

# DATA SHEET

## **051/053 PEC-PW**

Aluminum electrolytic capacitors  
Power Economic Printed Wiring

Product specification  
Supersedes data of January 1998  
File under BC Components, BC01

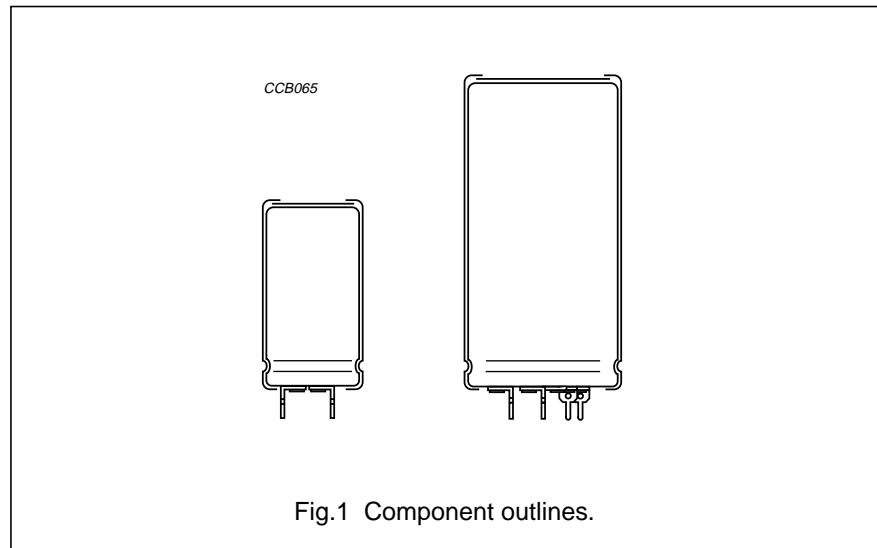
2000 Jan 18

# Aluminum electrolytic capacitors Power Economic Printed Wiring

051/053 PEC-PW

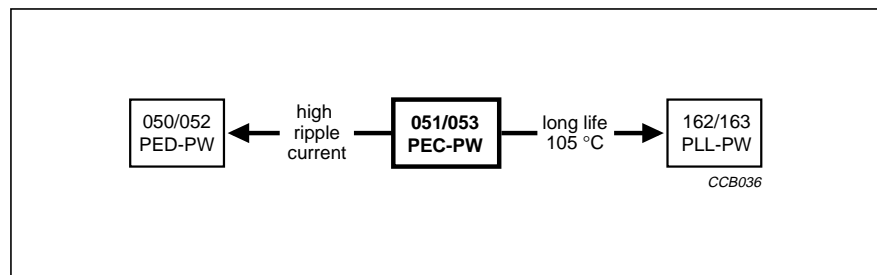
## FEATURES

- Polarized aluminum electrolytic capacitors, non-solid electrolyte
- Large types with reduced dimensions, cylindrical aluminum case, insulated with a blue sleeve
- Provided with keyed polarity
- Pressure relief on the top of the aluminium case
- Charge and discharge proof
- Long useful life:  
12000 hours at 85 °C
- High ripple current capability
- High resistance to shock and vibration.



## APPLICATIONS

- General purpose, industrial and audio/video systems
- Smoothing and filtering
- Standard and switched mode power supplies
- Energy storage in pulse systems.



## QUICK REFERENCE DATA

DESCRIPTION	VALUE	
	051	053
Case size ( $\varnothing D_{nom} \times L_{nom}$ in mm)	25 × 30 to 40 × 100	
Rated capacitance range (E6 series), $C_R$	680 to 150000 $\mu F$	68 to 2200 $\mu F$
Tolerance on $C_R$	±20%	
Rated voltage range, $U_R$	10 to 100 V	200 to 400 V
Category temperature range	-40 to +85 °C	
Endurance test at 85 °C	5000 hours	
Useful life at 85 °C	12000 hours	
Useful life at 40 °C, $1.4 \times I_R$ applied	200000 hours	
Shelf life at 0 V, 85 °C	500 hours	
Based on sectional specification	IEC 60384-4/EN130300	
Climatic category IEC 60068	40/085/56	

# Aluminum electrolytic capacitors

## Power Economic Printed Wiring

051/053 PEC-PW

### Selection chart for $C_R$ , $U_R$ and relevant nominal case sizes ( $\varnothing D \times L$ in mm)

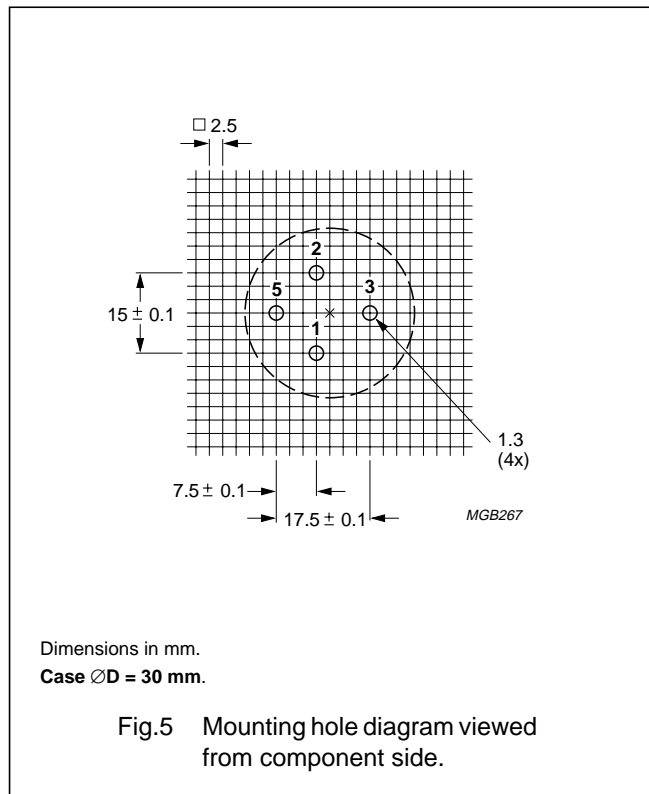
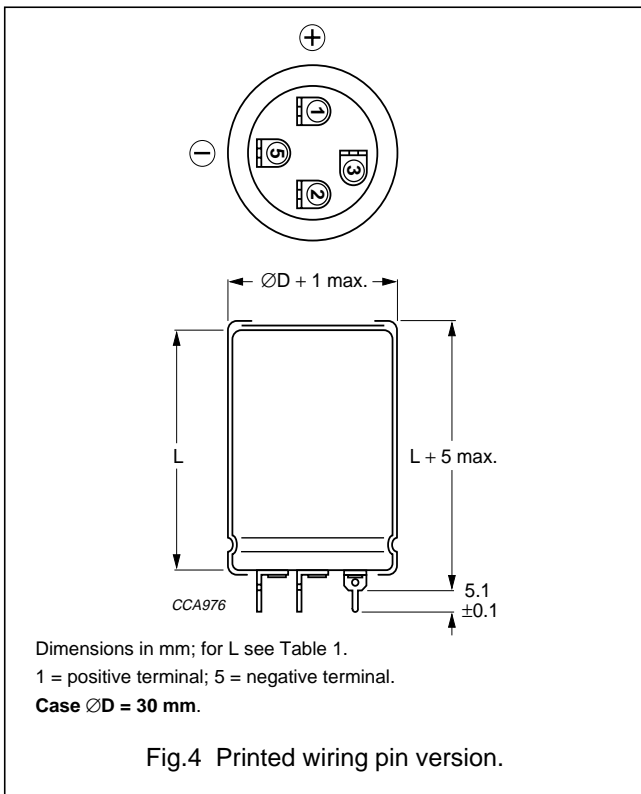
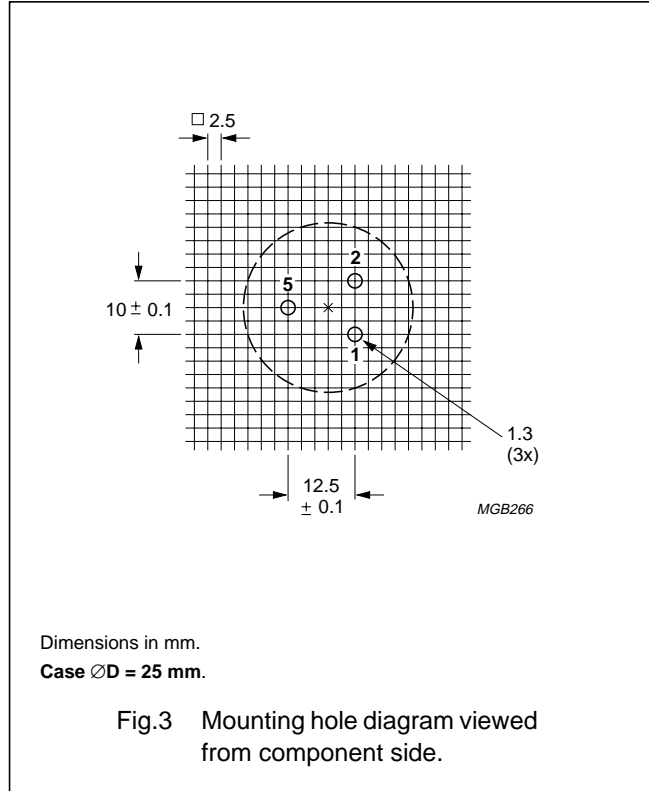
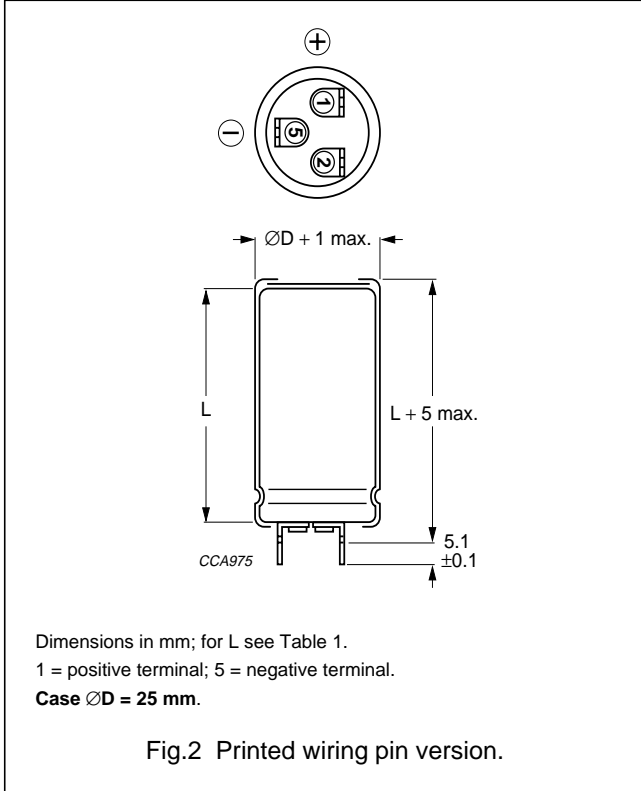
Preferred types in **bold**

