

MKT Capacitors

B 32520
... B 32529

SIEMENS AKTIENGESELLSCHAFT 47E D

A-05-17-05

Metalized polyester film capacitors in accordance with DIN 44112

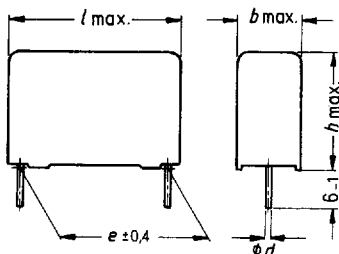
$V_R = 63$ to 630 Vdc

With quality assessment according to CECC 30401-043, edition 1, June 1983.

Self-healing capacitor with polyethyleneterephthalate dielectric. Encapsulated in a flame-retardant rectangular plastic case (in accordance with UL 94 V-0). Epoxy resin sealed for humidity resistance. For improved solderability, the package is provided with spacers. Connections: parallel leads, tinned, plug-in in the lead spacing. Particularly suited for space-saving assembly at high packing density on any PC board.

Packaging on continuous tapes

Capacitors with 5 mm and 7.5 mm lead spacing, as well as capacitors with a lead spacing of 7.5/5 mm (leads crimped to a lead spacing of 5 mm) are also available on continuous tape. For taping instructions and ordering code information refer to page 46.



l	Lead spacing e	dia. d
7.5	5	0.5
10	7.5	0.6
13	10	0.6
18	15	0.8
27	22.5	0.8
31.5	27.5	0.8

Dimensions in mm

DIN climatic category
in acc. with DIN 40040
Lower category temperature
Upper category temperature
Humidity category

Failure rate
($40^\circ\text{C}/104^\circ\text{F}$, V_R)

Load duration

F M E / J R

- F** - $55^\circ\text{C}/-67^\circ\text{F}$
- M** $+100^\circ\text{C}/+212^\circ\text{F}$)
- E** average relative humidity $\leq 75\%$;
95% for 30 days per year continuously;
85% for the remaining days occasionally;
rare, brief dew precipitation permitted
- J** $30 \times 10^{-9}/h = 30$ fit
for conversion tables for other stresses and
temperatures see page 42.
- R** $\geq 10^5$ h

Failure criteria

Total failure

Failure due to variations

- Short or open circuit
- Capacitance change $\frac{\Delta C}{C} > \pm 10\%$
- Dissipation factor $\tan \delta > 2 \times$ upper category values
- Insulation resistance $< 150 \text{ M}\Omega$ ($\leq 0.33 \mu\text{F}$)
 $< 50 \text{ s}$ ($> 0.33 \mu\text{F}$)

1) Shelf and service life at temperatures $> 100 \dots 125^\circ\text{C}/212 \dots 257^\circ\text{F}$, 1000 h max., $V_C = 0.5 V_R$.

MKT-Capacitors

A-05-17-05

B32520
... B32529

SIEMENS AKTIENGESELLSCHAFT 47E D

Lead spacing		LS 15mm				
Rated dc voltage		63V	100V	250V	400V	630V
Rated capacitance		Dimensions b x h x l (mm) and ordering code				
CR	Tolerance	B32522 -				
0.01	μF					
0.015	μF					
0.022	μF					
0.033	μF					5.0x10.5x18.0 N8333
0.047	μF				5.0x10.5x18.0 C6473	6.0x11.0x18.0 N8473
0.068	μF				5.0x10.5x18.0 C6683	7.0x12.5x18.0 N8683
0.1	μF			5.0x10.5x18.0 C3104	5.0x10.5x18.0 C6104	8.5x14.5x18.0 N8104
0.15	μF			5.0x10.5x18.0 C3154	6.0x11.0x18.0 C6154	
0.22	μF			5.0x10.5x18.0 C3224	7.0x12.5x18.0 C6224	
0.33	μF	± 20% M	5.0x10.5x18.0 C1334	6.0x11.0x18.0 C3334	8.5x14.5x18.0 C6334	
0.47	μF	± 10% K	5.0x10.5x18.0 C1474	7.0x12.5x18.0 C3474		
0.68	μF	± 5% J	5.0x10.5x18.0 C684	5.0x10.5x18.0 C1684	8.5x14.5x18.0 C3684	
1	μF		5.0x10.5x18.0 C105	6.0x11.0x18.0 C1105	9.0x17.5x18.0 C3105	
1.5	μF		5.0x10.5x18.0 C155	7.0x12.5x18.0 C1155		
2.2	μF		7.0x12.5x18.0 C225	8.5x14.5x18.0 C1225		
3.3	μF		8.5x14.5x18.0 C335			
4.7	μF					
6.8	μF					

