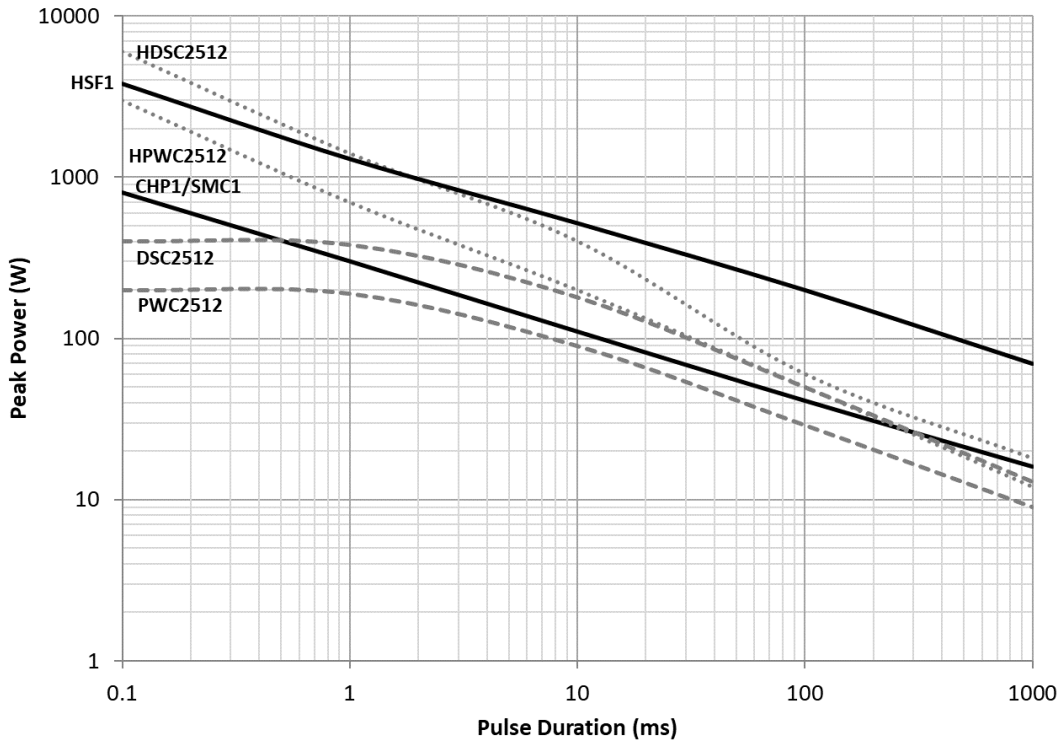
Single Pulse / Low Repetition Surge 1206 Footprint



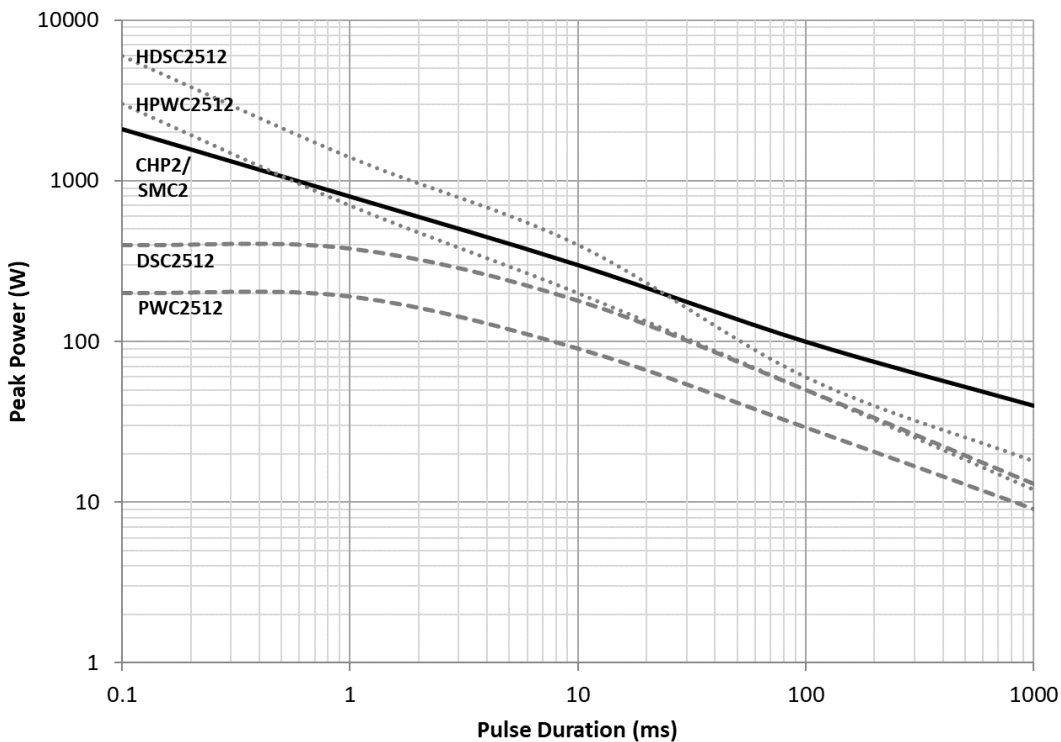
Single Pulse / Low Repetition Surge 2010 Footprint



