DATA SHEET

Class 2, X7R 16/25/50/100/200 and 500 V Noble Metal Electrode

Surface mount ceramic multilayer capacitors

Product specification
Supersedes data of 7th June 1999
File under Advanced Ceramics and Modules, ACM2

1999 Dec 06

Philips Components

PHILIPS

Surface mount ceramic multilayer capacitors

Class 2, X7R 16/25/50/100/200 and 500 V Noble Metal Electrode

FEATURES

- Seven standard sizes
- High capacitance per unit volume
- Supplied in tape on reel or in bulk case
- NiSn terminations (AgPd on request).

APPLICATIONS

- Consumer electronics, for example:
  - Tuners
  - Television receivers
  - Video recorders
  - All types of cameras
- Telecommunications
- Automotive
- Data processing.

DESCRIPTION

The capacitor consists of a rectangular block of ceramic dielectric in which a number of interleaved precious metal electrodes are contained. This structure gives rise to a high capacitance per unit volume.

The inner electrodes are connected to the two terminations, either by silver palladium (AgPd) alloy in the ratio 65 : 35, or silver dipped with a barrier layer of plated nickel and finally covered with a layer of plated tin (NiSn). A cross section of the structure is shown in Fig.1.

QUICK REFERENCE DATA

DESCRIPTION	VALUE
Rated voltage U_R (DC)	16 V, 25 V, 50 V, 100 V, 200 V and 500 V (IEC)
Capacitance range (E12 series); note 1:	
16 V	4.7 nF to 100 nF
25 V	3.3 nF to 220 nF
50 V; note 2	100 pF to 470 nF
100 V	180 pF to 330 nF
200 V	180 pF to 120 nF
500 V	470 pF to 15 nF
Tolerance on capacitance	±20%; ±10%; ±5%
Test voltage (DC) for 1 minute:	
16 V, 25 V, 50 V and 100 V	$2.5 \times U_R$
200 V	$3 \times U_R$
500 V	$2 \times U_R$
Sectional specifications	IEC 60384-10, second edition 1989-04; also based on CECC 32 100
Detailed specification	based on CECC 32 101-801
Climatic category (IEC 60068)	55/125/56

Notes

1. Non E12 values are available on request.
2. Also applicable for applications up to 63 V.

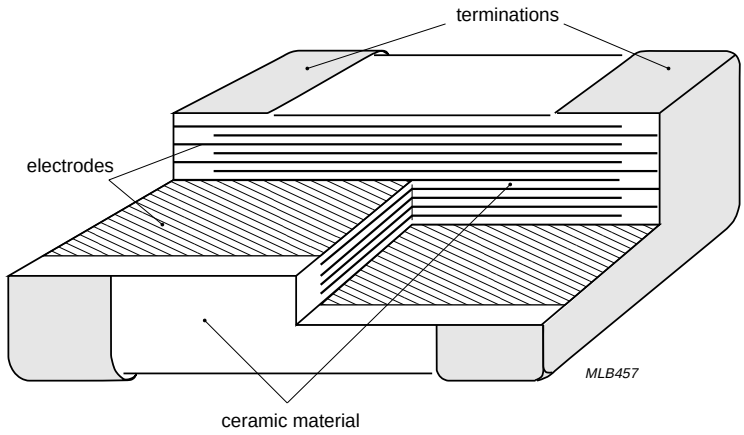
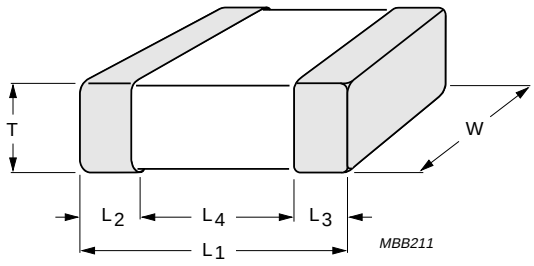


Fig.1 Construction of a ceramic multilayer capacitor.

MECHANICAL DATA



For dimensions see Table 1.

Fig.2 Component outline.