MKT Capacitors

A-05-17-05

B 32520
...B 32529

SIEMENS AKTIENGESELLSCHAFT 47E D

IEC climatic category in acc. with DIN IEC 68-1	55/100/56																
Damp heat test in acc. with DIN IEC 68-2-3	Conditions Test temperature +40°C/+104°F Relative humidity (93 \pm 2 / -3) % Test duration 56 days Test criteria Capacitance change $\frac{\Delta C}{C}$ $\leq \pm 5\%$ Dissipation factor change $\Delta \tan \delta$ at 1 kHz $\leq 5 \times 10^{-3}$ Insulation resistance $\geq 50\%$ of the minimum value as supplied																
Resistance to vibration Test Fc in acc. with DIN IEC 68-2-6: vibration, sinusoidal	Duration of endurance conditioning 6 h Frequency range 10... 55 Hz Displacement amplitude 0.75 mm (conforming to 98.1 m/s ² max. or to 10 g) At 10 Hz... 2 kHz capacitors with LS ≥ 22.5 mm must additionally be fixed at the case.																
Resistance to soldering heat¹⁾ Test Tb in acc. with DIN IEC 68-2-20	Solder bath temperature max. 260°C/500°F Soldering duration max. 5 s Capacitance change $\frac{\Delta C}{C}$ $\leq \pm 2\%$																
Resistance to cleaning agents	Refer to section "General Information", page 37.																
Capacitance drift i_z	$\pm 3\%$																
Self inductance	<table border="1" style="display: inline-table; border-collapse: collapse;"> <tr> <td style="padding: 2px;">Lead spacing (mm)</td> <td style="padding: 2px;">5</td> <td style="padding: 2px;">7.5</td> <td style="padding: 2px;">10</td> <td style="padding: 2px;">15</td> <td style="padding: 2px;">22.5</td> <td style="padding: 2px;">27.5</td> </tr> <tr> <td style="padding: 2px;">Self inductance (approx. nH)</td> <td style="padding: 2px;">5</td> <td style="padding: 2px;">8</td> <td style="padding: 2px;">9</td> <td style="padding: 2px;">10</td> <td style="padding: 2px;">20</td> <td style="padding: 2px;">20</td> </tr> </table>		Lead spacing (mm)	5	7.5	10	15	22.5	27.5	Self inductance (approx. nH)	5	8	9	10	20	20	
Lead spacing (mm)	5	7.5	10	15	22.5	27.5											
Self inductance (approx. nH)	5	8	9	10	20	20											
Dissipation factor $\tan \delta$ measured at 20°C/68°F	<table border="1" style="display: inline-table; border-collapse: collapse;"> <tr> <td colspan="3" style="text-align: center; padding: 2px;">Upper limits/Average production values</td> </tr> <tr> <td style="padding: 2px;">$C_R < 0.1 \mu\text{F}$</td> <td style="padding: 2px;">$C_R \geq 0.1 \dots < 1 \mu\text{F}$</td> <td style="padding: 2px;">$C_R \geq 1 \mu\text{F}$</td> </tr> <tr> <td style="padding: 2px;">at 1 kHz</td> <td style="padding: 2px;">8/ 5×10^{-3}</td> <td style="padding: 2px;">10/ 6×10^{-3}</td> </tr> <tr> <td style="padding: 2px;">at 10 kHz</td> <td style="padding: 2px;">15/ 12×10^{-3}</td> <td style="padding: 2px;">20/ 15×10^{-3}</td> </tr> <tr> <td style="padding: 2px;">at 100 kHz</td> <td style="padding: 2px;">30/ 18×10^{-3}</td> <td style="padding: 2px;">-</td> </tr> </table>		Upper limits/Average production values			$C_R < 0.1 \mu\text{F}$	$C_R \geq 0.1 \dots < 1 \mu\text{F}$	$C_R \geq 1 \mu\text{F}$	at 1 kHz	8/ 5×10^{-3}	10/ 6×10^{-3}	at 10 kHz	15/ 12×10^{-3}	20/ 15×10^{-3}	at 100 kHz	30/ 18×10^{-3}	-
Upper limits/Average production values																	
$C_R < 0.1 \mu\text{F}$	$C_R \geq 0.1 \dots < 1 \mu\text{F}$	$C_R \geq 1 \mu\text{F}$															
at 1 kHz	8/ 5×10^{-3}	10/ 6×10^{-3}															
at 10 kHz	15/ 12×10^{-3}	20/ 15×10^{-3}															
at 100 kHz	30/ 18×10^{-3}	-															

