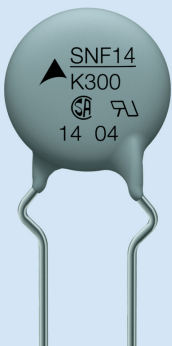


EPCOS Product Brief 2014

Protection Devices for On-Board Chargers



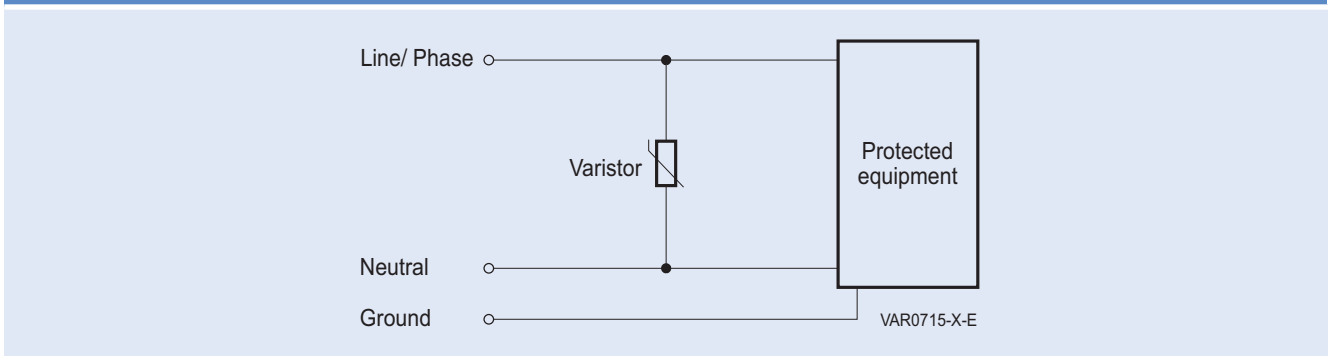
Protection Devices for On-Board Chargers

The batteries of electric and hybrid vehicles can be charged either at public charging points or at home using home charge devices (wall box).

For this purpose, electric and hybrid vehicles are equipped with an on-board charger (OBC). The electronics of the OBC controls and monitors the process of charging the battery. Overvoltages can occur during charging which can damage or destroy the electronics of the OBC.

Varistors (Figure 1) or a combination of varistors and surge arresters are used (Figure 2 circuit 2 x varistor and 1 x surge arrester) to protect the OBC against such overvoltages.

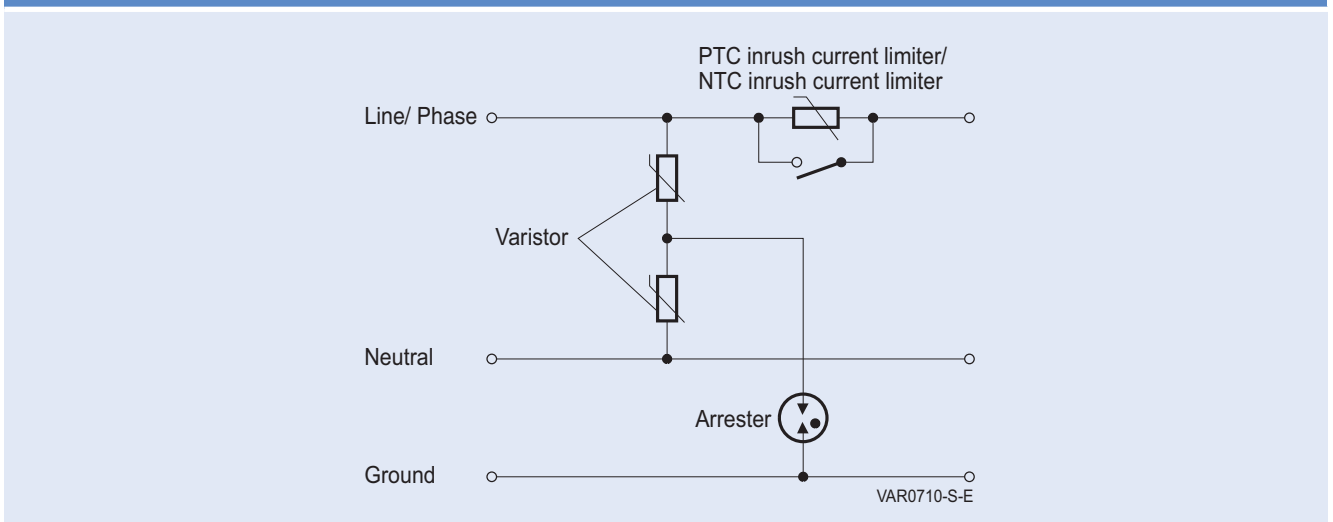
Figure 1 Overvoltage protection concept with varistors (line to line protection)