Single Pulse / Low Repetition Surge 2512 Footprint

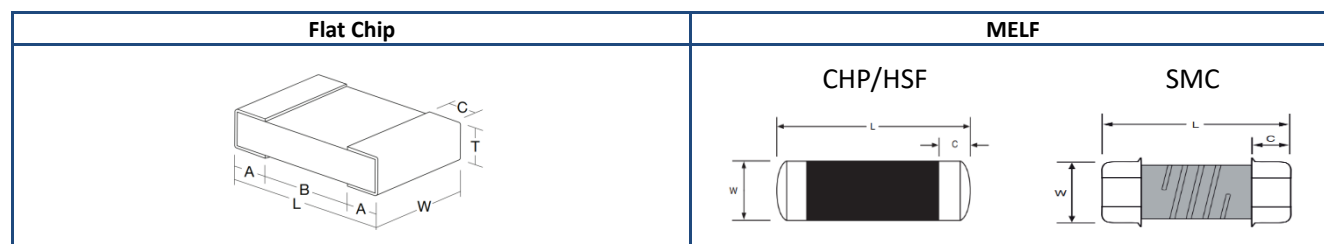


Single Pulse / Low Repetition Surge 3610 Footprint



Physical Data Comparison

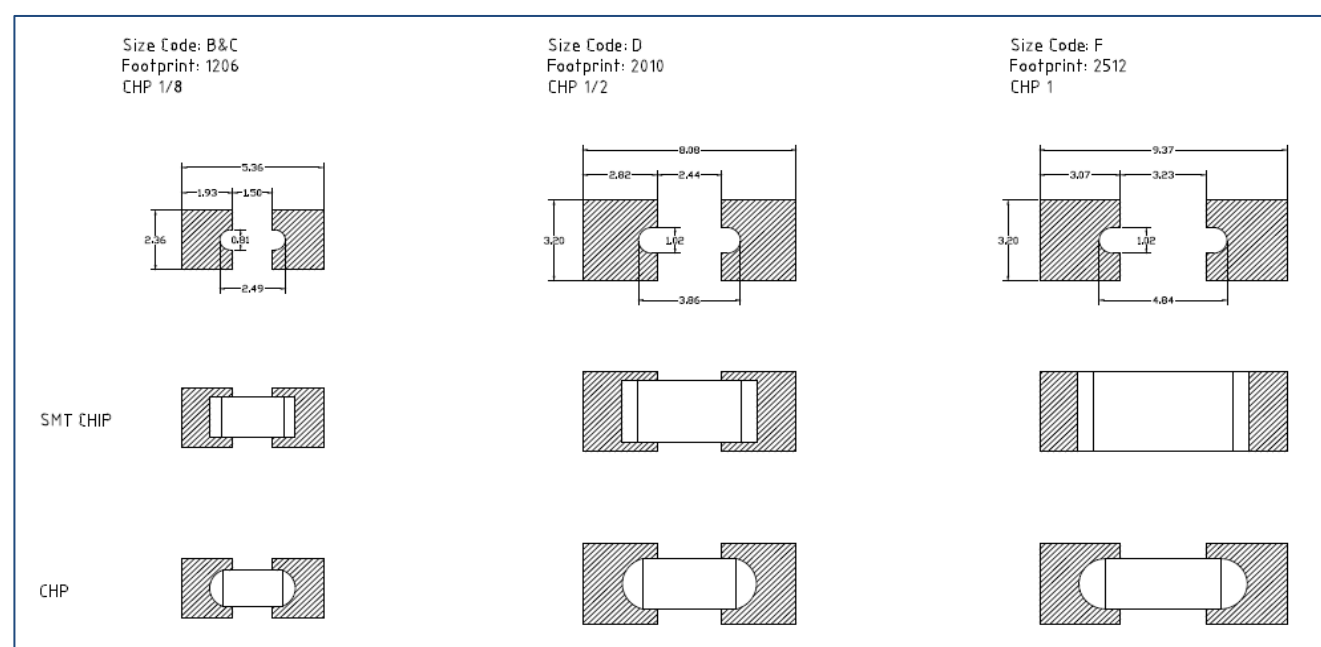
In general, the flat chip products are nearly identical in length, somewhat wider in the larger sizes and considerably lower in height.