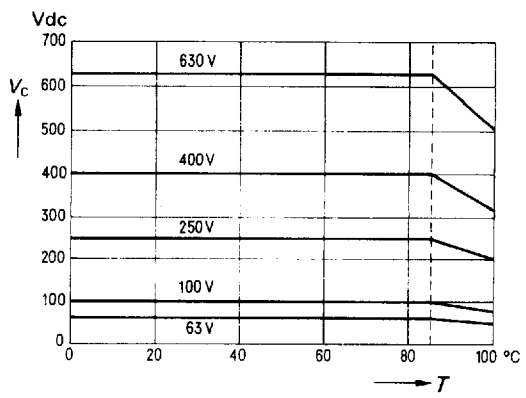
A-05-17-05

B 32520
... B 32529

SI SIEMENS AKTIENGESELLSCHAFT 47E D

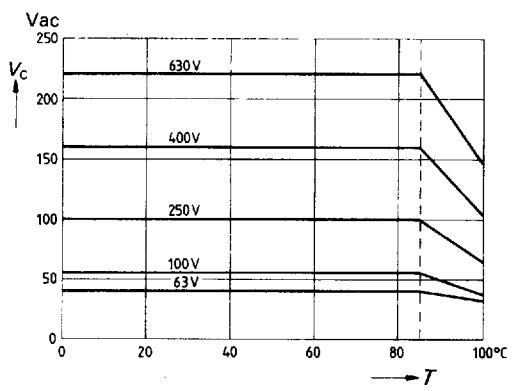
Category voltage V_C versus temperature T at dc operation

2000 h max. $1.25 \times V_C$
for milliseconds (e.g. switchings) $1.50 \times V_C$

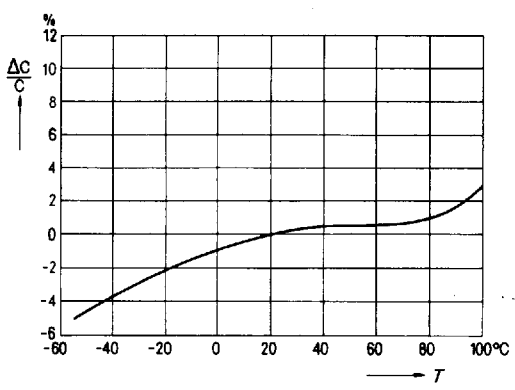


Category voltage V_C versus temperature T at ac operation at 50 Hz

max. 2000 hours $1.25 \times V_C$
for milliseconds (e.g. switchings) $1.50 \times V_C$



Capacitance change $\frac{\Delta C}{C}$ versus temperature T (typical values, measured at 1 kHz)



1) The sum of the dc voltage and the peak value of an ac voltage superimposed on the dc voltage may not exceed the rated voltage.
2) Capacitors of the 630 Vdc series can be used as 250 Vac line power parallel capacitors if it is ensured that voltage peaks occurring occasionally during operation do not exceed 1000 V.