Physical dimensions

Table 1 Capacitor dimensions

CASE SIZE	L_1	W	T		L_2 and L_3		L_4 MIN.
			MIN.	MAX.	MIN.	MAX.	
Dimensions in millimetres							
0402	1.0 ±0.05	0.5 ±0.05	0.45	0.55	0.20	0.30	0.40
0603	1.6 ±0.10	0.8 ±0.07	0.73	0.87	0.25	0.65	0.40
0805	2.0 ±0.10	1.25 ±0.10	0.50	1.35	0.25	0.75	0.55
1206	3.2 ±0.15	1.6 ±0.15	0.50	1.75	0.25	0.75	1.40
1210	3.2 ±0.20	2.5 ±0.20	0.50	1.80	0.25	0.75	1.40
1812	4.5 ±0.20	3.2 ±0.20	0.50	1.80	0.25	0.75	2.20
2220	5.7 ±0.20	5.0 ±0.20	0.50	1.80	0.25	0.75	2.90
Dimensions in inches							
0402	0.040 ±0.002	0.020 ±0.002	0.018	0.022	0.008	0.012	0.016
0603	0.063 ±0.004	0.032 ±0.003	0.029	0.035	0.010	0.026	0.016
0805	0.079 ±0.004	0.049 ±0.004	0.020	0.053	0.010	0.030	0.022
1206	0.126 ±0.006	0.063 ±0.006	0.020	0.069	0.010	0.030	0.056
1210	0.126 ±0.008	0.098 ±0.008	0.020	0.072	0.010	0.030	0.056
1812	0.177 ±0.008	0.126 ±0.008	0.020	0.072	0.010	0.030	0.088
2220	0.224 ±0.008	0.197 ±0.008	0.020	0.072	0.010	0.030	0.114

SELECTION CHART FOR 16 V AND 25 V

C (nF)	LAST TWO DIGITS OF 12NC	16 V				25 V				
		0402	0603	0805	1206	0402	0603	0805	1206	1210
3.3	29									
3.9	31					0.5 ±0.05				
4.7	32									
5.6	33									
6.8	34									
8.2	35									
10	36	0.5 ±0.05								
12	37									
15	38						0.8 ±0.07			
18	39							0.6 ±0.1		
22	41									
27	42									
33	43									
39	44									
47	45		0.8 ±0.07							
56	46			0.6 ±0.1				0.85 ±0.1		
68	47									
82	48									
100	49									
120	51									
150	52			0.85 ±0.1					0.85 ±0.1	
180	53									
220	54									
270	55				0.85 ±0.1				1.15 ±0.1	0.5 to 1.0
330	56									
390	57			1.25 ±0.1						
470	58									0.9 to 1.3
560	59									
680	61				1.15 ±0.1	Values in shaded cells indicate thickness classification.				
820	62									
1000	63									

Thickness classification and packaging quantities

THICKNESS CLASSIFICATION (mm)	8 mm TAPE WIDTH AMOUNT PER REEL				AMOUNT PER BULK CASE		
	∅180 mm; 7"		∅330 mm; 13"				
	PAPER	BLISTER	PAPER	BLISTER	0402	0603	0805
0.5 ±0.05	10000	–	50000	–	50000	–	–
0.6 ±0.1	4000	–	20000	–	–	–	10000
0.85 ±0.1	4000	–	15000	–	–	–	8000
0.5 to 1.0	–	4000	–	10000	–	–	–
0.8 ±0.07	4000	–	15000	–	–	15000	–
0.9 to 1.3	–	3000	–	10000	–	–	–
1.15 ±0.1	–	3000	–	10000	–	–	–
1.25 ±0.1	–	3000	–	10000	–	–	5000

ORDERING INFORMATION FOR 16 V AND 25 V

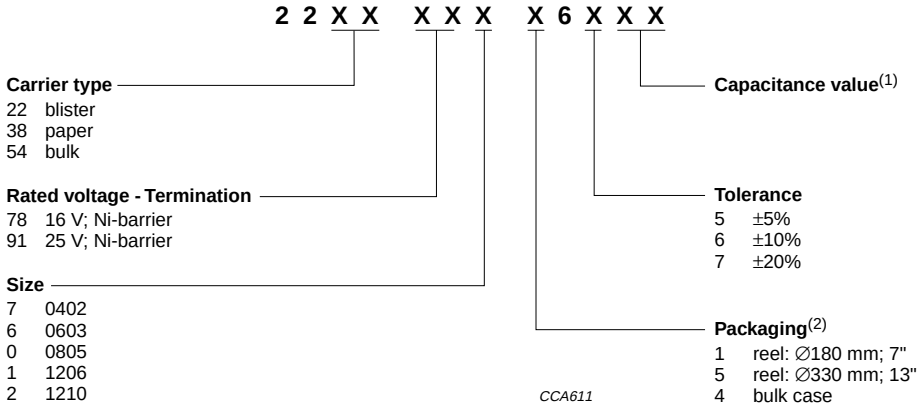
Components may be ordered by using either a simple 15-digit clear text code or Philips unique 12NC.