$C_R$ ( $\mu F$ )	$U_R$ (V)								
	10	16	25	40	63	100	200	385	400
68	–	–	–	–	–	–	–	25 × 30	25 × 30
<b>100</b>	–	–	–	–	–	–	–	<b>25 × 40</b>	<b>25 × 40</b>
150	–	–	–	–	–	–	25 × 30	30 × 40	30 × 40
<b>220</b>	–	–	–	–	–	–	<b>25 × 40</b>	<b>35 × 40</b>	<b>35 × 40</b>
330	–	–	–	–	–	–	30 × 40	<b>35 × 50</b>	<b>35 × 50</b>
	–	–	–	–	–	–	–	40 × 40	40 × 40
<b>470</b>	–	–	–	–	–	–	<b>35 × 40</b>	<b>40 × 50</b>	<b>40 × 50</b>
680	–	–	–	–	–	25 × 30	<b>35 × 50</b>	40 × 70	40 × 70
	–	–	–	–	–	–	40 × 40	–	–
<b>1000</b>	–	–	–	–	–	<b>25 × 40</b>	<b>40 × 50</b>	<b>40 × 100</b>	<b>40 × 100</b>
1500	–	–	–	–	–	30 × 40	40 × 70	–	–
<b>2200</b>	–	–	–	–	<b>25 × 30</b>	<b>35 × 40</b>	<b>40 × 100</b>	–	–
3300	–	–	–	25 × 30	25 × 40	<b>35 × 50</b>	–	–	–
	–	–	–	–	–	40 × 40	–	–	–
<b>4700</b>	–	–	<b>25 × 30</b>	<b>25 × 40</b>	<b>30 × 40</b>	<b>40 × 50</b>	–	–	–
6800	–	25 × 30	25 × 40	30 × 40	35 × 40	40 × 70	–	–	–
<b>10000</b>	<b>25 × 30</b>	<b>25 × 40</b>	<b>30 × 40</b>	<b>35 × 40</b>	<b>35 × 50</b>	<b>40 × 100</b>	–	–	–
	–	–	–	–	40 × 40	–	–	–	–
15000	25 × 40	30 × 40	35 × 40	<b>35 × 50</b>	40 × 70	–	–	–	–
	–	–	–	40 × 40	–	–	–	–	–
<b>22000</b>	<b>30 × 40</b>	<b>35 × 40</b>	<b>35 × 50</b>	<b>40 × 50</b>	<b>40 × 100</b>	–	–	–	–
	–	–	40 × 40	–	–	–	–	–	–
33000	35 × 40	<b>35 × 50</b>	40 × 50	40 × 70	–	–	–	–	–
	–	40 × 40	–	–	–	–	–	–	–
<b>47000</b>	<b>35 × 50</b>	<b>40 × 50</b>	<b>40 × 70</b>	<b>40 × 100</b>	–	–	–	–	–
	40 × 40	–	–	–	–	–	–	–	–
68000	40 × 50	40 × 70	40 × 100	–	–	–	–	–	–
<b>100000</b>	<b>40 × 70</b>	<b>40 × 100</b>	–	–	–	–	–	–	–
150000	40 × 100	–	–	–	–	–	–	–	–

Aluminum electrolytic capacitors  
Power Economic Printed Wiring

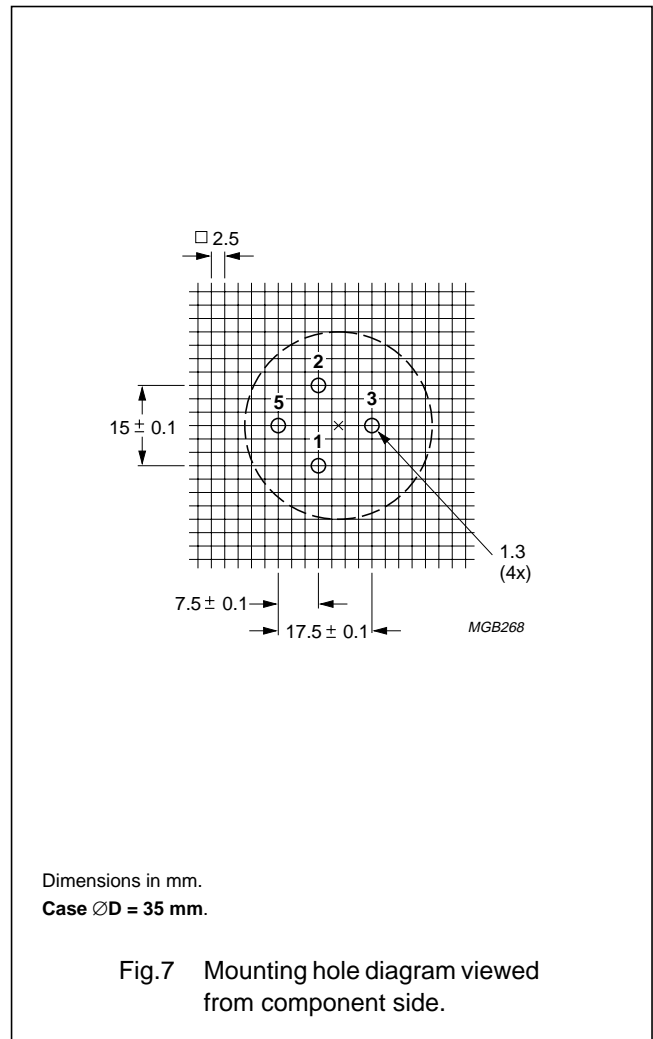
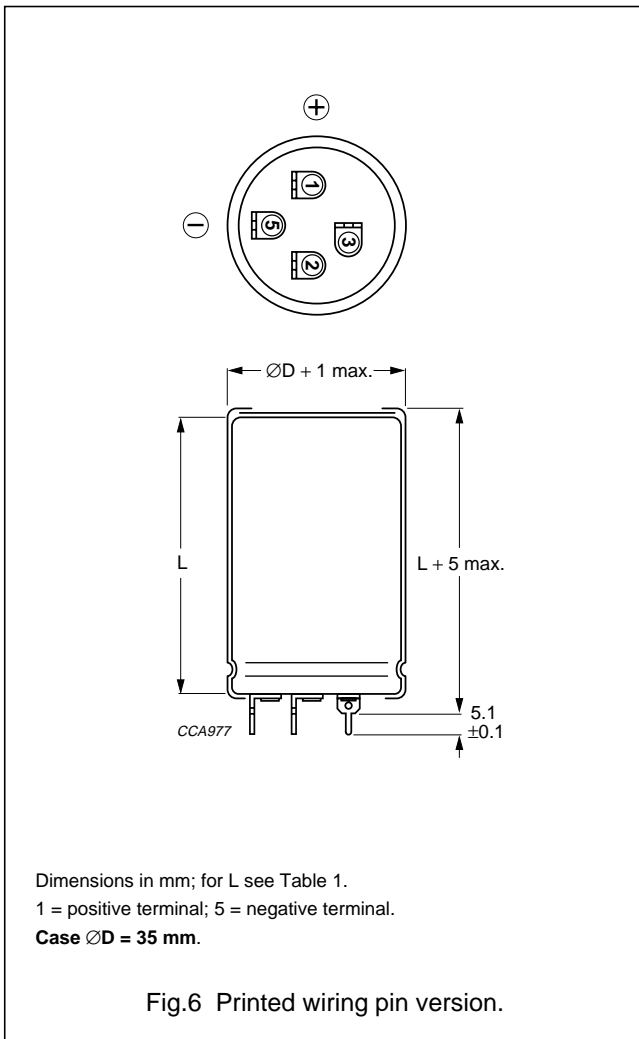
051/053 PEC-PW

MECHANICAL DATA AND PACKAGING QUANTITIES



Aluminum electrolytic capacitors  
Power Economic Printed Wiring

051/053 PEC-PW

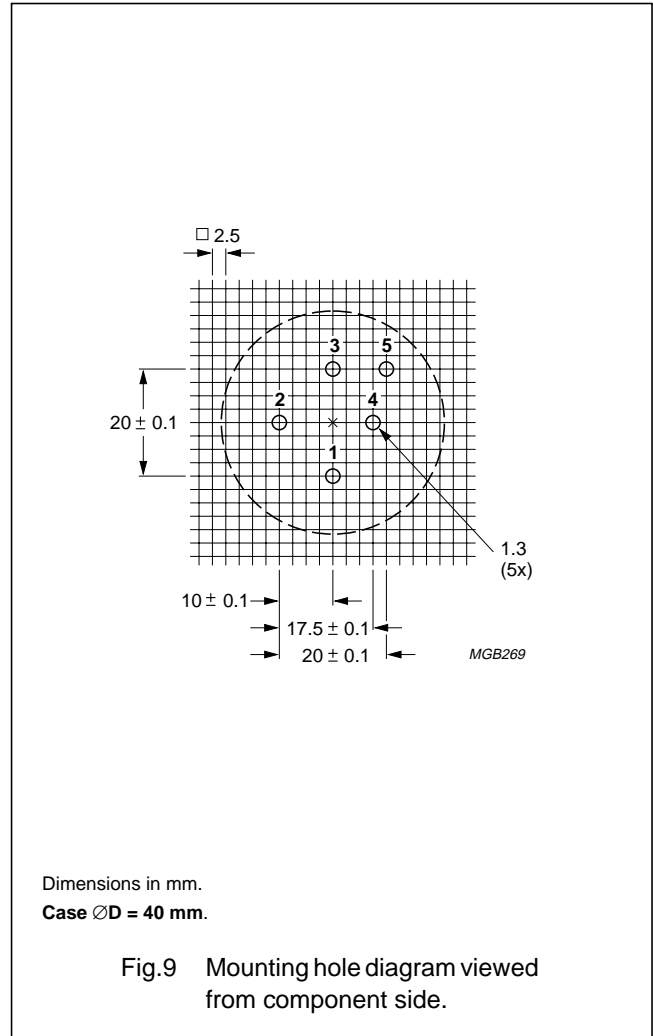
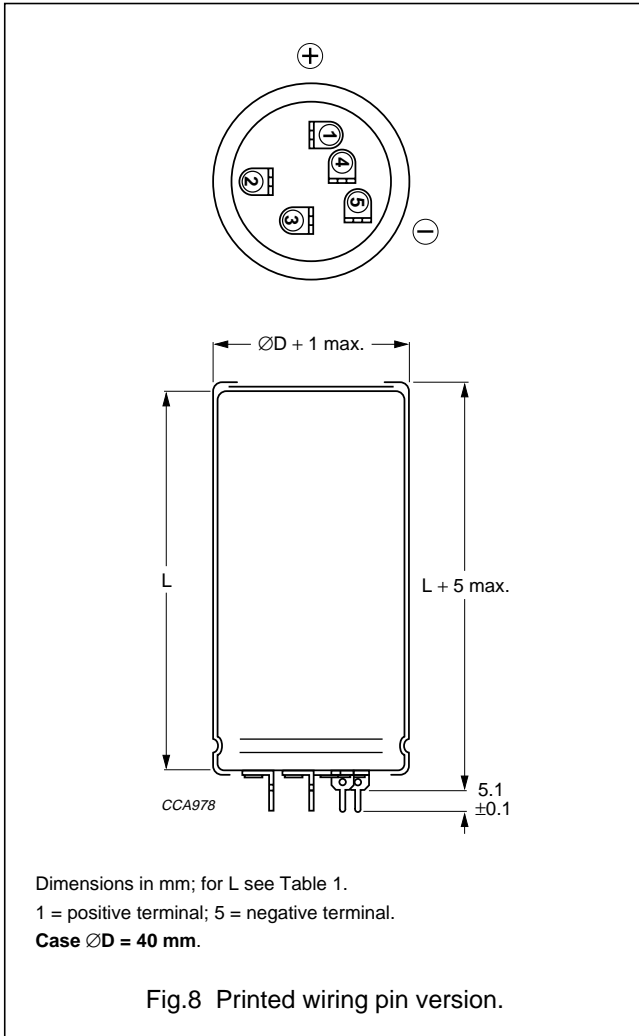


**Table 1** Physical dimensions, mass and packaging information; see Figs 2, 4, 6 and 8

NOMINAL CASE SIZE $\varnothing D \times L$ (mm)	$\varnothing D_{max}$ (mm)	$L_{max}$ (mm)	MASS (g)	PACKAGING QUANTITIES (units per box)	CARDBOARD BOX DIMENSIONS $l \times w \times h$ (mm)
25 × 30	26	35	≈24	100	290 × 280 × 50
25 × 40	26	45	≈28	100	290 × 280 × 60
30 × 40	31	45	≈38	100	340 × 330 × 60
35 × 40	36	45	≈51	50	390 × 198 × 60
35 × 50	36	55	≈66	50	390 × 198 × 70
40 × 40	41	45	≈78	50	440 × 223 × 60
40 × 50	41	55	≈82	50	440 × 223 × 70
40 × 70	41	75	≈110	50	440 × 223 × 90
40 × 100	41	105	≈176	50	440 × 223 × 120

Aluminum electrolytic capacitors  
Power Economic Printed Wiring

051/053 PEC-PW



**Mounting**

When a number of capacitors are connected in a bank, they must not be closer together than 15 mm, when no derating of ripple current and/or temperature is applied.

