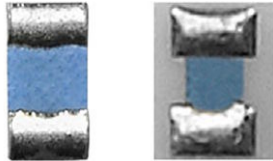# High Frequency 50 GHz Thin Film Chip Resistor

FEATURES

- Operating frequency 50 GHz
- Thin film microwave resistors
- SMD wraparound or flip chip resistor
- Small size, down to 20 mils by 16 mils
- Edged trimmed block resistors
- Pure alumina substrate (99.5 %)
- Ohmic range: 10R to 500R
- Design kits available
- Small internal reactance (LC down to 1×10^{-24})
- Tolerance 1 %, 2 %, 5 %, 10 %
- TCR: 100 ppm/°C in (-55 °C, +155 °C) temperature range
- Material categorization: for definitions of compliance please see www.vishay.com/doc?99912

Pb-free

RoHS
COMPLIANT

HALOGEN FREE

GREEN
(5-2008)

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 50 GHz.

STANDARD ELECTRICAL SPECIFICATIONS

MODEL	SIZE	RESISTANCE RANGE Ω	RATED POWER Pn W	LIMITING ELEMENT VOLTAGE V	TOLERANCE ± %	TEMPERATURE COEFFICIENT ± ppm/°C
CH02016	02016	10 to 500	0.030	30	2, 5, 10	100
CH0402	0402	10 to 500	0.050	37	1, 2, 5, 10	100
CH0603	0603	10 to 500	0.125	50	1. 2, 5, 10	100

DIMENSIONS in millimeters (inches)

CASE SIZE MAX. TOL. + 0.1 (+ 0.004) MIN. TOL. - 0.1 (- 0.004)	DIMENSIONS				
	A [1] MAX. TOL. + 0.1 (+ 0.004) MIN. TOL. - 0.1 (- 0.004)	B MAX. TOL. + 0.1 (+ 0.004) MIN. TOL. - 0.1 (- 0.004)	C MAX. TOL. + 0.127 (+ 0.005) MIN. TOL. - 0.127 (- 0.005)	D/E	
				MIN.	MAX.
02016	0.48 (0.020)	0.39 (0.016)	0.42 (0.02) [2]	0.11 (0.004)	0.15 (0.008)
0402	1.00 (0.040)	0.6 (0.023)	0.5 (0.02)	0.15 (0.006)	0.35 (0.014)
0603	1.52 (0.060)	0.75 (0.030)	0.5 (0.02)	0.25 (0.010)	0.51 (0.020)

Notes

[1] For CH0402 and CH0603 with P termination, A dimension is increased by 0.2 mm

[2] + or - 0.07 mm

LAND PATTERN FLIP CHIP TERMINATIONS in millimeters

CHIP SIZE	$Z_{max.}$	$X_{max.}$	$G_{min.}$
02016	0.53	0.44	0.15
0402	1.4	0.650	0.4
0603	1.71	0.9	0.760

Note

• Suggested land pattern: According to IPC-7351

Dimension and tolerance of land pattern shall be defined by PCB designer; PCB can be designed according to IPC-7351A "Generic Requirements for Surface Mount Design and Land Pattern Standard"

Example of land pattern: Fabrication allowance, assembly location and min. or max. level density board are not included in the exemple bellow.

According to IPC-7351A "Generic Requirements for Surface Mount Design and Land Pattern Standard":

$Z_{max.} = A_{min.} + 2J_T + \sqrt{(C_A{}^2 + F^2 + P^2)}$ with C: "Unilateral profile tolerance for the component";

$G_{min.} = F_{max.} + 2J_H - \sqrt{(C_F{}^2 + F^2 + P^2)}$ F: "Unilateral profile tolerance for the board land pattern";

$X_{max.} = B_{min.} + 2J_S + \sqrt{(C_B{}^2 + F^2 + P^2)}$ and P: "Diameter of true position placement accuracy to the center of land pattern".