Clear text code

Example: 08052R104K8BB00

SIZE CODE	TEMP. CHAR.	CAPACITANCE	TOL.	VOLTAGE	TERMINATION	PACKAGING	MARKING	SERIES
0402 0603 0805 1206 1210	2R = X7R	104 = 100000 pF; the third digit signifies the multiplying factor: 2 = × 100 3 = × 1000 4 = × 10000 5 = × 100000	J = ±5% K = ±10% M = ±20%	7 = 16 V 8 = 25 V	B = Ni-barrier	2 = 180 mm; 7" paper 3 = 330 mm; 13" paper B = 180 mm; 7" blister F = 330 mm; 13" blister P = bulk case	0 = no marking 2 = 2-character marking in North America only	0 = conv. ceramic

Ordering code 12NC



(1) Refer to chapter “Selection chart for 16 V and 25 V”.

(2) Amount on reel depends on thickness classification, see section “Thickness classification and packaging quantities”.

SELECTION CHART FOR 50 V

C (pF)	LAST TWO DIGITS OF 12NC	50 V						
		0402	0603	0805	1206	1210	1812	2220
100	01							
120	02							
150	03							
180	04							
220	05							
270	06							
330	07							
390	08							
470	09							
560	11	0.5 ±0.05						
680	12							
820	13							
1000	14							
1200	15		0.8 ±0.07					
1500	16							
1800	17			0.6 ±0.1				
2200	18							
2700	19							
3300	21							
3900	22							
4700	23							
5600	24							
6800	25				0.85 ±0.1			
8200	26							
10000	27							
12000	28							
15000	29							
18000	31							
22000	32							
27000	33							
33000	34					0.5 to 1.0		
39000	35			0.85 ±0.1				
47000	36							
56000	37							
68000	38							
82000	39			1.25 ±0.1				
100000	41							
120000	42							
150000	43							
180000	44				1.15 ±0.1	0.9 to 1.3	0.5 to 1.0	
220000	45							
270000	46							
330000	47							
390000	48							0.5 to 1.0
470000	49						0.9 to 1.3	
560000	51							
680000	52		Values in shaded cells indicate thickness classification.					
820000	53							
1000000	54							0.9 to 1.3

Thickness classification and packaging quantities

THICKNESS CLASSIFICATION (mm)	8 mm TAPE WIDTH AMOUNT PER REEL				12 mm TAPE WIDTH AMOUNT PER REEL		AMOUNT PER BULK CASE		
	∅180 mm; 7"		∅330 mm; 13"		∅180 mm; 7" BLISTER				
	PAPER	BLISTER	PAPER	BLISTER	1812	2220	0402	0603	0805
0.5 ±0.05	10000	–	50000	–	–	–	50000	–	–
0.6 ±0.1	4000	–	20000	–	–	–	–	–	10000
0.85 ±0.1	4000	–	15000	–	–	–	–	–	8000
0.5 to 1.0	–	4000	–	10000	2000	1500	–	–	–
0.8 ±0.07	4000	–	15000	–	–	–	–	15000	–
0.9 to 1.3	–	3000	–	10000	1500	1500	–	–	–
1.15 ±0.1	–	3000	–	10000	–	–	–	–	–
1.25 ±0.1	–	3000	–	10000	–	–	–	–	5000

ORDERING INFORMATION FOR 50 V

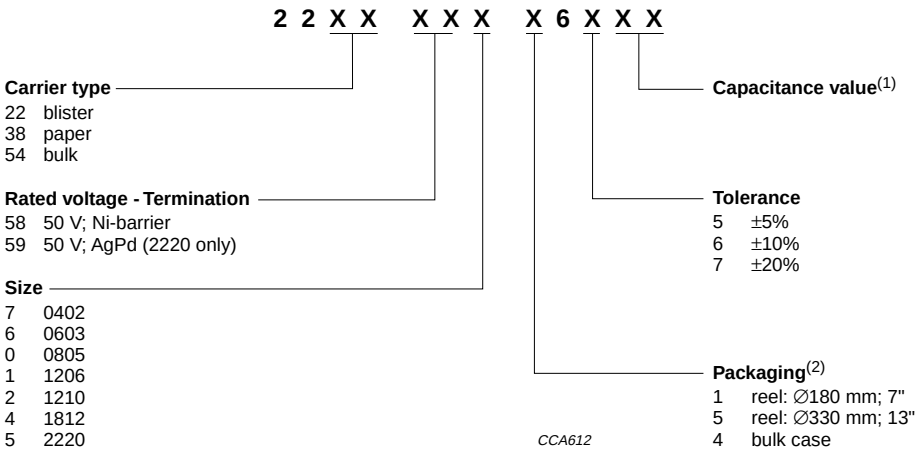
Components may be ordered by using either a simple 15-digit clear text code or Philips unique 12NC.