**Pin numbers 2, 3 and 4 (if present) must be free from the electrical circuit.**

**MARKING**

The capacitors are marked (where possible) with the following information:

- Rated capacitance (in  $\mu F$ )
- Tolerance on rated capacitance (M for  $\pm 20\%$ )

- Rated voltage (in V)
- Climatic category in accordance with "IEC 60068"
- Date code (year and week) in accordance with "IEC 60062"
- Code for factory of origin
- Name of manufacturer
- Polarity of the terminals and '-' sign to indicate the negative terminal, visible from the top and/or side of the capacitor
- Code number
- Code for basic specification in accordance with "IEC 60384-4-1" and "CECC 30301".

# Aluminum electrolytic capacitors

## Power Economic Printed Wiring

051/053 PEC-PW

### ELECTRICAL DATA AND ORDERING INFORMATION

Unless otherwise specified, all electrical values in Tables 2 and 3 apply at  
 $T_{amb} = 20\text{ °C}$ ,  $P = 86\text{ to }106\text{ kPa}$ ,  $RH = 45\text{ to }75\%$ .

SYMBOL	DESCRIPTION
$C_R$	rated capacitance at 100 Hz
$I_R$	rated RMS ripple current at 100 Hz, 85 °C or at 20 kHz, 70 °C
$I_{L1}$	max. leakage current after 1 minute at $U_R$
$I_{L5}$	max. leakage current after 5 minutes at $U_R$
ESR	max. equivalent series resistance at 100 Hz
Z	max. impedance at 10 kHz

### Ordering example

Electrolytic capacitor 051 series

10000  $\mu\text{F}/25\text{ V}$ ;  $\pm 20\%$ Nominal case size:  $\varnothing 30 \times 40\text{ mm}$ 

Catalogue number: 2222 051 56103.

**Table 2** Electrical data and ordering information for **051** series; preferred types in **bold**

$U_R$ (V)	$C_R$ 100 Hz ( $\mu\text{F}$ )	NOMINAL CASE SIZE $\varnothing D \times L$ (mm)	$I_R$ 100 Hz 85 °C (A)	$I_R$ 20 kHz 70 °C (A)	$I_{L1}$ 1 min (mA)	$I_{L5}$ 5 min (mA)	ESR 100 Hz (m $\Omega$ )	Z 10 kHz (m $\Omega$ )	CATALOGUE NUMBER 2222 ... ..
10	<b>10000</b>	<b>25 × 30</b>	3.1	5.9	0.60	0.20	51	40	<b>051 54103</b>
	15000	25 × 40	4.1	7.8	0.90	0.30	37	30	051 54153
	<b>22000</b>	<b>30 × 40</b>	5.0	9.5	1.32	0.44	30	25	<b>051 54223</b>
	33000	35 × 40	5.5	10.4	1.98	0.66	28	24	051 54333
	<b>47000</b>	<b>35 × 50</b>	6.8	12.9	2.82	0.94	23	20	<b>051 54473</b>
	47000	40 × 40	5.8	10.4	2.82	0.94	29	22	051 44473
	68000	40 × 50	7.1	13.5	4.08	1.36	24	20	051 54683
	<b>100000</b>	<b>40 × 70</b>	9.2	17.4	6.00	2.00	19	16	<b>051 54104</b>
150000	40 × 100	12.0	22.7	9.00	3.00	16	14	051 54154	
16	6800	25 × 30	3.1	5.9	0.65	0.22	53	42	051 55682
	<b>10000</b>	<b>25 × 40</b>	4.0	7.6	0.96	0.32	39	34	<b>051 55103</b>
	15000	30 × 40	5.0	9.5	1.44	0.48	31	27	051 55153
	<b>22000</b>	<b>35 × 40</b>	5.5	10.4	2.12	0.71	29	26	<b>051 55223</b>
	33000	35 × 50	6.7	12.7	3.17	1.06	23	21	051 55333
	33000	40 × 40	5.7	10.8	3.17	1.06	30	24	051 45333
	<b>47000</b>	<b>40 × 50</b>	7.0	13.3	4.52	1.51	24	20	<b>051 55473</b>
	68000	40 × 70	9.2	17.4	6.53	2.18	19	16	051 55683
<b>100000</b>	<b>40 × 100</b>	12.0	22.7	9.60	3.20	16	14	<b>051 55104</b>	
25	<b>4700</b>	<b>25 × 30</b>	2.9	5.5	0.71	0.24	60	42	<b>051 56472</b>
	6800	25 × 40	3.9	7.4	1.02	0.34	42	34	051 56682
	<b>10000</b>	<b>30 × 40</b>	4.8	9.1	1.50	0.50	34	27	<b>051 56103</b>
	15000	35 × 40	5.3	10.0	2.25	0.75	30	26	051 56153
	<b>22000</b>	<b>35 × 50</b>	6.5	12.3	3.30	1.10	24	21	<b>051 56223</b>
	22000	40 × 40	5.7	10.8	3.30	1.10	31	24	051 46223
	33000	40 × 50	7.0	13.3	4.95	1.65	25	20	051 56333
	<b>47000</b>	<b>40 × 70</b>	9.2	17.4	7.05	2.35	19	16	<b>051 56473</b>
68000	40 × 100	12.0	22.7	10.20	3.40	16	14	051 56683	

## Aluminum electrolytic capacitors Power Economic Printed Wiring

051/053 PEC-PW

$U_R$ (V)	$C_R$ 100 Hz ( $\mu$ F)	NOMINAL CASE SIZE $\varnothing D \times L$ (mm)	$I_R$ 100 Hz 85 °C (A)	$I_R$ 20 kHz 70 °C (A)	$I_{L1}$ 1 min (mA)	$I_{L5}$ 5 min (mA)	ESR 100 Hz (m $\Omega$ )	Z 10 kHz (m $\Omega$ )	CATALOGUE NUMBER 2222 ... ..
40	3300	25 × 30	2.9	5.5	0.80	0.27	87	63	051 57332
	<b>4700</b>	<b>25 × 40</b>	3.8	7.2	1.13	0.38	62	47	<b>051 57472</b>
	6800	30 × 40	4.7	8.9	1.64	0.55	49	38	051 57682
	<b>10000</b>	<b>35 × 40</b>	5.2	9.8	2.40	0.80	48	37	<b>051 57103</b>
	15000	35 × 50	6.3	11.9	3.60	1.20	37	28	051 57153
	15000	40 × 40	5.6	10.6	3.60	1.20	50	35	051 47153
	<b>22000</b>	<b>40 × 50</b>	5.8	11.0	5.28	1.76	39	28	<b>051 57223</b>
	33000	40 × 70	7.8	14.8	7.92	2.64	28	21	051 57333
	<b>47000</b>	<b>40 × 100</b>	10.4	19.7	11.28	3.76	22	17	<b>051 57473</b>
63	<b>2200</b>	<b>25 × 30</b>	2.5	4.7	0.84	0.28	83	62	<b>051 58222</b>
	3300	25 × 40	3.3	6.2	1.25	0.42	58	42	051 58332
	<b>4700</b>	<b>30 × 40</b>	4.1	7.8	1.78	0.60	49	38	<b>051 58472</b>
	6800	35 × 40	4.5	8.5	2.57	0.86	48	37	051 58682
	<b>10000</b>	<b>35 × 50</b>	5.4	10.2	3.78	1.26	37	28	<b>051 58103</b>
	10000	40 × 40	4.6	8.7	3.78	1.26	52	37	051 48103
	15000	40 × 70	7.5	14.2	5.67	1.89	29	24	051 58153
	<b>22000</b>	<b>40 × 100</b>	10.0	19.0	8.32	2.77	22	19	<b>051 58223</b>
100	680	25 × 30	1.74	3.30	0.41	0.14	190	130	051 59681
	<b>1000</b>	<b>25 × 40</b>	2.34	4.44	0.60	0.20	130	90	<b>051 59102</b>
	1500	30 × 40	2.95	5.59	0.90	0.30	95	67	051 59152
	<b>2200</b>	<b>35 × 40</b>	3.69	7.00	1.32	0.44	71	53	<b>051 59222</b>
	3300	35 × 50	4.37	8.29	1.98	0.66	55	41	051 59332
	3300	40 × 40	4.16	7.89	1.98	0.66	64	48	051 49332
	<b>4700</b>	<b>40 × 50</b>	5.21	9.88	2.82	0.94	49	38	<b>051 59472</b>
	6800	40 × 70	6.97	13.22	4.08	1.36	35	28	051 59682
	<b>10000</b>	<b>40 × 100</b>	9.50	18.00	6.00	2.00	26	21	<b>051 59103</b>



# Aluminum electrolytic capacitors

## Power Economic Printed Wiring

051/053 PEC-PW

**Table 3** Electrical data and ordering information for **053** series; preferred types in **bold**

$U_R$ (V)	$C_R$ 100 Hz ( $\mu$ F)	NOMINAL CASE SIZE $\varnothing D \times L$ (mm)	$I_R$ 100 Hz 85 °C (A)	$I_R$ 20 kHz 70 °C (A)	$I_{L1}$ 1 min (mA)	$I_{L5}$ 5 min (mA)	ESR 100 Hz (m $\Omega$ )	Z 10 kHz (m $\Omega$ )	CATALOGUE NUMBER 2222 ... ..
200	150	25 × 30	0.70	1.33	0.18	0.06	1000	770	053 52151
	<b>220</b>	<b>25 × 40</b>	0.94	1.78	0.26	0.09	680	525	<b>053 52221</b>
	330	30 × 40	1.27	2.41	0.40	0.14	460	360	053 52331
	<b>470</b>	<b>35 × 40</b>	1.66	3.15	0.57	0.19	320	250	<b>053 52471</b>
	680	35 × 50	2.19	4.15	0.82	0.28	220	170	053 52681
	680	40 × 40	2.17	4.11	0.82	0.28	220	170	053 42681
	<b>1000</b>	<b>40 × 50</b>	2.86	5.42	1.20	0.40	150	115	<b>053 52102</b>
	1500	40 × 70	3.81	7.22	1.80	0.60	110	85	053 52152
	<b>2200</b>	<b>40 × 100</b>	5.20	9.86	2.64	0.88	80	60	<b>053 52222</b>
385	68	25 × 30	0.47	0.89	0.16	0.06	2200	1480	053 58689
	<b>100</b>	<b>25 × 40</b>	0.64	1.21	0.23	0.08	1500	1020	<b>053 58101</b>
	150	30 × 40	0.90	1.71	0.35	0.12	1000	700	053 58151
	<b>220</b>	<b>35 × 40</b>	1.15	2.18	0.51	0.17	680	480	<b>053 58221</b>
	330	35 × 50	1.53	2.90	0.77	0.26	450	340	053 58331
	330	40 × 40	1.52	2.88	0.77	0.26	450	340	053 48331
	<b>470</b>	<b>40 × 50</b>	1.96	3.72	1.09	0.36	320	260	<b>053 58471</b>
	680	40 × 70	2.70	5.12	1.58	0.53	220	190	053 58681
	<b>1000</b>	<b>40 × 100</b>	3.70	7.02	2.31	0.78	180	140	<b>053 58102</b>
400	68	25 × 30	0.54	1.02	0.16	0.06	2100	1000	053 56689
	<b>100</b>	<b>25 × 40</b>	0.73	1.38	0.24	0.08	1400	780	<b>053 56101</b>
	150	30 × 40	0.98	1.86	0.36	0.12	950	520	053 56151
	<b>220</b>	<b>35 × 40</b>	1.28	2.43	0.52	0.17	650	400	<b>053 56221</b>
	330	35 × 50	1.67	3.17	0.79	0.26	480	280	053 56331
	330	40 × 40	1.67	3.17	0.79	0.26	480	280	053 46331
	<b>470</b>	<b>40 × 50</b>	2.12	4.02	1.12	0.37	340	220	<b>053 56471</b>
	680	40 × 70	2.90	5.50	1.63	0.54	235	155	053 56681
	<b>1000</b>	<b>40 × 100</b>	4.05	7.68	2.40	0.80	160	110	<b>053 56102</b>

