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AEC-Q200 Qualified
High Frequency 70 GHz Thin Film Chip Resistor



FEATURES

- Operating frequency 70 GHz
- AEC-Q200 qualified (CHA02016 flip chip only)
- Thin film microwave resistors
- Flip chip, wraparound or one face termination
- Ohmic range: 10R to 500R
- Design kits available
- Modelithics® library available
- Small internal reactance (LC down to 1 x 10^{-24})
- Material categorization: for definitions of compliance please see www.vishay.com/doc?99912

Pb-free
RoHS COMPLIANT
HALOGEN FREE
GREEN (5-2008)

LINKS TO ADDITIONAL RESOURCES

3D Models | S-Parameters | Simulation Tools | Application Notes | Capabilities and Custom Options | Did You Know? | Infographics | Why It Matters

Those miniaturized components are designed in such a way that their internal reactance is very small. When correctly mounted and utilized, they function as almost pure resistors on a very large range of frequency, up to 70 GHz for CHA02016 from 50 Ω to 100 Ω.

STANDARD ELECTRICAL SPECIFICATIONS

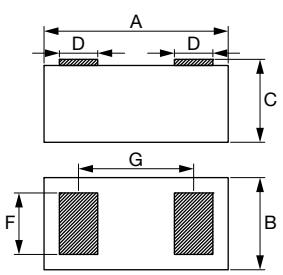
MODEL	SIZE	RESISTANCE RANGE Ω	RATED POWER Pn (1) W	LIMITING ELEMENT VOLTAGE V	TOLERANCE ± %	TEMPERATURE COEFFICIENT ± ppm/°C
CHA02016	02016	10 to < 50	0.030	30	5	100 (50 upon request)
CHA02016	02016	50 to ≤ 500	0.030	30	2, 5	100 (50 upon request)
CHA02016	02016	50 and 100	0.030	30	1, 2, 5	100 (50 upon request)

Note

(1) PCB mounting with +70 °C ambient temperature

DIMENSIONS in millimeters (inches)

CHA02016 F



CASE SIZE / MODEL / TERMINATION	DIMENSIONS						
	A ± 0.10 (± 0.004)	B ± 0.10 (± 0.004)	C ± 0.127 (± 0.005)	D E when applicable MIN.	D E when applicable MAX.	F ± 0.050 (± 0.002)	G ± 0.050 (± 0.002)
CHA02016F	0.480 (0.020)	0.390 (0.016)	0.420 (0.016)	0.110 (0.004)	0.150 (0.006)	0.260 (0.010)	0.300 (0.012)

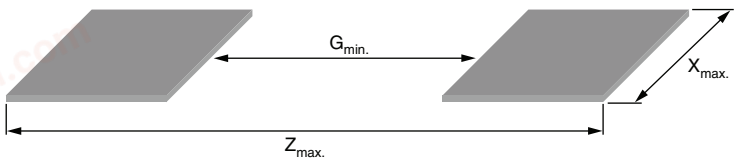
For technical questions, contact: sferthinfilm@vishay.com

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TOLERANCE VS. OHMIC VALUES		
Ohmic range	10 Ω ≤ *R* < 50 Ω	50 Ω ≤ *R* ≤ 500 Ω
Tolerance CHA02016	5 %	1 % for 50 Ω and 100 Ω, 2 %, 5 %

LAND PATTERN FOR F "FLIP CHIP" TERMINATIONS in millimeters (inches)



CHIP SIZE	$Z_{max.}$	$X_{max.}$	$G_{min.}$
02016	0.53 (0.021)	0.44 (0.017)	0.15 (0.006)

Note

- Suggested land pattern: according to IPC-7351

PERFORMANCE (CHA02016 F TERMINATION)