MKT Capacitors

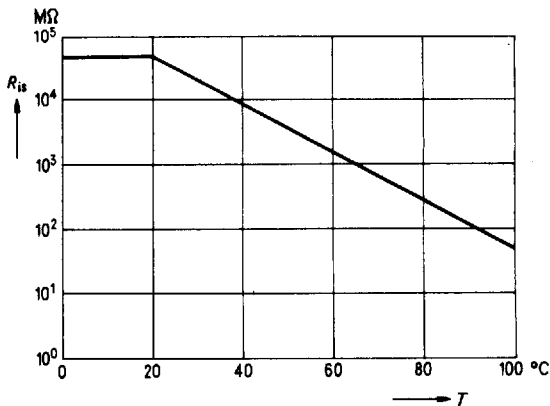
A-05-17-05

B 32520

... B 32529

SIEMENS AKTIENGESELLSCHAFT 47E D

Insulation resistance R_{is} versus temperature T



Typical values measured at 20°C/68°F and a relative humidity $\leq 65\%$

Insulation resistance R_{is} and time constant τ

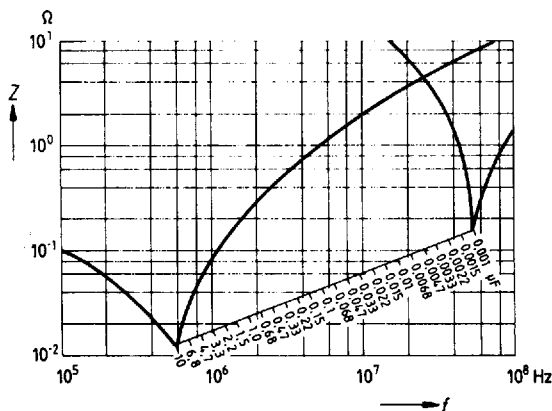
Minimum value as supplied¹⁾

V_R	$C_R \leq 0.33 \mu F$	$C_R > 0.33 \mu F$
$\leq 100 V$	3750 MΩ	1250 sec
$\geq 250 V$	7500 MΩ	2500 sec

Average value as supplied

V_R	$C_R \leq 0.33 \mu F$	$C_R > 0.33 \mu F$
$\leq 100 V$	> 30 000 MΩ	> 10 000 sec
$\geq 250 V$	> 75 000 MΩ	> 25 000 sec

Impedance Z versus frequency f (typical values)



¹⁾ The indicated values apply at the time of delivery. During the service life, the insulation may temporarily decrease to approx. 10% of the value at the time of delivery, especially if the max. permissible relative humidity of 95% of the humidity category E is applied for a longer period, or if the capacitor is operated close to the upper category temperature.

Pulse Handling Capability

Rated Voltage		LS 5	LS 7.5	LS 10	LS 15	LS 22.5	LS 27.5	
63 V -	U_{SS}/τ in V/ μ S k_0 in V ² / μ S	150 20.000	80 10.000	50 6.300	30 3.800	2 250		
100 V -		200 40.000	100 20.000	75 15.000	50 10.000	2.5 500	2 400	
250 V -		400 125.000	200 100.000	150 75.000	100 50.000	4 2.000	3 1.500	
400 V -		500 320.000	250 200.000	175 150.000	125 100.000	7 5.600	5 4.000	
630 V -					15 19.000	10 12.600	8 10.000	

For a voltage deviation of $V_{pp} < V_R$ the value of the permissible voltage rate of rise V_{pp}/τ can be multiplied by the factor V_R/V_{pp} . The data of the nomogram must be considered in case of periodic pulses. See also calculation example in section "General Information", para. 5.2.6.

AC power handling capability at higher frequencies

The maximum permissible peak voltage \hat{V} for sinusoidal and non-sinusoidal voltages (pulse, sawtooth, trapezoidal voltages) can be determined from the nomogram.

The nomogram is based on 10°C/50°F inherent temperature rise of the capacitor; this must be considered during operation with regard to the permissible upper category temperature.