Dimensions (mm) Flat Chip (MELF)	Length max. L (L)	Width (Diameter) max. W (W)	Height (Diameter) max. T (W)	Termination Depth nom. A (C)
CHP1/8	3.43	1.60	1.60	0.51
1206 Chip	3.40	1.62	0.70	0.40
CHP1/2	5.33	2.29	2.29	0.76
2010 Chip	5.40	2.70	0.80	0.60
CHP1/HSF1 (SMC1)	6.63 (6.6)	2.29 (3.18)	2.29 (3.18)	1.02 (1.5)
2512 Chip	6.80	3.40	0.80	0.60
CHP2/HSF2 (SMC2)	9.57 (9.57)	2.95 (3.18)	2.95 (3.18)	1.27 (1.5)
2512 Chip	6.80	3.40	0.80	0.60

PCB Layout Examples

The drawings below show the three sizes of CHP (1206, 2010, 2512) and SMC1/HSF1 (2512) for which single chip replacement without redesign is often possible. Note that the size code H with 3610 footprint of CHP2/SMC2/HSF2 is not included as this will normally need PCB redesign. These show the recommended CHP/SMC/HSF pad designs, the same with corresponding flat chip replacement parts and finally with the original MELF products mounted.



Product Descriptions & Datasheets

CHP Cylindrical High Power	metal glaze MELF resistor https://www.ttelectronics.com/TTElectronics/media/ProductFiles/Datasheets/OBSOLETE-CHP.pdf
SMC Surface Mount Capped	metal glaze MELF resistor with cap terminations https://www.ttelectronics.com/TTElectronics/media/ProductFiles/Datasheets/OBSOLETE-SMC.pdf
HSF High Surge Film	metal glaze MELF resistor with no spiral trim https://www.ttelectronics.com/TTElectronics/media/ProductFiles/Datasheets/OBSOLETE-HSF.pdf
PWC Pulse Withstanding Chip	thick film chip resistor with pulse withstanding laser trim method https://www.ttelectronics.com/TTElectronics/media/ProductFiles/Datasheets/PWC.pdf
HPWC High Pulse Withstanding Chip	thick film chip resistor with no laser trim https://www.ttelectronics.com/TTElectronics/media/ProductFiles/Datasheets/HPWC.pdf
DSC Double-Sided Chip	thick film chip resistor with double element and pulse withstanding laser trim method https://www.ttelectronics.com/TTElectronics/media/ProductFiles/Datasheets/DSC.pdf
HDSC High Pulse Double-Sided Chip	thick film chip resistor with double element and no laser trim https://www.ttelectronics.com/TTElectronics/media/ProductFiles/Datasheets/HDSC.pdf