Clear text code

EXAMPLE: 08052R104K9BB00

SIZE CODE	TEMP. CHAR.	CAPACITANCE	TOL.	VOLTAGE	TERMINATION	PACKAGING	MARKING	SERIES
0402 0603 0805 1206 1210 1812 2220	2R = X7R	104 = 100000 pF; the third digit signifies the multiplying factor: 1 = × 10 2 = × 100 3 = × 1000 4 = × 10000 5 = × 100000	J = ±5% K = ±10% M = ±20%	9 = 50 V	B = Ni-barrier A = AgPd (2220 only)	2 = 180 mm; 7" paper 3 = 330 mm; 13" paper B = 180 mm; 7" blister F = 330 mm; 13" blister P = bulk case	0 = no marking 2 = 2-character marking in North America only	0 = conv. ceramic

Ordering code 12NC



(1) Refer to chapter “Selection chart for 50 V”.

(2) Amount on reel depends on thickness classification, see section “Thickness classification and packaging quantities”.

SELECTION CHART FOR 100 V, 200 V AND 500 V

C (pF)	LAST TWO DIGITS OF 12NC	100 V				200 V				500 V		
		0805	1206	1210	1812	0805	1206	1210	1812	1206	1210	1812
180	13											
220	14											
270	15											
330	16											
390	17											
470	18											
560	19											
680	21											
820	22											
1000	23					0.85 ±0.1				1.15 ±0.1		
1200	24											
1500	25	0.6 ±0.1										
1800	26											
2200	27											
2700	28											
3300	29		0.85 ±0.1				0.85 ±0.1					
3900	31										0.9 to 1.3	
4700	32											
5600	33											
6800	34					1.25 ±0.1					1.2 to 1.75	
8200	35											
10000	36											
12000	37											0.9 to 1.3
15000	38											
18000	39	0.85 ±0.1										
22000	41						1.15 ±0.1					
27000	42							0.8 to 1.0				
33000	43											
39000	44											
47000	45							0.9 to 1.3				
56000	46								0.5 to 1.0			
68000	47			0.5 to 1.0								
82000	48		1.15 ±0.1									
100000	49								0.9 to 1.3			
120000	51			0.9 to 1.3								
150000	52				0.5 to 1.0							
180000	53											
220000	54					Values in shaded cells indicate thickness classification.						
270000	55				0.9 to 1.3							
330000	56											

Thickness classification and packaging quantities

THICKNESS CLASSIFICATION (mm)	8 mm TAPE WIDTH AMOUNT PER REEL				12 mm TAPE WIDTH AMOUNT PER REEL	AMOUNT PER BULK CASE
	∅180 mm; 7"		∅330 mm; 13"		∅180 mm; 7" BLISTER	
	PAPER	BLISTER	PAPER	BLISTER	1812	0805
0.6 ±0.1	4000	–	20000	–	–	10000
0.85 ±0.1	4000	–	15000	–	–	8000
0.8 to 1.0	–	4000	–	10000	–	–
0.5 to 1.0	–	4000	–	10000	2000	–
0.9 to 1.3	–	3000	–	10000	1500	–
1.15 ±0.1	–	3000	–	10000	–	–
1.25 ±0.1	–	3000	–	10000	–	5000
1.2 to 1.75	–	2500	–	10000	–	–