The following limits may not be exceeded:

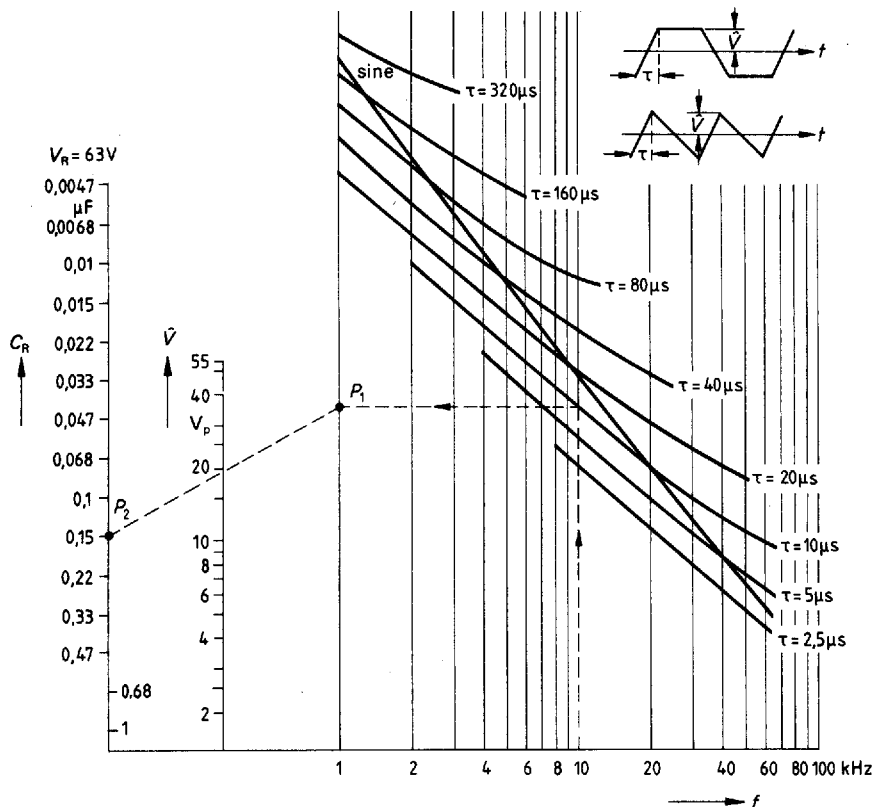
Rated dc voltage V_R	63 V	100 V	250 V	400 V	630 V
Limit voltage \hat{V}_l	55 V	85 V	140 V	224 V	280 V

B 32529, LS 5 mm

Nomogram to determine the permissible peak voltage \hat{V}

Determine the intersections P_1 and P_2 according to the plotted example. The intersection of the line connecting P_1 with P_2 and the \hat{V} scale gives the maximum permissible peak voltage.

In case of a trapezoidal voltage load, the second harmonic frequency must be considered. With sinusoidal voltage load, the "sine" characteristic applies.



Example:

- | | | |
|----------------------|------------------------|----------------------|
| $f = 10$ kHz | (repetition frequency) | } intersection P_1 |
| $\tau = 10$ μs | (rise time) | |
| $C_R = 0.15$ μF | (capacitance) | } intersection P_2 |
| $V_R = 63$ V | (rated voltage) | |

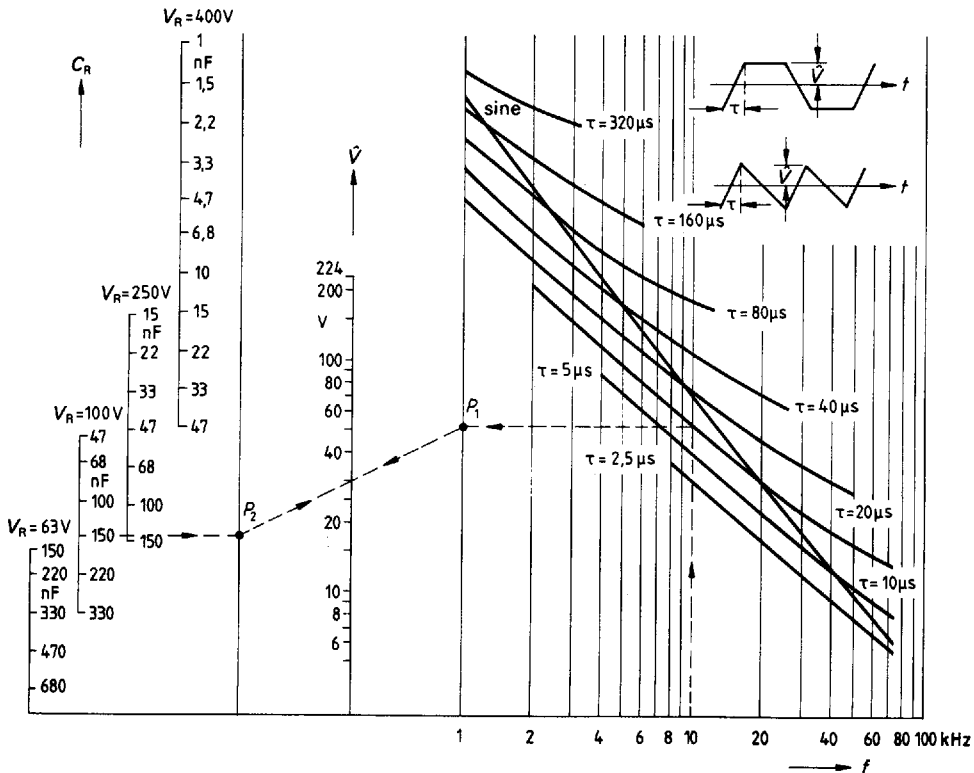
According to the dashed line in the above graph, this results in a max. peak voltage \hat{V} of approx. 19 V.