TEST PROCEDURES AND REQUIREMENTS

AEC-Q200 CLAUSE	TEST	PROCEDURE	GLOBAL PERFORMANCES	TYPICAL PERFORMANCES (25 Ω TO 250 Ω)
3	High temperature exposure	MIL-STD-202 method 108 1000 h at T = 125 °C, unpowered	± 2 % ± 0.05 Ω	± 0.2 % ± 0.05 Ω
4	Temperature cycling	JESD22 method JA-104 1000 cycles (-55 °C to +155 °C)	± 1.8 % ± 0.05 Ω	± 1.5 % ± 0.05 Ω
7	Biased humidity	MIL-STD-202 method 103 1000 h 85 °C / 85 % RH 10 % of operating power	± 2 % ± 0.05 Ω	± 0.75 % ± 0.05 Ω
8	Operational life	MIL-STD-202 method 108 condition D steady state T = 125 °C at rated power 90' on / 30' off / 1000 h	± 2.5 % ± 0.05 Ω	± 1 % ± 0.05 Ω
13	Mechanical shock	MIL-STD-202 method 213 condition C 100 *g*/6 ms 3.75 m/s 3 shock/direction, 2 directions along 3 axes (18 shocks)	± 0.05 % ± 0.05 Ω	± 0.015 % ± 0.05 Ω
14	Vibration	MIL-STD-202 method 204 5 g for 20 min, 12 cycles each of 3 orientations Test from 10 Hz to 2000 Hz	± 0.1 % ± 0.05 Ω	± 0.05 % ± 0.05 Ω
15	Resistance to soldering heat	MIL-STD-202 method 210 condition D Flux used: alpha 611 Solder temp.: 260 °C ± 5 °C Total immersion during 10 s	± 2.5 % ± 0.05 Ω	± 0.5 % ± 0.05 Ω
17	ESD	AEC-Q200-002	Classification 1C 1000 V_{DC} to 2000 V_{DC}	
18	Solderability	J-STD-002 - Preconditioning 4 h dry heat aging and 235 °C SnPb 5 s - 215 °C SnPb 5 s - 260 °C SnAgCu 10 s	Good tinning (≥ 95 % covered) No visible damage	
20	Flammability	UL 94	Class V-0 No burning	
21	Board flex	AEC-Q200-005	± 0.1 % ± 0.05 Ω	± 0.05 % ± 0.05 Ω
24	Flame retardance	AEC-Q200-001	No flame, no explosion, no temperature higher than 350 °C	

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PREFERRED MODELS AND VALUES

Recommended Values:

10R / 18R / 25R / 50R / 75R / 100R / 150R / 180R / 200R / 250R / 330R / 500R

Those values are available with a **MOQ of 100 pieces.**

Recommended termination:

F

Recommended tolerance:

2 %

Other values can be ordered upon request, but higher MOQ will apply: 1000 pieces for CHA02016.

DESIGN KITS

Design kits are available ex stock in CHA02016. There are 20 pieces per recommended value. F termination.

5 % tolerance.

Those kits are packaged in pieces of tape and delivered in ESD bags.

TEST BOARDS

TRL (Thru Reflect Line) and DUT (Device Under Test) evaluation boards (50 Ω or 100 Ω) are available on request.

PACKAGING

Standard packaging is plastic tape and reel for all sizes.

One face:

Tin / silver terminations (F termination option): Active face down in tape and reel.

Active face up in waffle pack.

Note

- Please refer to Vishay Sfernice Application Note "Guidelines for Vishay Sfernice Resistive and Inductive Components" for soldering recommendation (document number 52029, section "3. Guidelines for Surface Mounting Components (SMD)", profile number 3 applies

SIZE	MOQ	NUMBER OF PIECES PER PACKAGE			TAPE WIDTH
		WAFFLE PACK 2" x 2"	TAPE AND REEL		
			MIN.	MAX.	
02016	See MOQ mentioned on preferred models and values	484	100	5000	8 mm

PACKAGING RULES

Waffle Pack

Can be filled up to maximum quantity indicated in the table here above, taking into account the minimum order quantity. When quantity ordered exceeds maximum quantity of a single waffle pack, the waffle packs are stacked up on the top of each other and closed by one single cover. To get "not stacked up" waffle pack in case of ordered quantity > maximum number of pieces per package: please consult Vishay Sfernice for specific ordering code.

Tape and Reel

See Part Numbering information to get the quantity desired by tape.

In regard to the CHA02016 size only, up to 5 empty cavities can be found every 1000 parts in the reel. Nevertheless, the number of requested parts will be respected.

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GLOBAL PART NUMBER INFORMATION

Part Number Example: CHA02016-100RGFTF (AEC-Q200 qualified CH series, 100 Ω, 2 % tolerance, 5000 pieces reels)

C	H	A	0	2	0	1	6	-	1	0	0	R	G	F	T	F

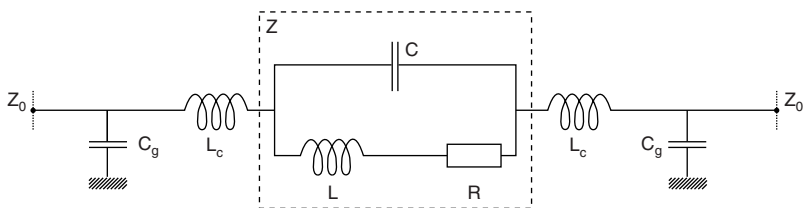
GLOBAL MODEL	SIZE	OHMIC VALUE	TOLERANCE	TERMINATION	PACKAGING
CHA	**02016**	**10R to 500R**	**F** = 1 % **G** = 2 % **J** = 5 %	**F** (flip chip): SnAg over nickel barrier	For more information see “Codification of Packaging” table