The SNF14 and SNF20 series of disk varistors were the first varistors worldwide to be developed specifically for overvoltage protection in 110/ 230 V AC networks and that are able to satisfy the tough requirements of the AEC-Q200, Rev. D standard, which is widely used in the automotive industry.

The SNF automotive product series features varistors with disk diameters of 14 mm and 20 mm in the voltage range of 275 V AC to 625 V AC. These disk varistors are suitable for use in both AC and DC applications.

Figure 2 Overvoltage protection concept with varistors and surge arresters (line to line and line to ground protection)



SIOV Metal Oxide Varistors, SNF14

Leaded Varistors, AdvancedD Series



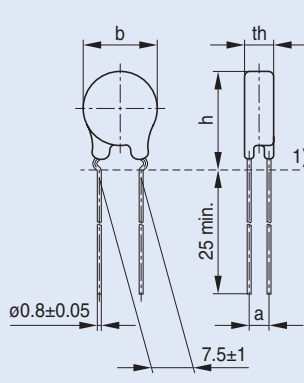
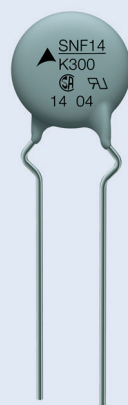
Electrical specification and ordering codes

Ordering code	Maximum ratings ($T_a = 125\text{ }^\circ\text{C}$)					Characteristics ($T_a = 25\text{ }^\circ\text{C}$)				Approvals	
	V_{RMS}	V_{DC}	I_{max} (8/20) 1 time	W_{max} (2 ms) 1 time	P_{max}	V_V (1 mA)	$v_{c,\text{max}}$ (i_c)	i_c	C_{typ} (1 kHz)	UL 1449	AEC-Q200, Rev. D
	V	V	A	J	W	V ΔV_V	V	A	pF		
B72214X2131K501	130	170	6000	50	0.6	205 \pm 10%	340	50	880	●	●
B72214X2141K501	140	180	6000	55	0.6	220 \pm 10%	360	50	820	●	●
B72214X2151K501	150	200	6000	60	0.6	240 \pm 10%	395	50	750	●	●
B72214X2171K501	175	225	6000	70	0.6	270 \pm 10%	455	50	670	●	●
B72214X2211K501	210	270	6000	80	0.6	330 \pm 10%	545	50	580	●	●
B72214X2231K501	230	300	6000	90	0.6	360 \pm 10%	595	50	530	●	●
B72214X2251K501	250	320	6000	100	0.6	390 \pm 10%	650	50	490	●	●
B72214X2271K501	275	350	6000	110	0.6	430 \pm 10%	710	50	440	●	●
B72214X2301K501	300	385	6000	125	0.6	470 \pm 10%	775	50	400	●	●
B72214X2321K501	320	420	6000	136	0.6	510 \pm 10%	840	50	370	●	●
B72214X2351K501	350	460	5000	136	0.6	560 \pm 10%	910	50	340	●	●
B72214X2381K501	385	505	5000	136	0.6	620 \pm 10%	1025	50	315	●	●
B72214X2421K501	420	560	5000	136	0.6	680 \pm 10%	1120	50	290	●	●
B72214X2461K501	460	615	5000	150	0.6	750 \pm 10%	1240	50	260	●	●
B72214X2511K501	510	670	5000	165	0.6	820 \pm 10%	1355	50	240	●	●
B72214X2551K501	550	745	5000	180	0.6	910 \pm 10%	1500	50	215	●	●