B 32520, LS 7.5 mm

Nomogram to determine the permissible peak voltage \hat{V}

Determine the intersections P_1 and P_2 according to the plotted example. The intersection of the line connecting P_1 with P_2 and the \hat{V} scale gives the maximum permissible peak voltage.

In case of a trapezoidal voltage load with two steep edges, the second harmonic frequency must be considered. With sinusoidal voltage load, the "sine" characteristic applies.



Example:

- | | | |
|---------------------|------------------------|----------------------|
| $f = 10$ kHz | (repetition frequency) | } intersection P_1 |
| $\tau = 10$ μ s | (rise time) | |
| $C_R = 150$ nF | (capacitance) | } intersection P_2 |
| $V_R = 100$ V | (rated voltage) | |

According to the dashed line in the above graph, this results in a max. peak voltage \hat{V} of approx. 30 V.

MKT Capacitors

A-05-17-05

B 32520

SIEMENS AKTIENGESELLSCHAFT 47E D D

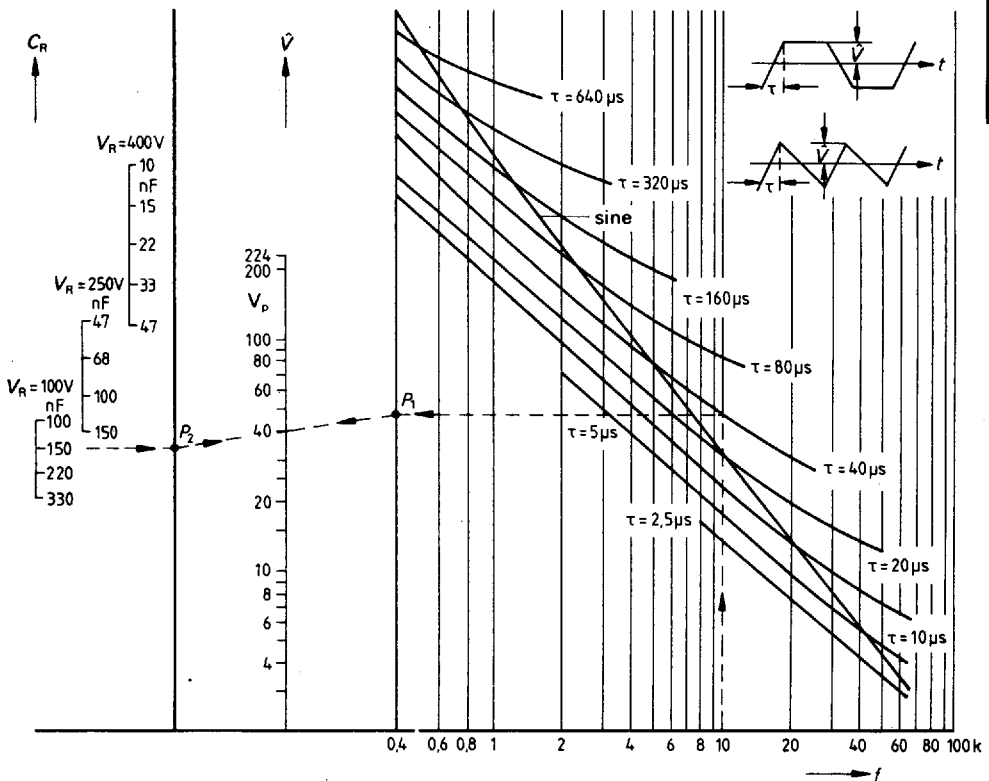
...B 32529

B 32521, LS 10 mm

Nomogram to determine the permissible peak voltage \hat{V}