CHKIT Part Numbers: CHKIT-02016

CODIFICATION OF PACKAGING

WAFFLE PACK (available for all sizes)	
W	100 min., 1 mult.; 100 pcs max.
PLASTIC TAPE (standard packaging for all sizes) - TA, TB, TC, TD NOT RECOMMENDED FOR NEW DESIGNS	
T	100 min., 100 mult.; delivered in reels of 1000 pcs max.
TA	100 min., 100 mult.; delivered in reels of 100 pcs
TB	250 min., 250 mult.; delivered in reels of 250 pcs
TC	500 min., 500 mult.; delivered in reels of 500 pcs
TD	1000 min., 1000 mult.; delivered in reels of 1000 pcs
TF	5000 min., 5000 mult.; delivered in reels of 5000 pcs
PAPER TAPE (available for 0402 and 0603 with F, N, and G terminations) - NOT RECOMMENDED FOR NEW DESIGNS	
PT	100 min., 100 mult.; delivered in reels of 1000 pcs max.
PA	100 min., 100 mult.; delivered in reels of 100 pcs
PB	250 min., 250 mult.; delivered in reels of 250 pcs
PC	500 min., 500 mult.; delivered in reels of 500 pcs

TYPICAL HIGH FREQUENCY PERFORMANCE ELECTRICAL MODEL



C	Internal shunt capacitance
L	Internal inductance
R	Resistance
Z	Internal impedance (R, L, C)
L_c	External connection inductance
C_g	External capacitance to ground

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The complex impedance of the chip resistor is given by the following equations:

$$Z = \frac{R + j\omega(L - R^2C - L^2C\omega^2)}{1 + C[(R^2C - 2L)\omega^2 + L^2C\omega^4]}$$

$$\frac{[Z]}{R} = \frac{1}{1 + C[(R^2C - 2L)\omega^2 + L^2C\omega^4]} \times \sqrt{1 + \left[\frac{\omega(L - R^2C - L^2C\omega^2)}{R}\right]^2}$$

$$\theta = \tan^{-1}\frac{\omega(L - R^2C - L^2C\omega^2)}{R}$$

Notes

- $\omega = 2 \times \pi \times f$
- f: frequency

R, L and C are relevant to the chip resistor itself.

L_c and C_g also depend on the way the chip resistor is mounted.

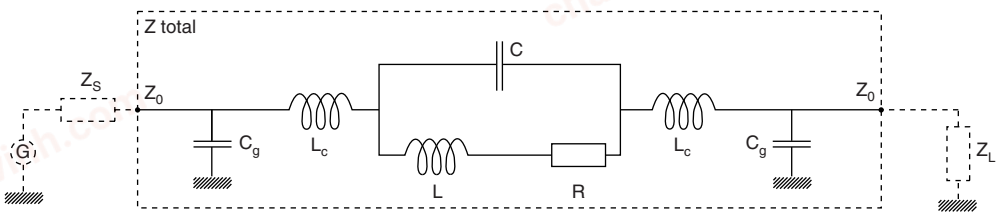
It is important to notice that after assembly the external reactance of L_c and C_g will be combined to internal reactance of L and C. This combination can upgrade or downgrade the HF behavior of the component.

This is why we are displaying three sets of data:

- $\frac{[Z]}{R}$ versus frequency curves which aim to show at a glance the intrinsic HF performance of a given chip resistor
- $\frac{[Z_{total}]}{R}$ versus frequency curves which aim to show the behavior of the chip resistor when mounted

These lines are terminated with adapted source and load impedance respectively Z_s and Z_l with $Z_0 = Z_L = Z_s$ (for others configurations please consult us).

Equivalent circuit for S-parameters:



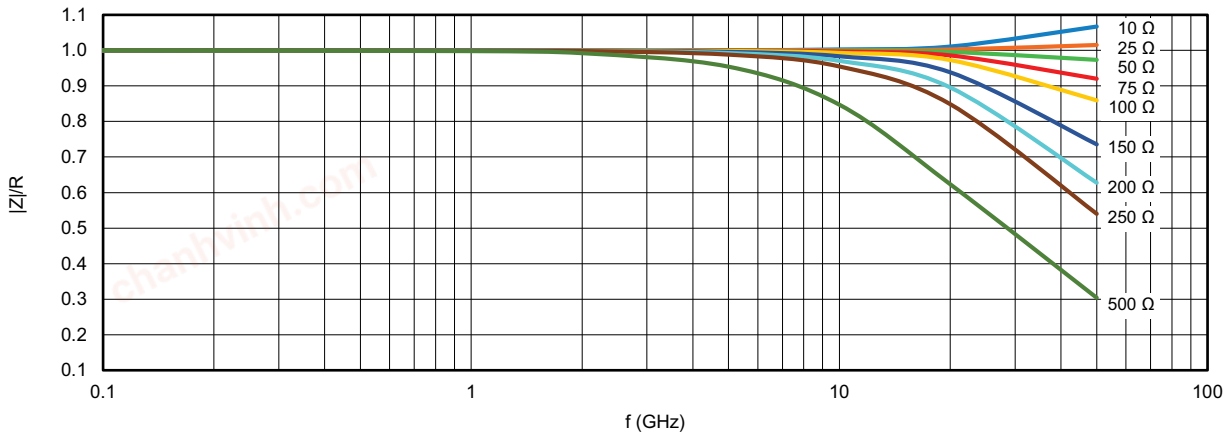
S-parameters are computed taking into account all the resistive, inductive and capacitive elements (Z total) and $Z_0 = Z_L = Z_s = R$.