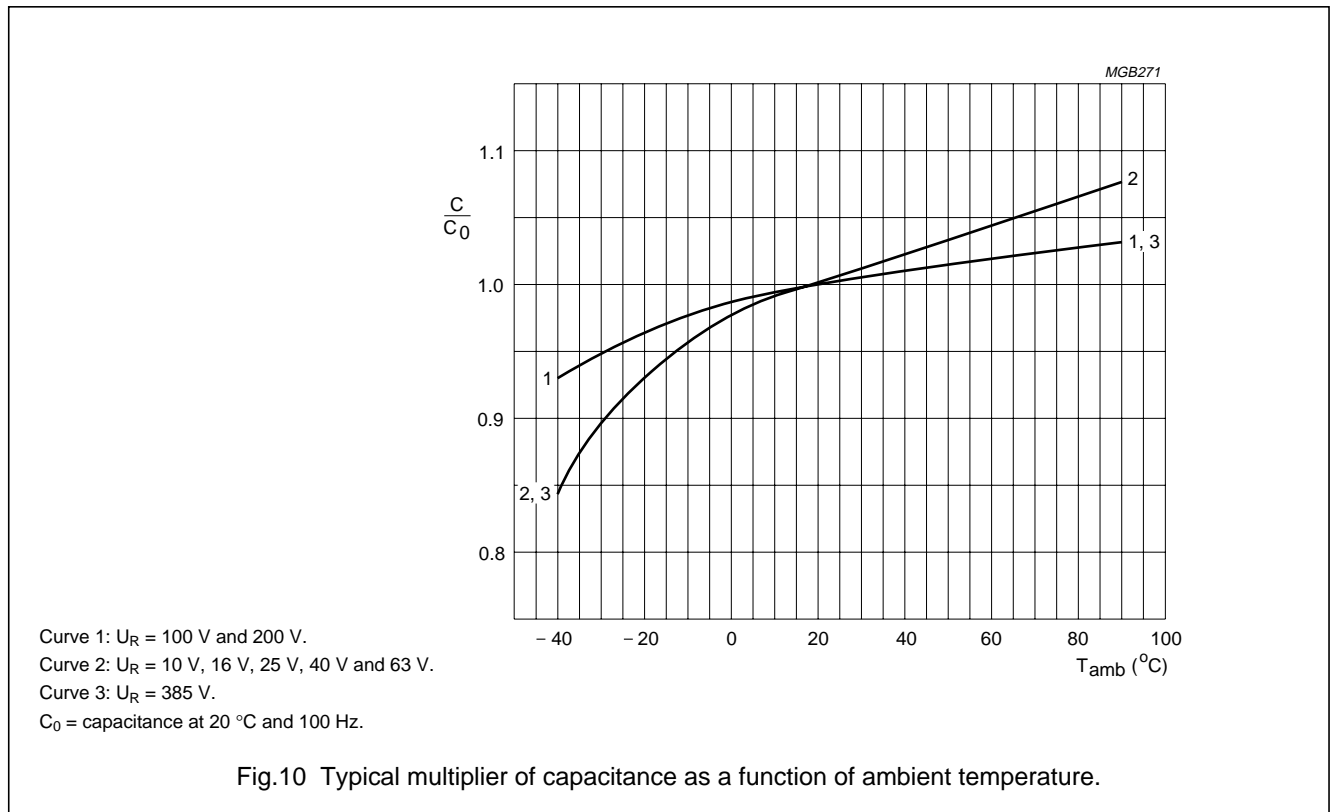
Aluminum electrolytic capacitors  
Power Economic Printed Wiring

051/053 PEC-PW

Additional electrical data

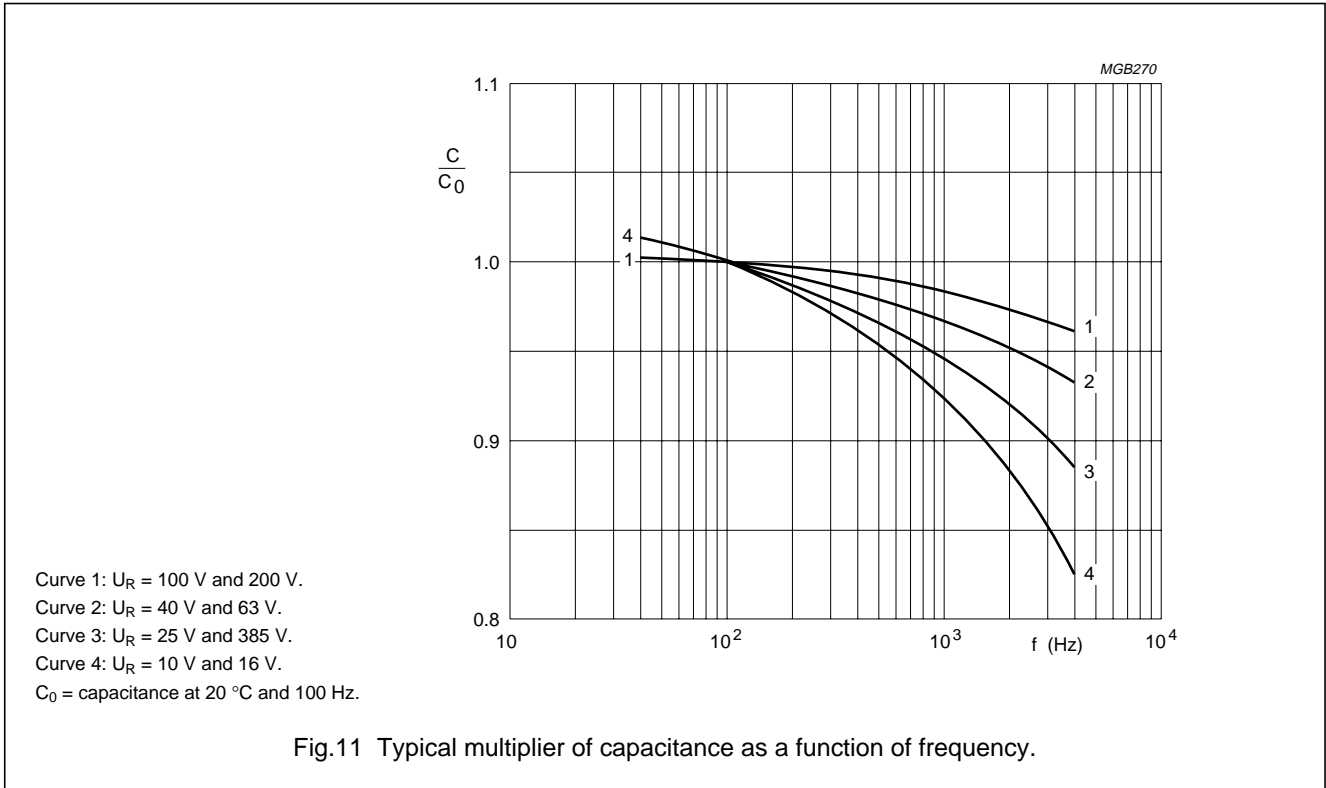
PARAMETER	CONDITIONS	VALUE
<b>Voltage</b>		
Surge voltage	≤250 V versions	$U_s = 1.15 \times U_R$
	≥385 V versions	$U_s = 1.1 \times U_R$
Reverse voltage		$U_{rev} \leq 1 \text{ V}$
<b>Current</b>		
Leakage current	after 1 minute at $U_R$	$I_{L1} \leq 0.006C_R \times U_R + 4 \mu\text{A}$
	after 5 minutes at $U_R$	$I_{L5} \leq 0.002C_R \times U_R + 4 \mu\text{A}$
<b>Inductance</b>		
Equivalent series inductance (ESL)	case $\varnothing D = 25 \text{ mm}$	max. 25 nH
	case $\varnothing D = 30 \text{ and } 35 \text{ mm}$	max. 30 nH
	case $\varnothing D = 40 \text{ mm}$	max. 35 nH

Capacitance (C)