Land Pattern Footprint

For rectangular component Flip-Chip mounting, we suggest:

JT (TOE)	0 mm
JH (HELL)	0 mm
JS (SDE)	0 mm

WRAPAROUND TERMINATIONS in millimeters

CHIP SIZE	$Z_{max.}$	$G_{min.}$	$X_{max.}$
0402	1.55	0.15	0.73
0603	2.37	0.35	0.98

TOLERANCE VS. OHMIC VALUES

Ohmic range	$10\ \Omega \leq R < 50\ \Omega$	$50\ \Omega \leq R < 100\ \Omega$	$100\ \Omega \leq R \leq 500\ \Omega$
Tolerance	5 %, 10 %	2 %, 5 %, 10 %	1 %, 2 %, 5 %, 10 % [1]

Note

[1] 1 % tolerance not applicable for case 02016.

PREFERRED MODELS AND VALUES

Vishay Sfernice highly recommend to use the smallest sizes and flip chip version to get the best performances.

Recommended Values:

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

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

Other values can be ordered upon request, but higher MOQ will apply: 1000 pieces for CH02016, 500 pieces for CH0402, 50 pieces for CH0603.

Recommended terminations:

F

Recommended tolerance:

2 %

Design kits are available Ex Stock in CH02016 and CH0402 sizes. There are 20 pieces per recommended value. F termination. 5 % tolerance.

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

PACKAGING

Standard packaging is waffle pack for sizes 0402 and 0603 and plastic tape and reel (low conductivity) for size 02016.
Paper tape and reel is available for size 0402 and either paper tape and reel or plastic tape and reel (low conductivity) for size 0603.

Depending on the type of terminations, parts will be packed differently:

One face:

• Gold terminations: Active face up

• Tin/silver termination: Active face down

Note

• Please refer to Vishay Sfernice Application Note "Guidelines for Vishay Sfernice Resistive and Inductive Products" for soldering recommendation (document number 52029, 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
0402		100			
0603		100			

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.

GLOBAL PART NUMBER INFORMATION

New Global Part Numbering: CH0402-50RJF (preferred part number format)

C	H	0	4	0	2	-	5	0	R	J	F	T		9	9	9

| GLOBAL MODEL	SIZE	OHMIC VALUE	TOLERANCE	TERMINATION	PACKAGING	OPTION
CH	02016 0402 0603	10R to 500R	**F** = 1 % **G** = 2 % **J** = 5 % **K** = 10 %	**F** (Flip Chip): SnAg over nickel barrier **N** (W/A): SnAg over nickel barrier (except 02016) **P** (one face): [1] Gold bonding pads **G** (W/A): Gold (except 02016)	For more information see Codification of Packaging table	From 1 to 3 digits. Leave blank if no option.

Historical Part Number example: CH02016-100RGFPT1K (tapes of 1K pieces)
CH0402-50RJF (waffle pack)

Notes

- Historical part numbers are not recommended but can still be used for ordering.
[1] Gold termination for application in hermetic package.

CODIFICATION OF PACKAGING

WAFFLE PACK (standard packaging for CH0402 and CH0603)	
W	100 min., 1 mult
PLASTIC TAPE (standard packaging for CH02016 and CH0603)	
T	100 min., 1 mult
TA	100 min., 100 mult
TB	250 min., 250 mult
TC	500 min., 500 mult
TD	1000 min., 1000 mult
TE	2500 min., 2500 mult
TF	Full tape (qunatity depending on size of chips)
PAPER TAPE (standard packaging for CH0402 - available for CH0603)	
PT	100 min., 1 mult
PA	100 min., 100 mult
PB	250 min., 250 mult
PC	500 min., 500 mult
PD	1000 min., 1000 mult
PE	2500 min., 2500 mult
PF	Full tape (quantity depending on size of chips)

TYPICAL HIGH FREQUENCY PERFORMANCE ELECTRICAL MODEL
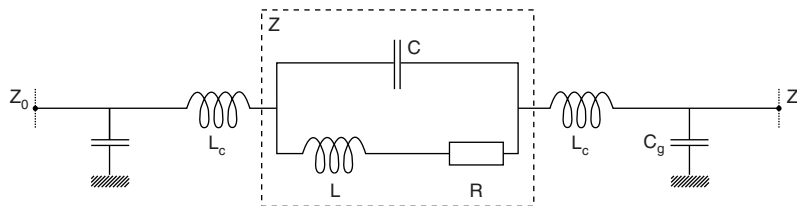
C	Internal shunt capacitance
L	Internal inductance
R	Resistance
Z	Internal impedance (R, L, C)
L_c	External connection inductance
C_g	External capacitance to ground