ORDERING INFORMATION FOR 100 V, 200 V AND 500 V

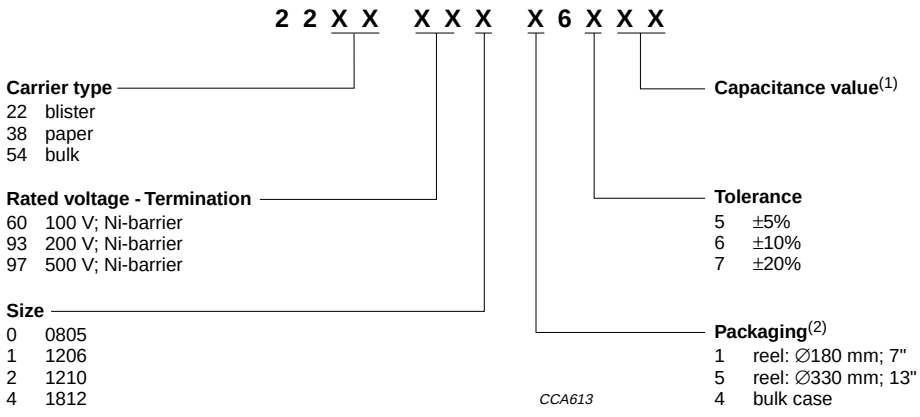
Components may be ordered by using either a simple 15-digit clear text code or Philips unique 12NC.

Clear text code

Example: 18122R104KBBB00

SIZE CODE	TEMP. CHAR.	CAPACITANCE	TOL.	VOLTAGE	TERMINATION	PACKAGING	MARKING	SERIES
0805 1206 1210 1812	2R = X7R	104 = 100000 pF; the third digit signifies the multiplying factor: 1 = × 10 2 = × 100 3 = × 1000 4 = × 10000	J = ±5% K = ±10% M = ±20%	0 = 100 V B = 200 V D = 500 V	B = Ni-barrier	2 = 180 mm; 7" paper 3 = 330 mm; 13" paper B = 180 mm; 7" blister F = 330 mm; 13" blister P = bulk case	0 = no marking 2 = 2-character marking in North America only	0 = conv. ceramic

Ordering code 12NC



(1) Refer to chapter “Selection chart for 100 V, 200 V and 500 V”.

(2) Amount on reel depends on thickness classification, see section “Thickness classification and packaging quantities”.

ELECTRICAL CHARACTERISTICS

Class 2 capacitors; X7R dielectric; AgPd and NiSn terminations

Unless otherwise stated all electrical values apply at an ambient temperature of 20 ±1 °C, an atmospheric pressure of 86 to 106 kPa, and a relative humidity of 63 to 67%.

DESCRIPTION	VALUE
Capacitance range (E12 series); note 1	100 pF to 100 nF
Tolerance on capacitance after 1000 hours	±20%; ±10%; ±5%; note 2
Tan δ; note 1	≤2.5%; 16 V range ≤3.5%
Insulation resistance after 1 minute at U_R (DC):	
$C \leq 10$ nF	$R_{ins} > 100$ GΩ
$C > 10$ nF	$R_{ins} \times C > 1000$ seconds
Maximum capacitance change as a function of temperature (for typical values see Fig.3)	±15%
Ageing	typical 1% per time decade

Notes

1. Measured at 1 V, 1 kHz, using a four-gauge method.
2. Tolerance of ±1% available on request.

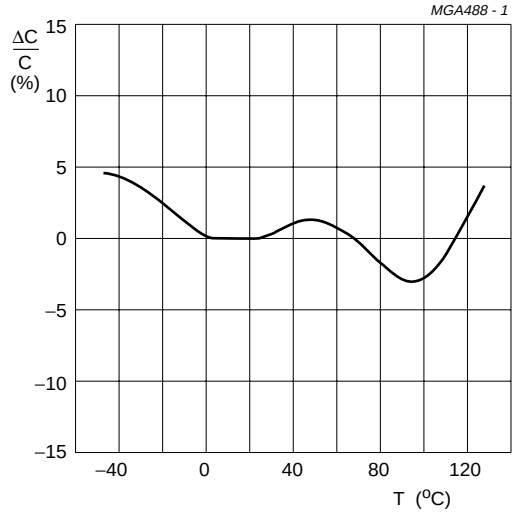
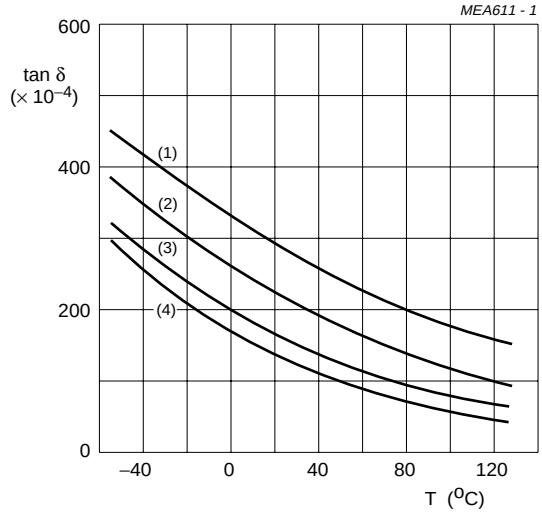


Fig.3 Typical capacitance change as a function of temperature.