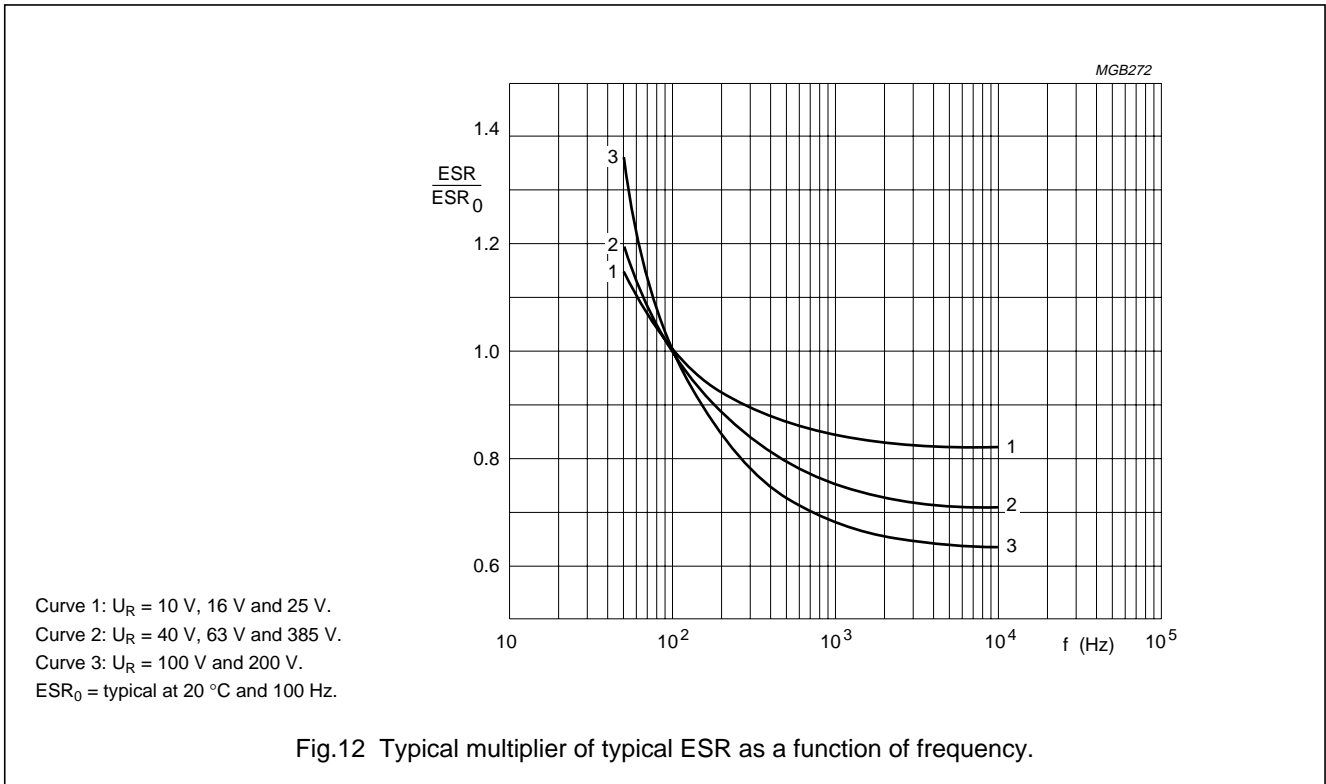


Aluminum electrolytic capacitors  
Power Economic Printed Wiring

051/053 PEC-PW

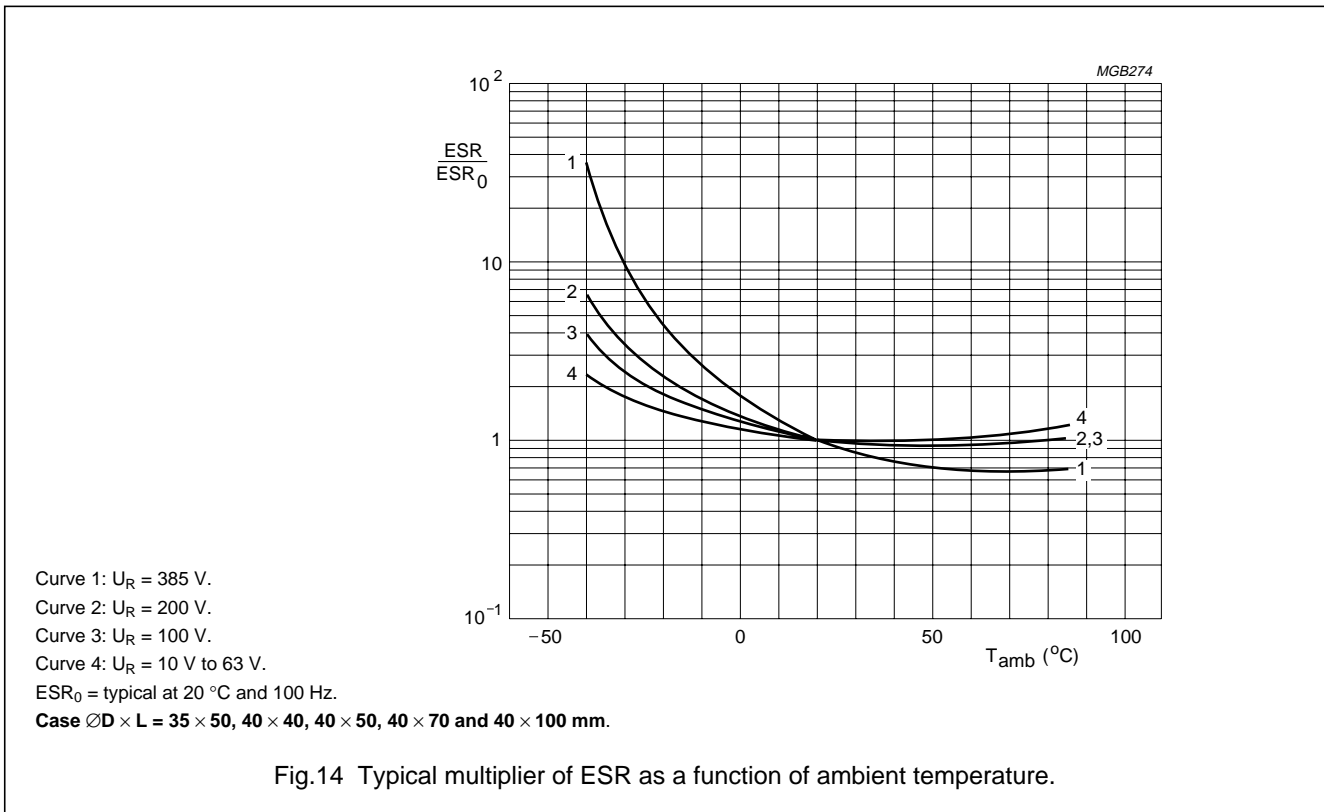
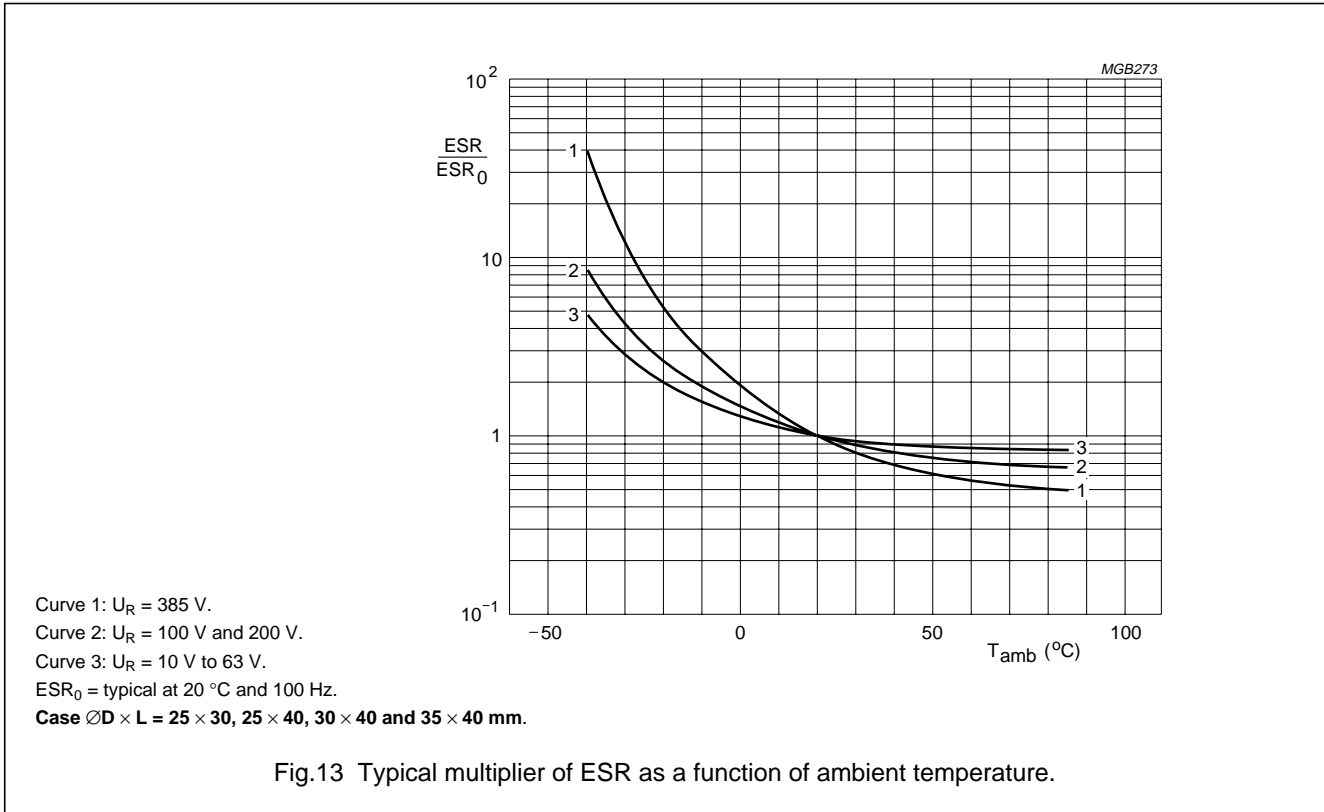


Equivalent series resistance (ESR)



Aluminum electrolytic capacitors  
Power Economic Printed Wiring

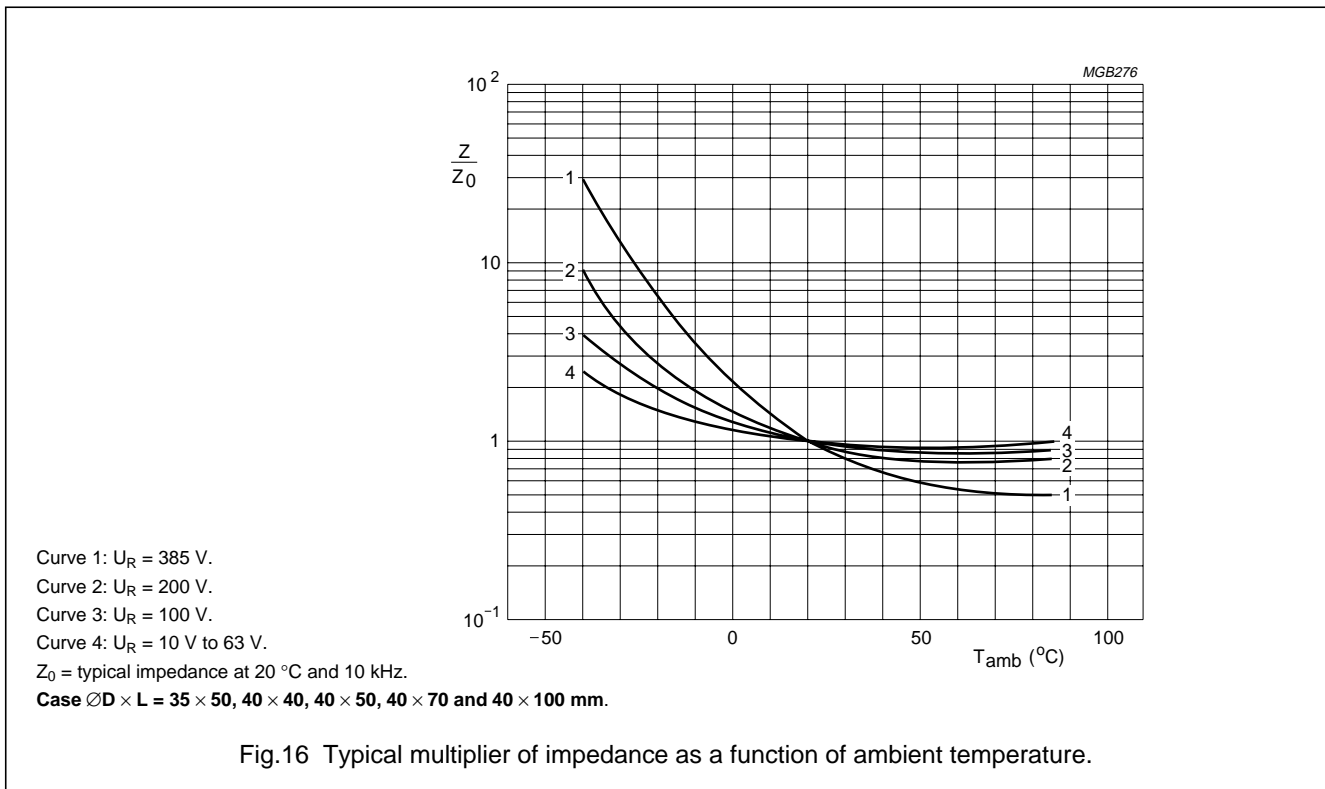
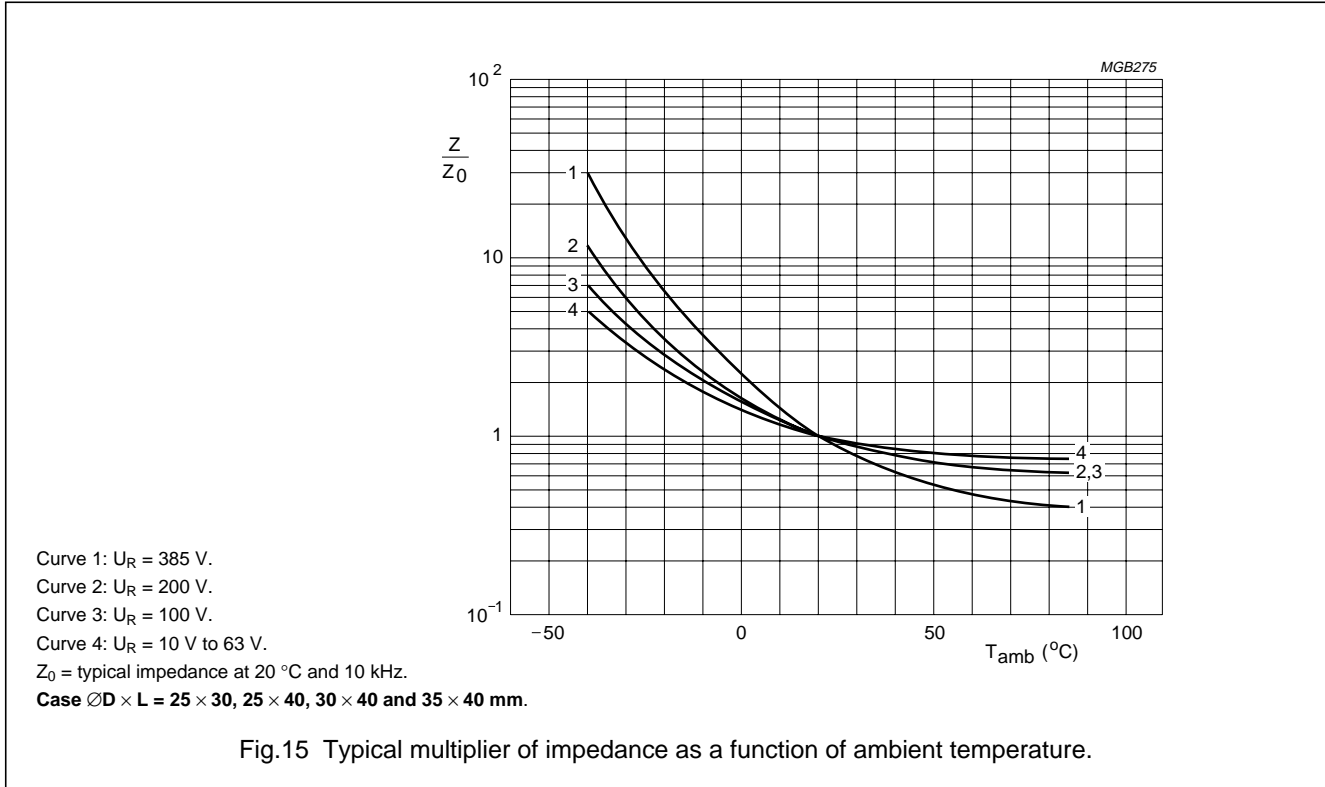
051/053 PEC-PW