For technical questions, contact: sferthinfilm@vishay.com

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

The chip resistor itself is purely resistive when $R = \sqrt{\dfrac{L}{C}}$. The smaller the L x C product the greater the frequency range over which the resistor looks approximately resistive.
This can be seen on the graphs showing the ratio $\dfrac{[Z]}{R}$ versus frequency.
R, L and C are relevant to the chip resistor itself.
L_c and C_g also depends 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 two sets of data:
- $\dfrac{[Z]}{R}$ versus frequency curves which aims to show at a glance the intrinsic HF performance of a given chip resistor
- S-parameters versus frequency curves relevant to chip resistor when assembled on ideal Z0 impedance transmission line

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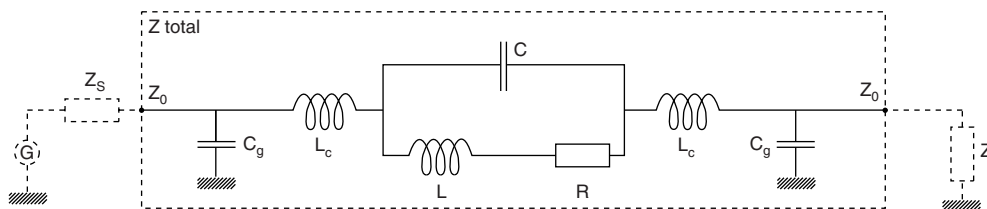
S-parameters are computed taking into account all the resistive, inductive and capacitive elements (Z total) and $Z_0 = Z_L = Z_s = R$.

INTERNAL IMPEDANCE CURVES

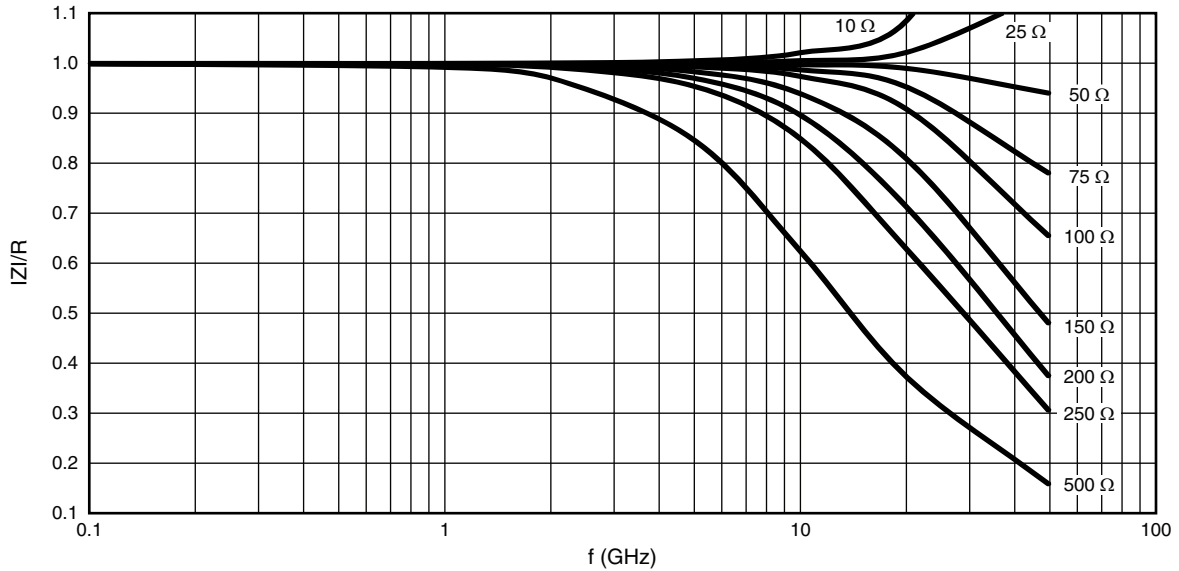Internal impedance curve for 02016 size (F and P terminations)

Internal impedance curve for 0402 size (F and P terminations)