Operating temperature for all types: $-40/+125\text{ }^\circ\text{C}$

Dimensional drawing

Ordering code	Type SIOV-	b_{max} mm	h_{max} mm	th_{max} mm	$a \pm 1$ mm
B72214X2131K501	SNF14K130E2S5	17.5	23.0	7.6	1.9
B72214X2141K501	SNF14K140E2S5	17.5	23.0	7.7	2.0
B72214X2151K501	SNF14K150E2S5	17.5	23.0	7.8	2.1
B72214X2171K501	SNF14K175E2S5	17.5	23.0	7.9	2.2
B72214X2211K501	SNF14K210E2S5	17.5	23.0	8.0	1.9
B72214X2231K501	SNF14K230E2S5	17.5	23.0	8.1	2.0
B72214X2251K501	SNF14K250E2S5	17.5	23.0	8.2	2.1
B72214X2271K501	SNF14K275E2S5	17.5	23.0	8.4	2.2
B72214X2301K501	SNF14K300E2S5	17.5	23.0	8.6	2.3
B72214X2321K501	SNF14K320E2S5	17.5	23.5	8.8	2.4
B72214X2351K501	SNF14K350E2S5	17.5	23.5	9.5	2.9
B72214X2381K501	SNF14K385E2S5	17.5	23.5	10.1	3.4
B72214X2421K501	SNF14K420E2S5	17.5	23.5	10.5	3.6
B72214X2461K501	SNF14K460E2S5	17.5	23.5	10.8	3.8
B72214X2511K501	SNF14K510E2S5	17.5	23.5	11.1	4.0
B72214X2551K501	SNF14K550E2S5	17.5	23.5	11.5	4.7

VAR0713-V-E

SIOV Metal Oxide Varistors, SNF20

Leaded Varistors, AdvanceD Series



Electrical specification and ordering codes												
Ordering code	Maximum ratings ($T_a = 125\text{ }^\circ\text{C}$)					Characteristics ($T_a = 25\text{ }^\circ\text{C}$)				Approvals		
	V_{RMS}	V_{DC}	I_{max} (8/20) 1 time	W_{max} (2 ms) 1 time	P_{max}	V_V (1 mA)		$v_{\text{c,max}}$ (i_c)	i_c	C_{typ} (1 kHz)	UL 1449	AEC-Q200, Rev. D
	V	V	A	J	W	V	ΔV_V	V	A	pF		
B72220X2131K501	130	170	10000	100	1	205 ±10%		340	100	1850	●	●
B72220X2141K501	140	180	10000	110	1	220 ±10%		360	100	1700	●	●
B72220X2151K501	150	200	10000	120	1	240 ±10%		395	100	1550	●	●
B72220X2171K501	175	225	10000	135	1	270 ±10%		455	100	1350	●	●
B72220X2211K501	210	270	10000	160	1	330 ±10%		545	100	1100	●	●
B72220X2231K501	230	300	10000	180	1	360 ±10%		595	100	1000	●	●
B72220X2251K501	250	320	10000	195	1	390 ±10%		650	100	940	●	●
B72220X2271K501	275	350	10000	215	1	430 ±10%		710	100	850	●	●
B72220X2301K501	300	385	10000	250	1	470 ±10%		775	100	780	●	●
B72220X2321K501	320	420	10000	273	1	510 ±10%		840	100	720	●	●
B72220X2381K501	385	505	10000	273	1	620 ±10%		1025	100	600	●	●
B72220X2421K501	420	560	10000	273	1	680 ±10%		1120	100	550	●	●