Aluminum electrolytic capacitors  
Power Economic Printed Wiring

051/053 PEC-PW

Impedance (Z)



Aluminum electrolytic capacitors  
Power Economic Printed Wiring

051/053 PEC-PW

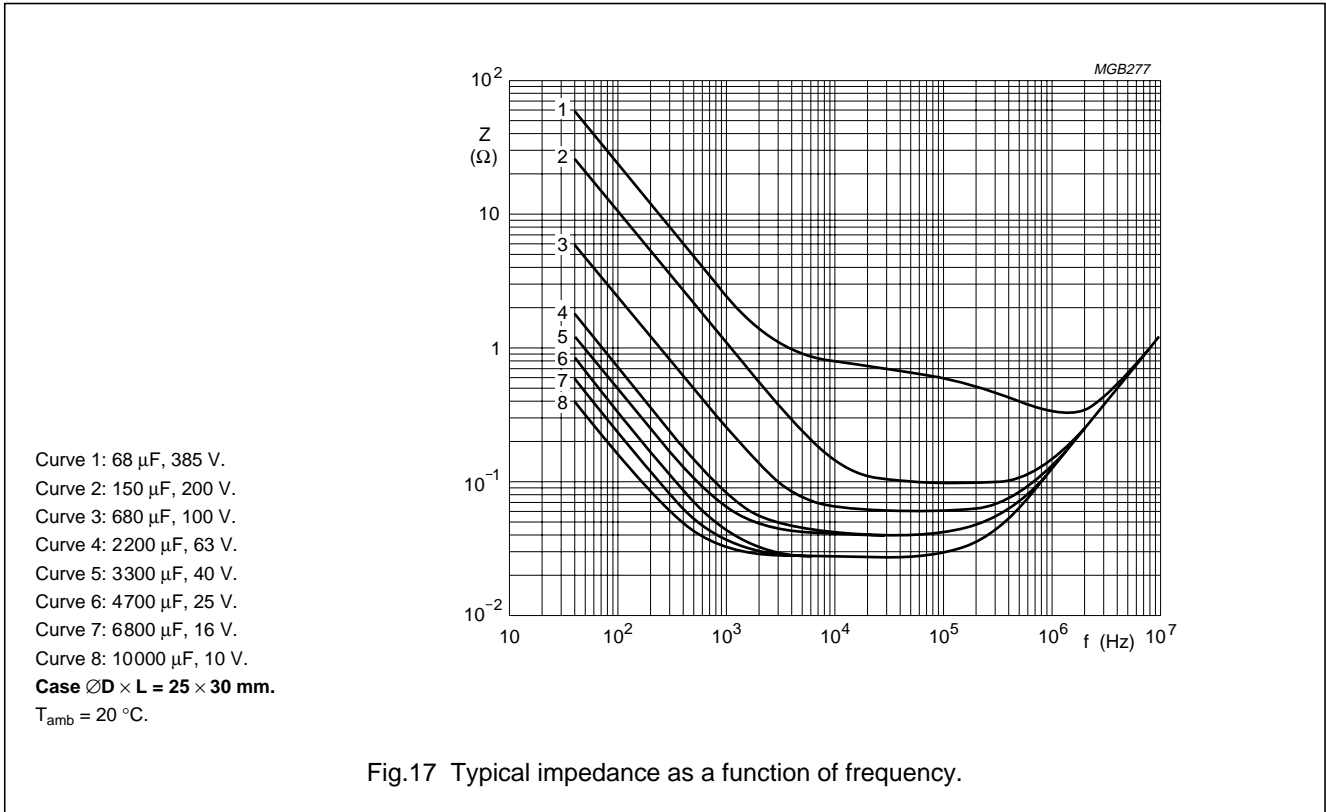


Fig.17 Typical impedance as a function of frequency.

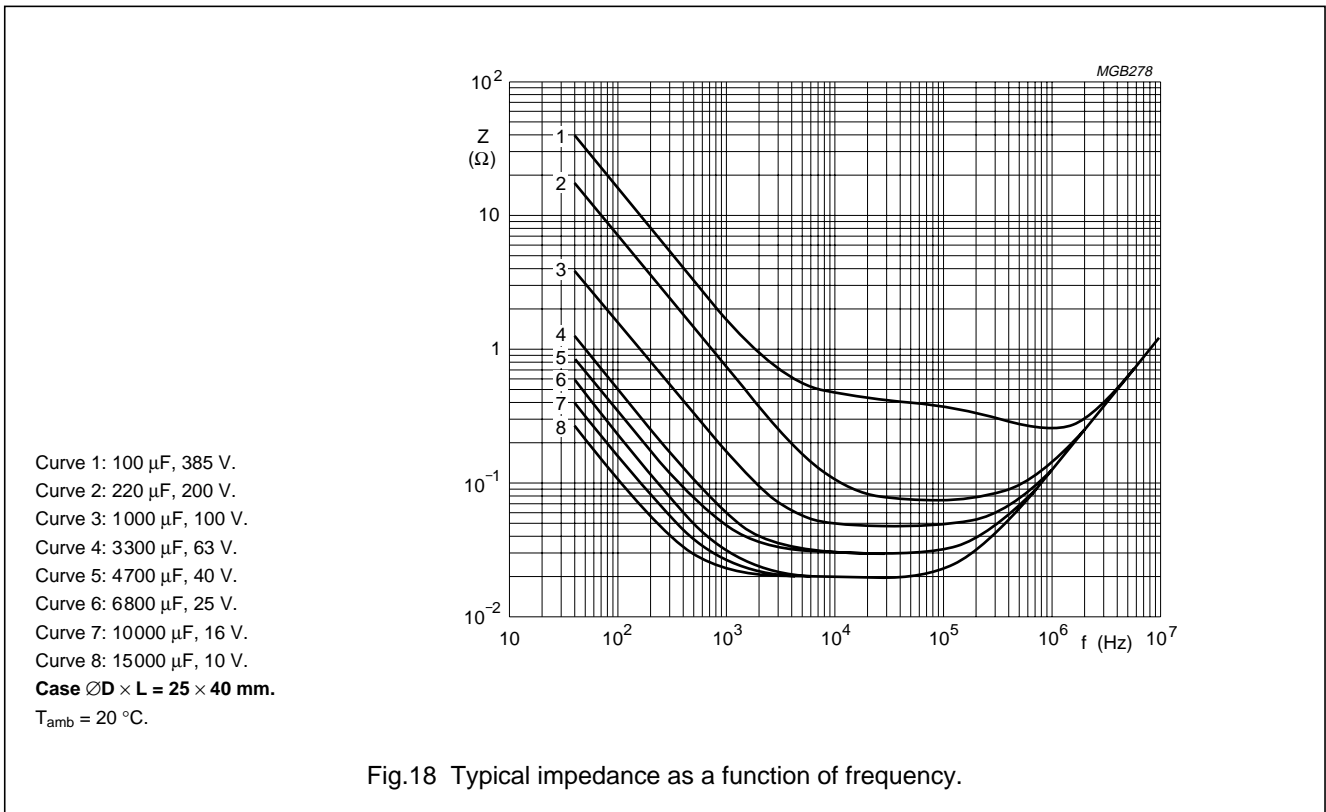


Fig.18 Typical impedance as a function of frequency.

# Aluminum electrolytic capacitors Power Economic Printed Wiring

051/053 PEC-PW

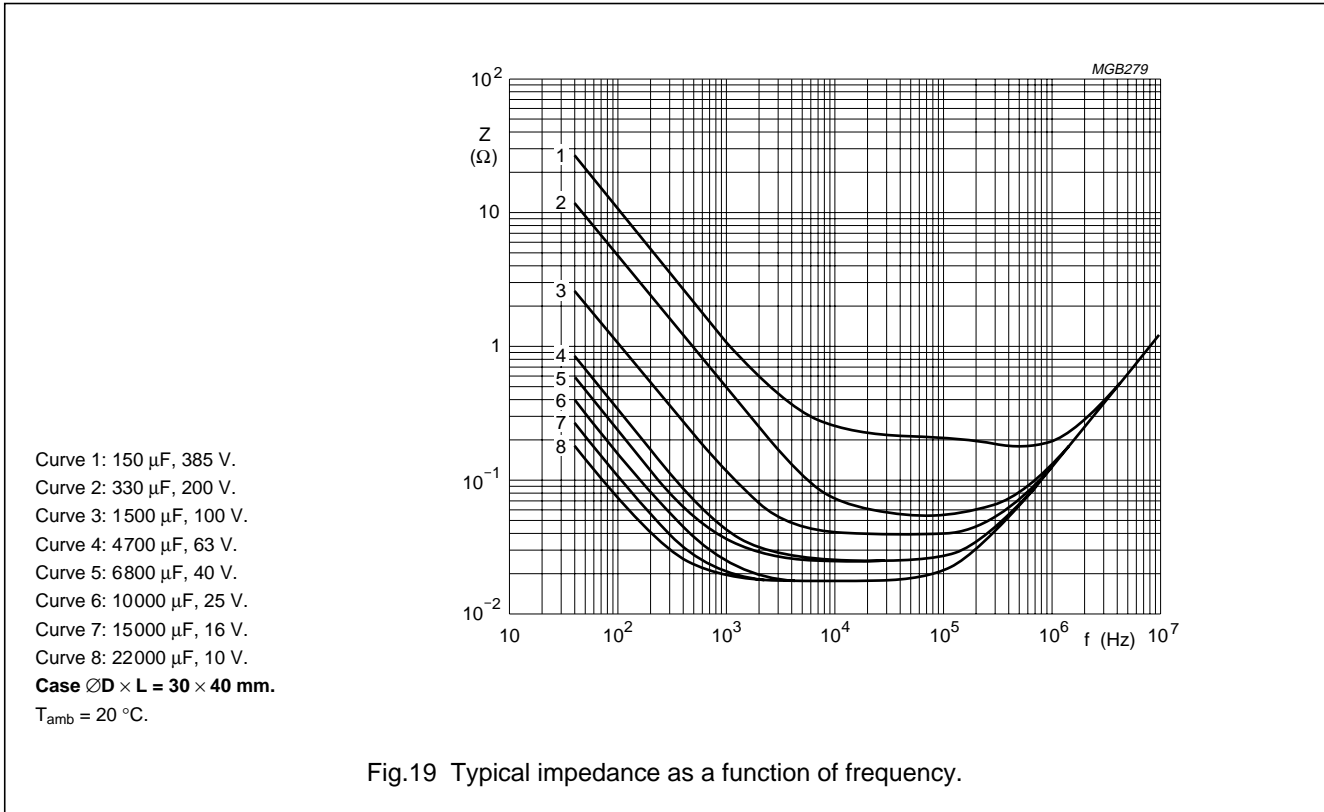


Fig.19 Typical impedance as a function of frequency.