For technical questions, contact: sferthinfilm@vishay.com

THIS DOCUMENT IS SUBJECT TO CHANGE WITHOUT NOTICE. THE PRODUCTS DESCRIBED HEREIN AND THIS DOCUMENT
ARE SUBJECT TO SPECIFIC DISCLAIMERS, SET FORTH AT www.vishay.com/doc?91000

INTERNAL IMPEDANCE CURVES

Internal impedance curve for 0402 size (N and G terminations)

Internal impedance curve for 0603 size (F and P terminations)

INTERNAL IMPEDANCE CURVES

Internal impedance curve for 0603 size (N and G terminations)

S-PARAMETER

CH02016 (F and P Terminations)
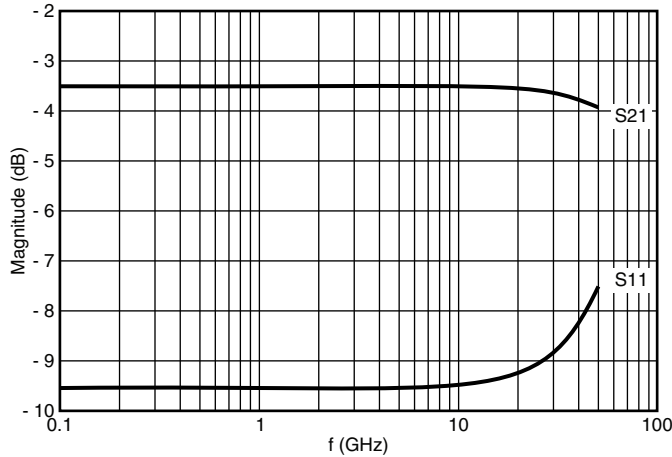

CH02016 flip chip ($Z_0 = Z_l = Z_s = R = 50$ Ω)

CH02016 flip chip ($Z_0 = Z_l = Z_s = R = 100$ Ω)
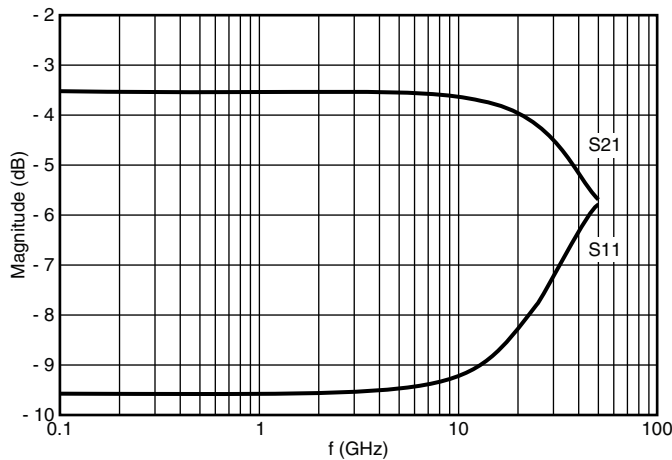
S-PARAMETER

CH0402 (F and P Terminations)

CH0402 flip chip ($Z_0 = Z_l = Z_s = R = 50\ \Omega$)

CH0402 flip chip ($Z_0 = Z_l = Z_s = R = 100\ \Omega$)

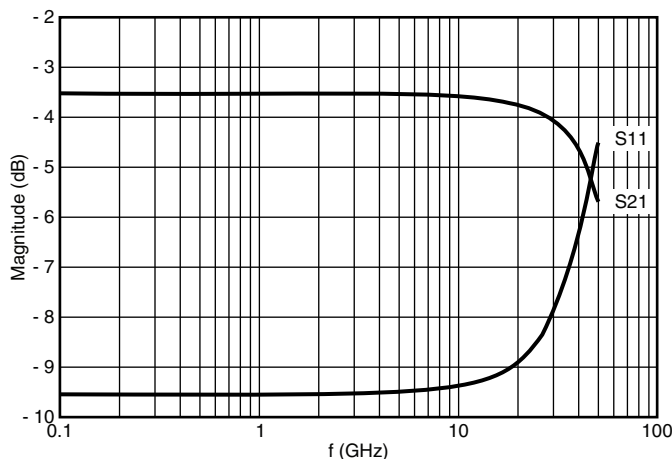### CH0402 (N and G Terminations)

CH0402 wraparound ($Z_0 = Z_l = Z_s = R = 50\ \Omega$)