Operating temperature for all types: $-40/+125\text{ }^\circ\text{C}$

Dimensional drawing						
Ordering code	Type SIOV-	b_{max} mm	h_{max} mm	th_{max} mm	$a \pm 1$ mm	
B72220X2131K501	SNF20K130E2S5	23.5	30.0	8.0	2.0	<p>1) Seating plane to IEC 60717 VAR0714-W-E</p>
B72220X2141K501	SNF20K140E2S5	23.5	30.0	8.1	2.1	
B72220X2151K501	SNF20K150E2S5	23.5	30.0	8.2	2.2	
B72220X2171K501	SNF20K175E2S5	23.5	30.0	8.3	2.3	
B72220X2211K501	SNF20K210E2S5	23.5	30.0	8.4	2.2	
B72220X2231K501	SNF20K230E2S5	23.5	30.0	8.5	2.3	
B72220X2251K501	SNF20K250E2S5	23.5	30.0	8.7	2.4	
B72220X2271K501	SNF20K275E2S5	23.5	30.0	8.8	2.6	
B72220X2301K501	SNF20K300E2S5	23.5	30.0	9.1	2.8	
B72220X2321K501	SNF20K320E2S5	23.5	30.0	9.2	2.9	
B72220X2381K501	SNF20K385E2S5	23.5	30.5	10.6	3.9	
B72220X2421K501	SNF20K420E2S5	23.5	30.5	10.9	4.2	

2-Electrode Arresters

For gas-filled surge arresters, we recommend the use of types from the A71* or EHV6* series. The surge arresters of the A71* or EHV6* series are available with rated DC spark-over voltages ranging from 800 V to 5500 V or from 800 V to 4500 V. With the use of surge arresters in series with varistors the leakage current can be reduced to an absolute minimum.

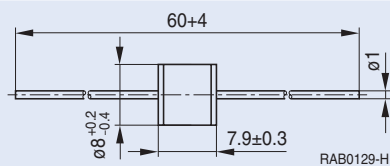


Medium-duty/ High-voltage types – A71-H**X 10 kA/ 10 A • \varnothing 8 × 8 mm

Electrical specification and ordering codes

Type	A71-H08X	A71-H25X	A71-H35X	
Ordering code	B88069X2140S102	B88069X2190S102	B88069X2200S102	
Nom. DC spark-over voltage V_{sdCN}	800	2500	3500	V
Impulse spark-over voltage @ 1 kV/ μ s	< 1100	< 3900	< 4900	V
Maximum current @ 8/20 μ s	15	15	15	kA
Service life 10 operations 8/20 μ s	10	10	10	kA
Insulation resistance R_{ins}	> 10	> 10	> 10	G Ω
Capacitance @ 1 MHz	< 1	< 1	< 1	pF
UL 1449 approval	●	●	●	

Dimensional drawing

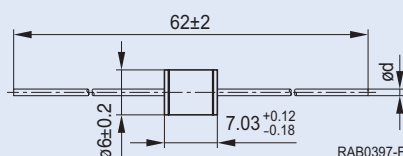


Light-duty/ High-voltage types – EHV63-H** 3 kA • \varnothing 6 × 7 mm

Electrical specification and ordering codes

Type	EHV63-H08	EHV63-H30	EHV63-H36	
Ordering code	on request	B88069X2553...	B88069X3003...	
Nom. DC spark-over voltage V_{sdCN}	800	3000	3600	V
Impulse spark-over voltage @ 1 kV/ μ s	< 1000	< 3500	< 4300	V
Maximum current @ 8/20 μ s	5	5	5	kA
Service life 3 operations 8/20 μ s	3	3	3	kA
Service life 300 operations 8/20 μ s	100	100	100	A
Insulation resistance R_{ins} @ 100 V DC	> 1	> 1	> 1	G Ω
Capacitance @ 1 MHz	< 1	< 1	< 1	pF
UL 1449 approval	●	●	●	

Dimensional drawing



Safety note: Surge arresters must not be operated directly in power supply networks. The follow current must be limited so that the arrester can be properly extinguished when the surge has decayed.

PTC Thermistors, Inrush Current Limiters

In addition to varistors and surge arresters designed to assure protection from overvoltages, on-board chargers also use other protection devices. PTC thermistors, for example, are used to limit inrush currents. Unlike fixed resistors, which are also widely used, PTC thermistors are characterized by being inherently safe in the event of a fault. In the case of constant overcurrents, e.g. a short circuit, PTC thermistors become highly resistive without suffering damage.