Determine the intersections P_1 and P_2 according to the plotted example. The intersection of the line connecting P_1 with P_2 and the \hat{V} scale gives the maximum permissible peak voltage.

In case of a trapezoidal voltage load with two steep edges, the second harmonic frequency must be considered. With sinusoidal voltage load, the "sine" characteristic applies.



Example:

- | | | | |
|---------------------|------------------------|---|--------------------|
| $f = 10$ kHz | (repetition frequency) | } | intersection P_1 |
| $\tau = 40$ μ s | (rise time) | | |
| $C_R = 150$ nF | (capacitance) | } | intersection P_2 |
| $V_R = 100$ V | (rated voltage) | | |

According to the dashed line in the above graph, this results in a max. peak voltage \hat{V} of approx. 40 V.

A-05-17-05

B 32520

SIEMENS AKTIENGESELLSCHAFT 47E D

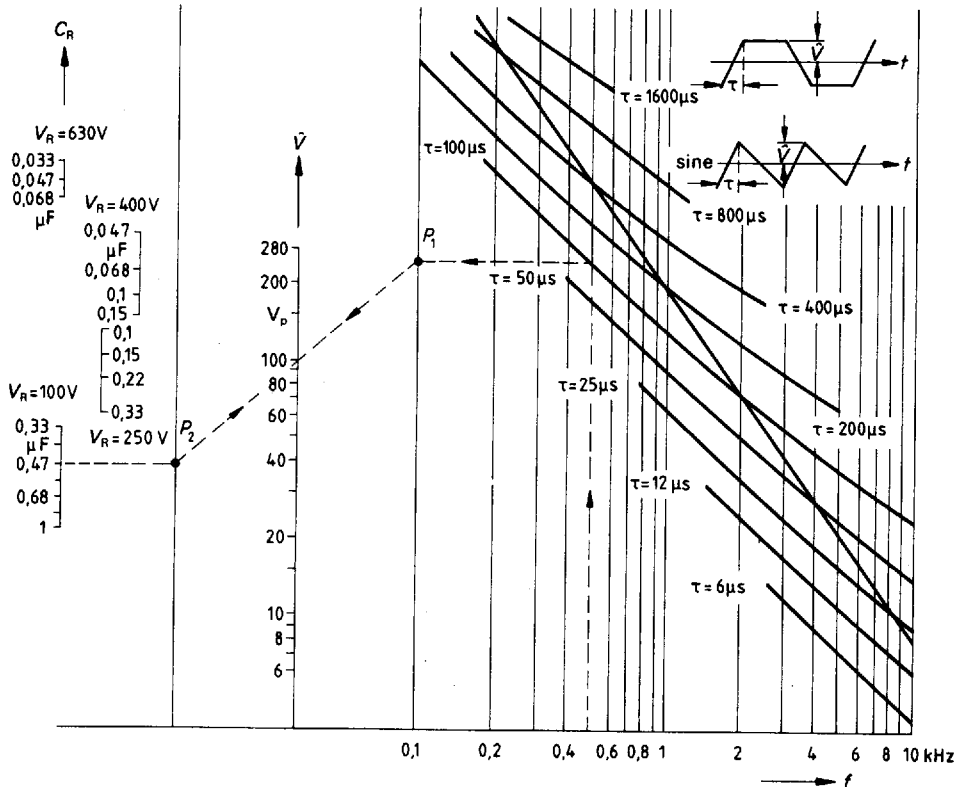
... B 32529

B 32522, LS 15 mm

Nomogram to determine the permissible peak voltage \hat{V}

Determine the intersections P_1 and P_2 according to the plotted example. The intersection of the line connecting P_1 with P_2 and the \hat{V} scale gives the maximum permissible peak voltage.