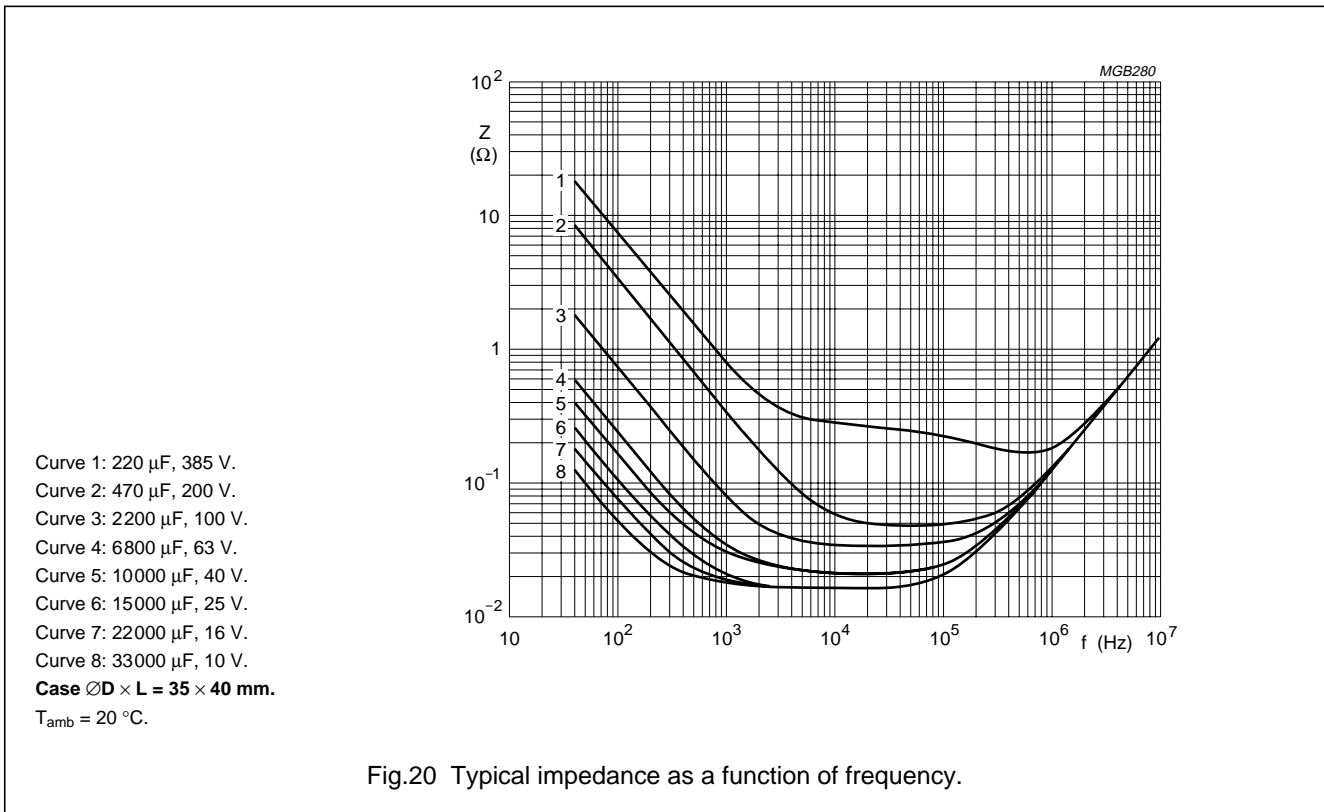


Fig.20 Typical impedance as a function of frequency.

Aluminum electrolytic capacitors  
Power Economic Printed Wiring

051/053 PEC-PW

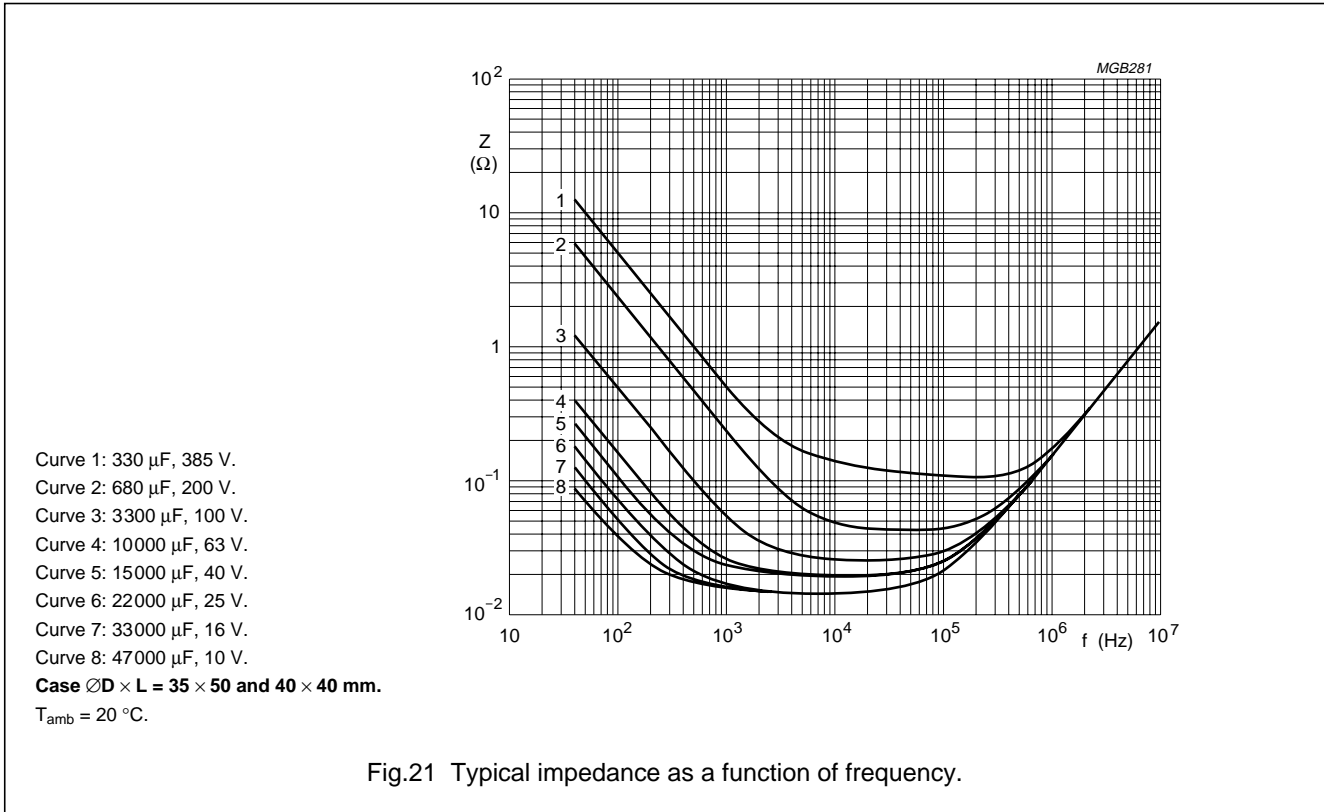


Fig.21 Typical impedance as a function of frequency.

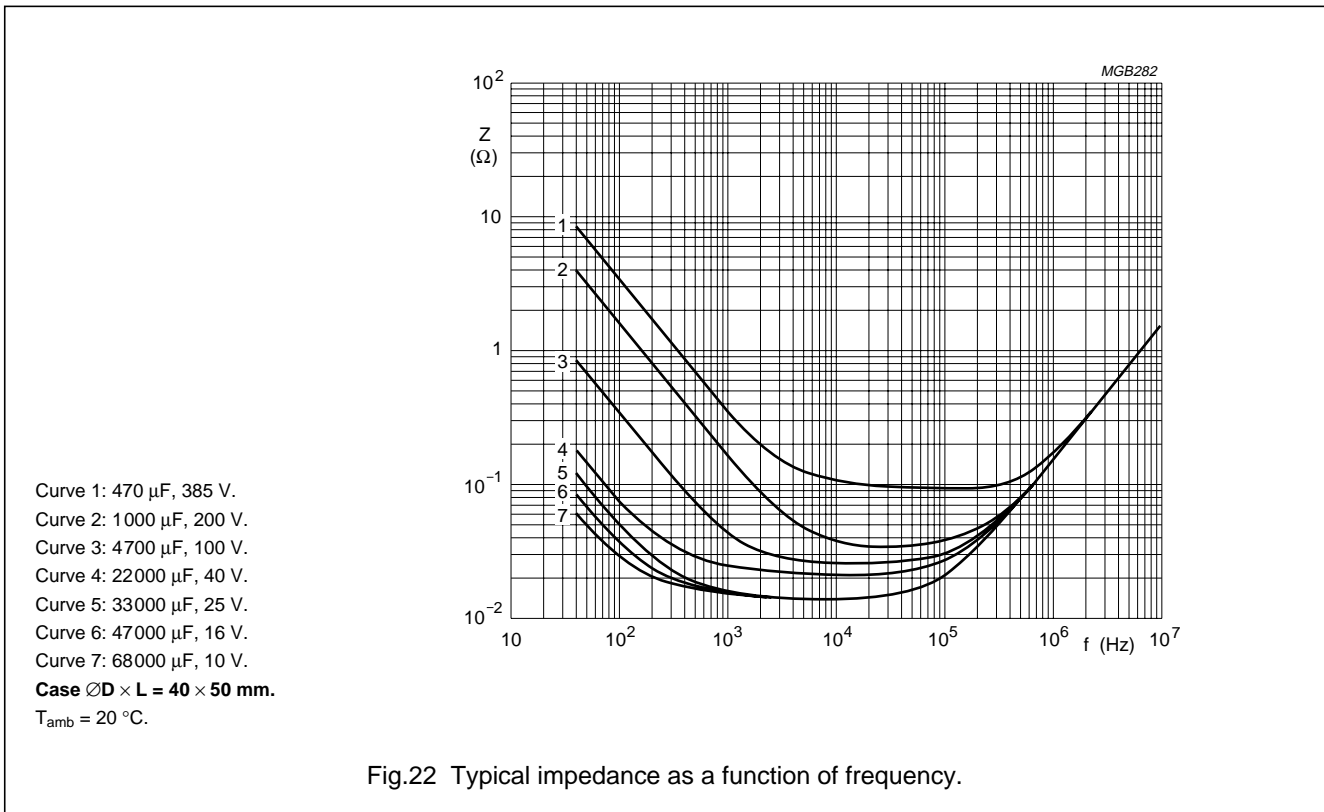


Fig.22 Typical impedance as a function of frequency.