For simulation purposes, those S-parameter data are available for download here: www.vishay.com/doc?53061

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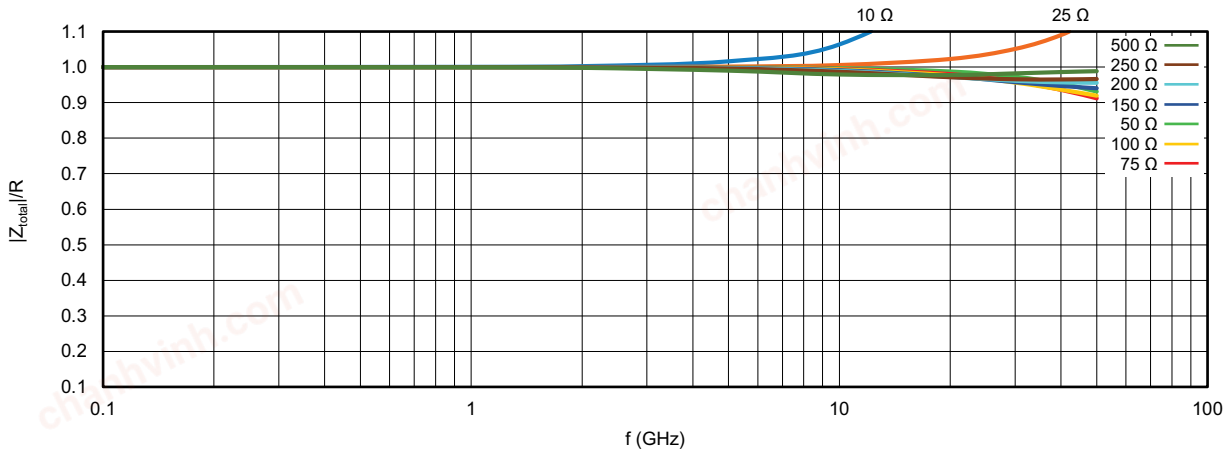
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INTERNAL IMPEDANCE CURVES



Internal impedance curve for 02016 size (F and P terminations)

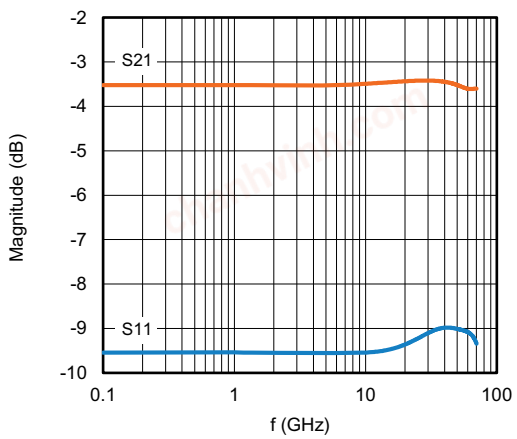
INTERNAL IMPEDANCE CURVES ($|Z_{TOTAL}|$ / R)



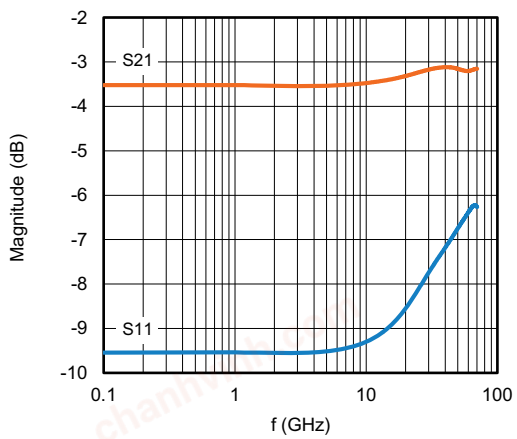
Internal impedance curve for 02016 size (F and P terminations)

S-PARAMETER

CHA02016 (F and P Terminations)



CHA02016 flip chip ($Z_0 = Z_l = Z_s = R = 50\ \Omega$)



CHA02016 flip chip ($Z_0 = Z_l = Z_s = R = 100\ \Omega$)

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