In case of a trapezoidal voltage load with two steep edges, the second harmonic frequency must be considered. With sinusoidal voltage load, the "sine" characteristic applies.



Example:

- | | | |
|----------------------|------------------------|----------------------|
| $f = 0.5$ kHz | (repetition frequency) | } intersection P_1 |
| $\tau = 100$ μs | (rise time) | |
| $C_R = 0.47$ μF | (capacitance) | } intersection P_2 |
| $V_R = 100$ V | (rated voltage) | |

According to the dashed line in the above graph, this results in a max. peak voltage \hat{V} of approx. 100 V.

For loads at frequencies > 10 kHz, please contact us.

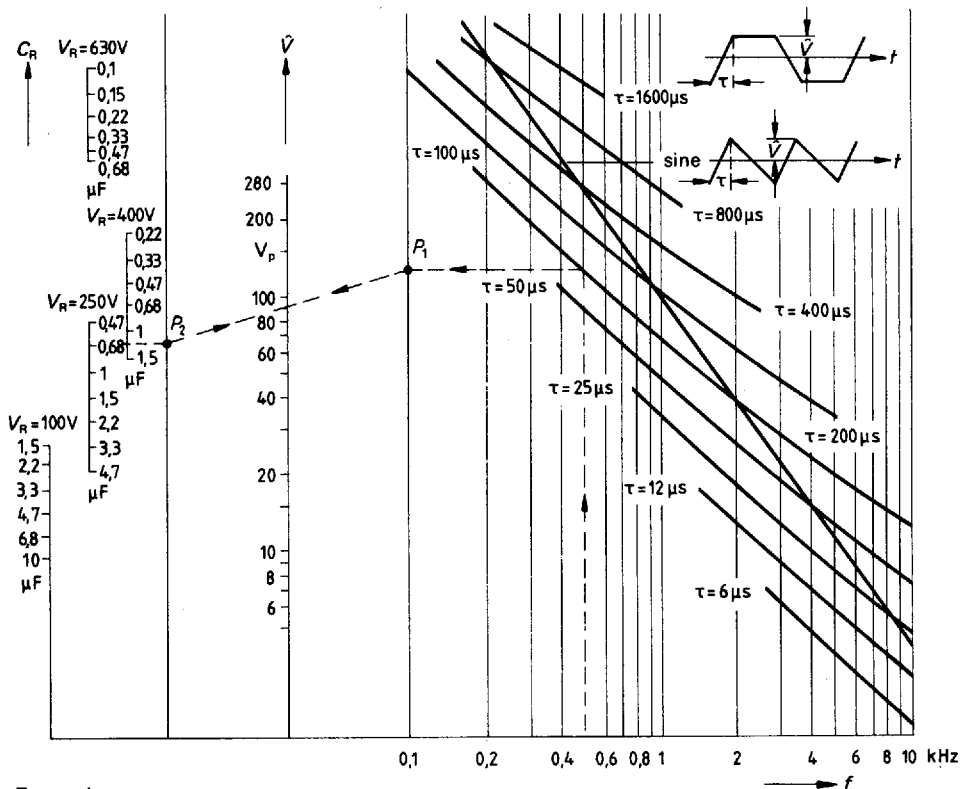
B 32523, LS 22.5 mm

B 32524, LS 27.5 mm

Nomogram to determine the permissible peak voltage \hat{V}

Determine the intersections P_1 and P_2 according to the plotted example. The intersection of the line connecting P_1 with P_2 and the \hat{V} scale gives the maximum permissible peak voltage.

In case of a trapezoidal voltage load with two steep edges, the second harmonic frequency must be considered. With sinusoidal voltage load, the "sine" characteristic applies.

**Example:**

$f = 0.5$ kHz (repetition frequency)	}	intersection P_1
$\tau = 100 \mu s$ (rise time)		
$C_R = 0.68 \mu F$ (capacitance)	}	intersection P_2
$V_R = 250 V$ (rated voltage)		

According to the dashed line in the above graph, this results in a max. peak voltage \hat{V} of approx. 90 V.

For loads at frequencies > 10 kHz, please contact us.