Aluminum electrolytic capacitors  
Power Economic Printed Wiring

051/053 PEC-PW

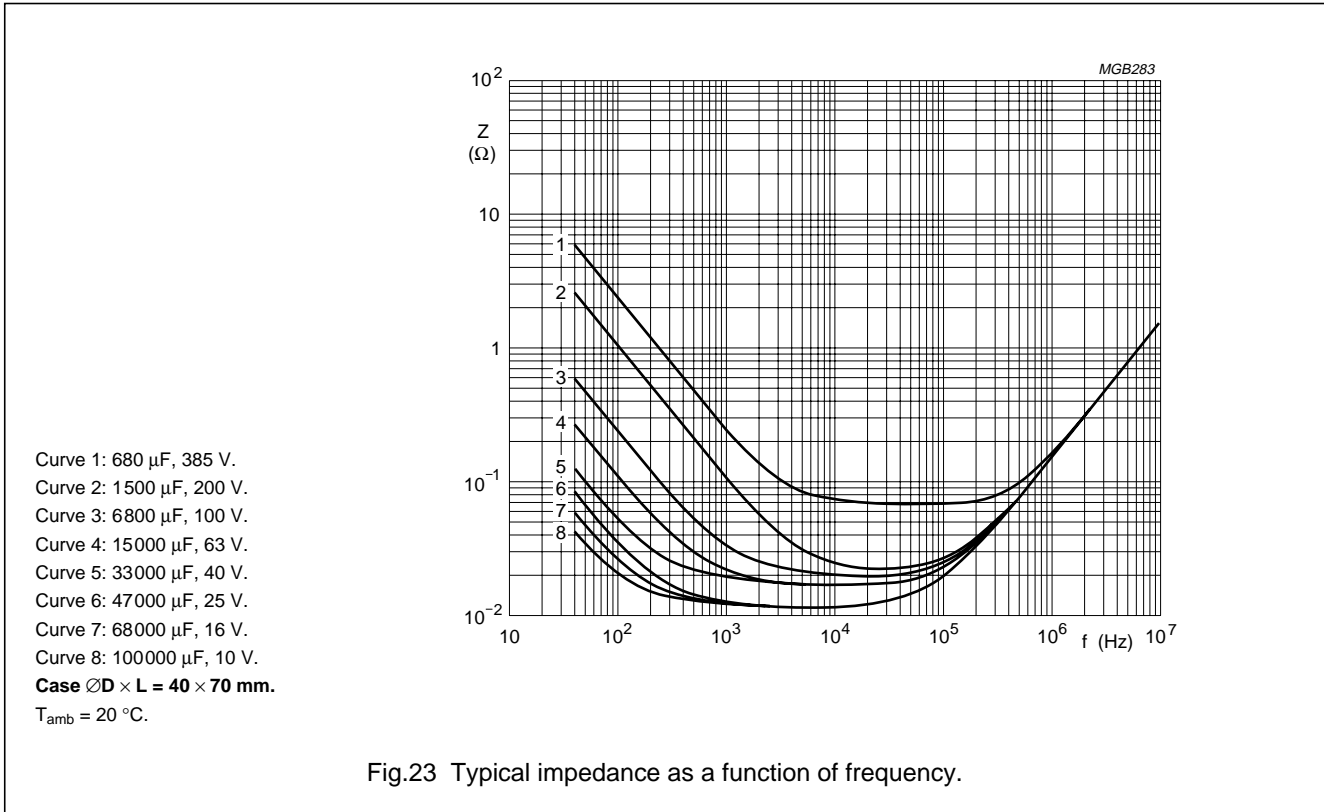


Fig.23 Typical impedance as a function of frequency.

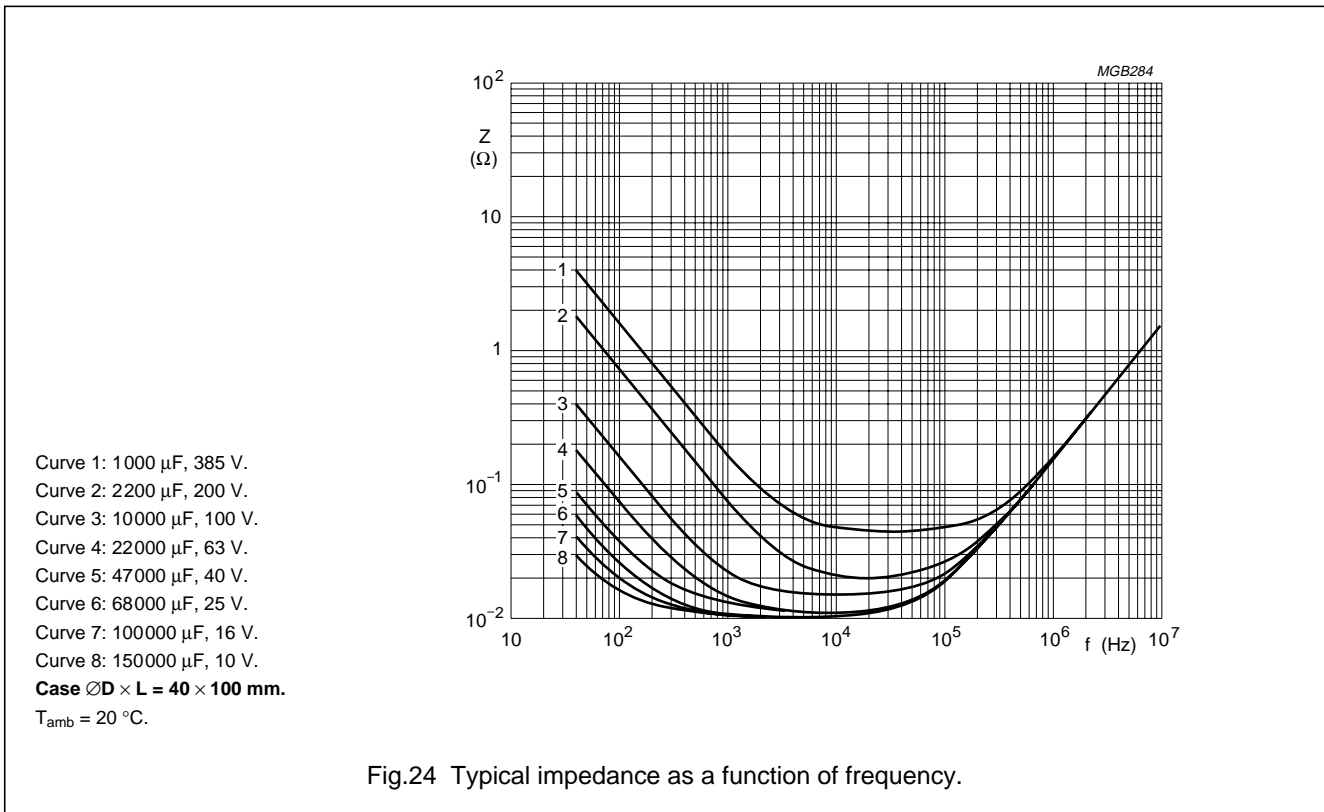


Fig.24 Typical impedance as a function of frequency.

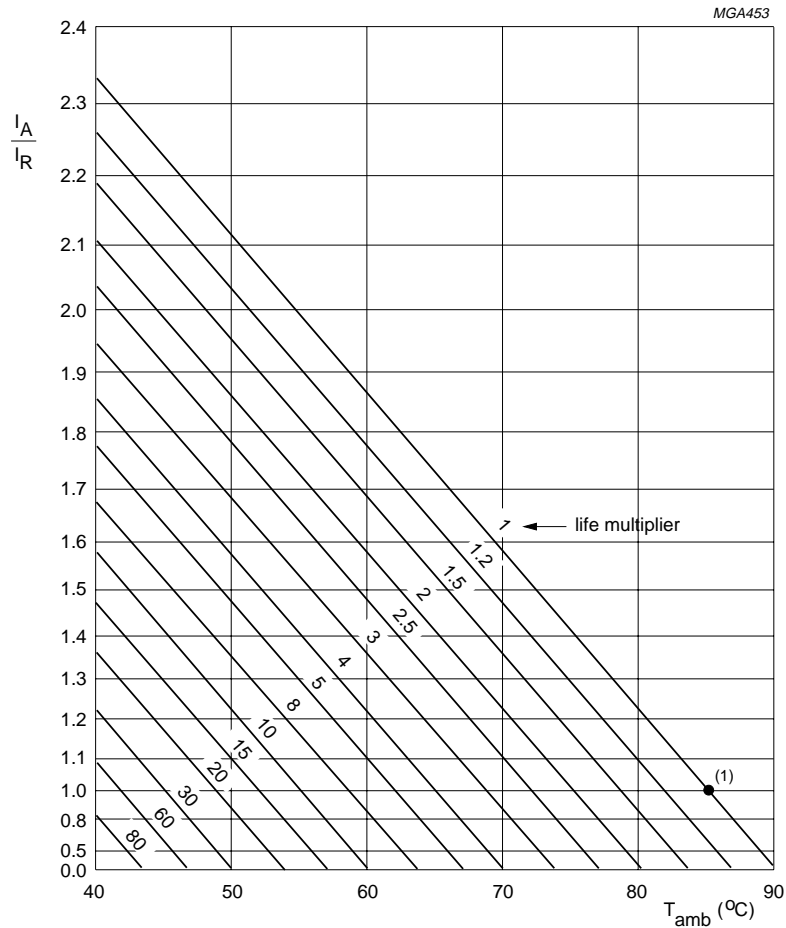
Aluminum electrolytic capacitors  
Power Economic Printed Wiring

051/053 PEC-PW

**RIPPLE CURRENT AND USEFUL LIFE**

**Table 4** Multiplier of ripple current ( $I_R$ ) as a function of frequency

FREQUENCY (Hz)	$I_R$ MULTIPLIER
50	0.83
100	1.00
200	1.10
400	1.15
1000	1.19
$\geq 2000$	1.20



$I_A$  = actual ripple current at 100 Hz and 85 °C.  
 $I_R$  = rated ripple current at 100 Hz and 85 °C.  
 (1) Useful life at 85 °C and  $I_R$  applied: 12000 hours.

Fig.25 Multiplier of useful life as a function of ambient temperature and ripple current load.

# Aluminum electrolytic capacitors

## Power Economic Printed Wiring

051/053 PEC-PW

### SPECIFIC TESTS AND REQUIREMENTS

General tests and requirements are specified in this handbook, section "Tests and Requirements".

**Table 5** Test procedures and requirements

TEST		PROCEDURE (quick reference)	REQUIREMENTS
NAME OF TEST	REFERENCE		
Endurance	IEC 60384-4/ EN130300 subclause 4.13	$T_{amb} = 85\text{ °C}$ ; $U_R$ applied; 5000 hours	$U_R \leq 100\text{ V}$ ; $\Delta C/C: \pm 15\%$ $U_R > 100\text{ V}$ ; $\Delta C/C: \pm 10\%$ $ESR \leq 1.3 \times \text{spec. limit}$ $Z \leq 2 \times \text{spec. limit}$ $I_{L5} \leq \text{spec. limit}$
Useful life	CECC 30301 subclause 1.8.1	$T_{amb} = 85\text{ °C}$ ; $U_R$ and $I_R$ applied; 12000 hours	$U_R \leq 100\text{ V}$ ; $\Delta C/C: \pm 45\%$ $U_R > 100\text{ V}$ ; $\Delta C/C: \pm 30\%$ $ESR \leq 3 \times \text{spec. limit}$ $Z \leq 3 \times \text{spec. limit}$ $I_{L5} \leq \text{spec. limit}$ no short or open circuit, no visible damage total failure percentage: $U_R \leq 100\text{ V}$ : $\leq 1\%$ ; $U_R > 100\text{ V}$ : $\leq 3\%$
Shelf life (storage at high temperature)	IEC 60384-4/ EN130300 subclause 4.17	$T_{amb} = 85\text{ °C}$ ; no voltage applied; 500 hours  after test: $U_R$ to be applied for 30 minutes, 24 to 48 hours before measurement	$\Delta C/C: \pm 10\%$ $ESR \leq 1.2 \times \text{spec. limit}$ $I_{L5} \leq 2 \times \text{spec. limit}$