Curve 1 = 16 V product.
Curve 2 = 25 V product.
Curve 3 = 50 V and 100 V products.
Curve 4 = 200 V and 500 V products.

Fig.4 Typical tan δ as a function of temperature.

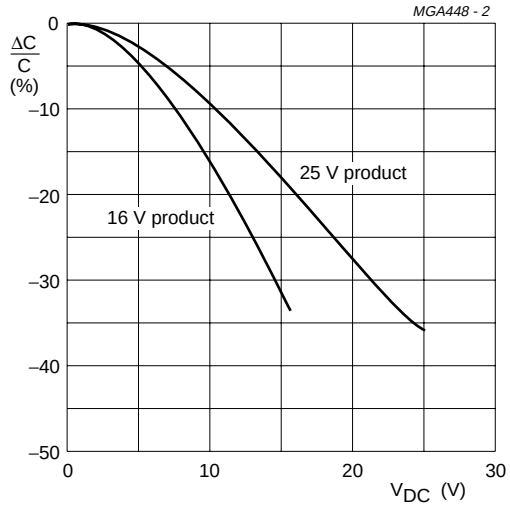


Fig.5 Typical capacitance change with respect to the capacitance at 1 V as a function of DC voltage at 20 °C.

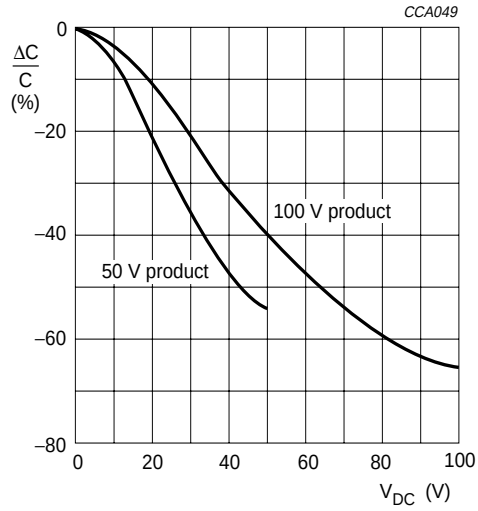


Fig.6 Typical capacitance change with respect to the capacitance at 1 V as a function of DC voltage at 20 °C.

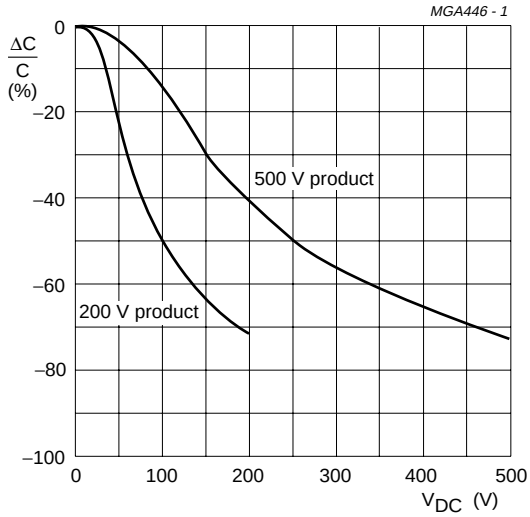


Fig.7 Typical capacitance change with respect to the capacitance at 1 V as a function of DC voltage at 20 °C.

DEFINITIONS

Data sheet status	
Objective specification	This data sheet contains target or goal specifications for product development.
Preliminary specification	This data sheet contains preliminary data; supplementary data may be published later.
Product specification	This data sheet contains final product specifications.
Application information	
Where application information is given, it is advisory and does not form part of the specification.	

LIFE SUPPORT APPLICATIONS

These products are not designed for use in life support appliances, devices, or systems where malfunction of these products can reasonably be expected to result in personal injury. Philips customers using or selling these products for use in such applications do so at their own risk and agree to fully indemnify Philips for any damages resulting from such improper use or sale.

NOTES

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