Leaded disks, coated										
Electrical specifications and ordering codes										
Ordering code	Type	V_{max}	$V_{link,max}$	R_R	ΔR_R	T_{ref} (typ.)	C_{th}	τ_{th}	Approvals	
		V AC	V DC	Ω	%	$^{\circ}C$	J/K	s		AEC-Q200, Rev. D
B59412C1130B070	C1412	440	620	120	± 25	130	2.1	100	–	●
B59451C1130B070	C1451	440	620	56	± 25	130	2.1	100	–	●
B59750C0120A070	C750	260	360	25	± 25	115	1.0	100	●	–
B59751C0120A070	C751	260	360	50	± 25	115	1.4	120	●	–
B59755C0115A070	C755	560	800	500	± 25	110	1.4	120	●	–

Dimensional drawing				
Type	w_{max} mm	h_{max} mm	th_{max} mm	ϕd mm
C1412	15.0	19.0	7.5	0.8
C1451	15.0	19.0	7.5	0.8
C750	12.5	16.5	5.0	0.6
C751	12.5	16.5	7.0	0.6
C755	12.5	16.5	7.0	0.6

TPT1101-Y

PTC thermistors in phenolic resin plastic case						
Electrical specifications and ordering codes				Dimensional drawing		
Ordering code	Type ¹⁾	V_{max}	$V_{link,max}$	R_R	ΔR_R	T_{ref} (typ.)
		V AC	V DC	Ω	%	$^{\circ}C$
B59105J0130A020	J105	260	360	22	25	130
B59107J0130A020	J107	440	620	56	25	130
B59109J0130A020	J109	560	800	100	25	130

TPT0665-T-E

A new product series of PTC thermistors is in preparation, which are packaged in a plastic case and are qualified to AEC-Q200, Rev. D.

NTC Thermistors, Inrush Current Limiters

S364 Series

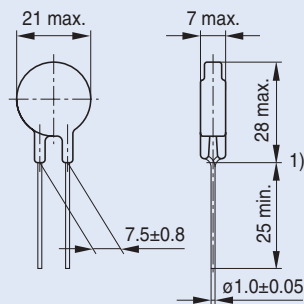
NTC inrush current limiters (NTC ICL) are another reliable solution for limiting inrush currents. They possess a high resistance at low temperatures (e.g. 25 °C), which limits the inrush currents. At higher powers, the NTC ICL is usually bridged with a relay or triac after the inrush current peaks have decayed. The NTC ICL must be selected so that it can carry the continuous current in the event that the relay is short-circuited.



Electrical specifications and ordering codes

Ordering code	R ₂₅ Ω	I _{max} (@ 0 ... 60 °C) A	I _{test} (@ 125 °C) A	B _{25/100} K	C _{test} (@ 110 V AC) μF	C _{test} (@ 230 V AC) μF	Operating temperature min/max °C	Approval AEC-Q200, Rev. D
B57364S1109M000	1	16.0	4.6	2800	4000	1000	-40/+125	●
B57364S1509M000	5	8.5	2.5	3060	4000	1000	-40/+125	●
B57364S1100M000	10	7.5	2.2	3300	4000	1000	-40/+125	●

Dimensional drawing



ICL0041-F-E



Symbols and Terms

Symbol	Term
$B_{25/100}$	B value determined by resistance measurement at 25 °C and 100 °C
C_{test}	Test capacitance
C_{typ}	Typical capacitance
C_{th}	Heat capacitance
i_c	Current at which $v_{c,\text{max}}$ is measured
I_{max}	Maximum current
I_{test}	Test current
P_{max}	Maximum power
R_R	Rated resistance
ΔR_R	Resistance tolerance
R_{25}	Resistance at 25 °C
T_{op}	Operating temperature
T_{ref}	Reference temperature
$v_{c,\text{max}}$	Maximum clamping voltage at specified current i_c
$V_{\text{clamp,max}}$	Maximum clamping voltage
V_{DC}	DC voltage
$V_{\text{link,max}}$	Maximum link voltage
V_{max}	Maximum voltage
V_{RMS}	AC operating voltage, root-mean-square value
V_V	Varistor voltage
W_{max}	Maximum energy absorption
τ_{th}	Thermal cooling time constant

Structure of ordering codes: The ordering code for one and the same product can be represented differently in data sheets, data books, other publications and the website of EPCOS, or in order-related documents such as shipping notes, order confirmations and product labels. **The varying representations of the ordering codes are due to different processes employed and do not affect the specifications of the respective products.** Detailed information can be found on the Internet under www.epcos.com/orderingcodes.

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