CH0402 wraparound ($Z_0 = Z_l = Z_s = R = 100\ \Omega$)

CH0603 (F and P Terminations)

CH0603 flip chip ($Z_0 = Z_l = Z_s = R = 50\ \Omega$)

CH0603 flip chip ($Z_0 = Z_l = Z_s = R = 100\ \Omega$)

S-PARAMETER

CH0603 (N and G Terminations)

CH0603 wraparound ($Z_0 = Z_l = Z_s = R = 50\ \Omega$)

CH0603 wraparound ($Z_0 = Z_l = Z_s = R = 100\ \Omega$)

Disclaimer

ALL PRODUCT, PRODUCT SPECIFICATIONS AND DATA ARE SUBJECT TO CHANGE WITHOUT NOTICE TO IMPROVE RELIABILITY, FUNCTION OR DESIGN OR OTHERWISE.

Vishay Intertechnology, Inc., its affiliates, agents, and employees, and all persons acting on its or their behalf (collectively, "Vishay"), disclaim any and all liability for any errors, inaccuracies or incompleteness contained in any datasheet or in any other disclosure relating to any product.

Vishay makes no warranty, representation or guarantee regarding the suitability of the products for any particular purpose or the continuing production of any product. To the maximum extent permitted by applicable law, Vishay disclaims (i) any and all liability arising out of the application or use of any product, (ii) any and all liability, including without limitation special, consequential or incidental damages, and (iii) any and all implied warranties, including warranties of fitness for particular purpose, non-infringement and merchantability.

Statements regarding the suitability of products for certain types of applications are based on Vishay's knowledge of typical requirements that are often placed on Vishay products in generic applications. Such statements are not binding statements about the suitability of products for a particular application. It is the customer's responsibility to validate that a particular product with the properties described in the product specification is suitable for use in a particular application. Parameters provided in datasheets and / or specifications may vary in different applications and performance may vary over time. All operating parameters, including typical parameters, must be validated for each customer application by the customer's technical experts. Product specifications do not expand or otherwise modify Vishay's terms and conditions of purchase, including but not limited to the warranty expressed therein.

Except as expressly indicated in writing, Vishay products are not designed for use in medical, life-saving, or life-sustaining applications or for any other application in which the failure of the Vishay product could result in personal injury or death. Customers using or selling Vishay products not expressly indicated for use in such applications do so at their own risk. Please contact authorized Vishay personnel to obtain written terms and conditions regarding products designed for such applications.

No license, express or implied, by estoppel or otherwise, to any intellectual property rights is granted by this document or by any conduct of Vishay. Product names and markings noted herein may be trademarks of their respective owners.

X-ON Electronics

Largest Supplier of Electrical and Electronic Components

Click to view similar products for Vishay *manufacturer:*

Other Similar products are found below :

RER60F3010RC02 RER75F2260PCSL RER75F6R49RC02 RER70F75R0RC02 RER65F5111RC02 C52TF15R0JB VS-8ETH06PBF DG1413EQ-T1-GE3 CRA04S0837K50JTD CRA06S08382K0JTA CRA06P08327R0JTA RER60F2430RC02 RER70FR100MC02 RER65F4870RC02 RER50F18R7RC02 M8340107K4751FGD03 M8340108K1052FGD03 CRA06S083180KJTA CRA06S083220KJTA DG211BDY CRA04S08368K0JTD VS-60EPS08PBF CRA06S0835K60JTA IH10EB600K12 VS-MBRB1545CTPBF VS-60CTQ150-N3 CNY651AGRST CRA04S0833K90JTD 1KAB100E D55342H07B10E0RT5 516D477M016MN6AE3 BFC237852224 VJ0402A4R7CNAAJ CRA04S08322K0JTD RS02C30K00FB12 TLHK5400 CRA04S08336R0JTD IRF644 PTN0805H40R2BBT1 516D227M016MM6AE3 MKP1848C65090JY5L CRA04S08320K0JTD 516D476M035LM6AE3 CRA04S08318K0JTD SIA406DJ-T1-GE3 CRA06P08318R0JTA CRA06S0834K30JTA CRA06S083360RJTA 562R5GAD47RR VJ1825A223FXAAT