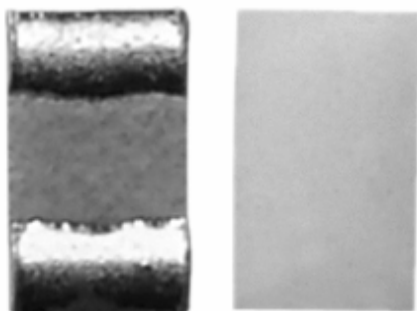


50 GHz Thin Film Microwave Resistors



FEATURES

- SMD wraparound or flip chip resistor
- Small size, down to 20 mils by 16 mils
- Edged trimmed block resistors
- Pure alumina substrate (99.5 %)
- Various terminations:
 - Pre-tinned over nickel barrier (wraparound (N) or flip chip (F)) for solder reflow
 - Gold pad for wire (or ribbon) bonding (one face only) (P) and for glue attach (G) wraparound
- 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
- Compliant to RoHS Directive 2002/95/EC

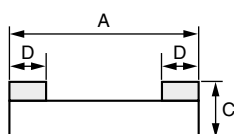


RoHS
COMPLIANT

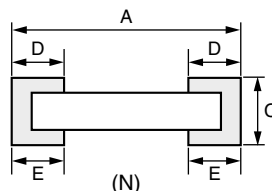
GREEN
(5-2008)**

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.

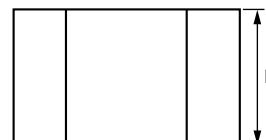
DIMENSIONS in millimeters (inches)



(F) and (P)



(N)



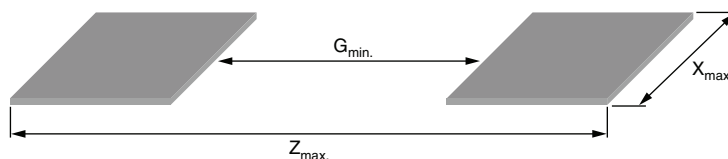
CASE SIZE MAX. TOL. + 0.1 (+ 0.004) MIN. TOL. - 0.1 (- 0.004)	DIMENSIONS					POWER RATING Pn mW	LIMITING ELEMENT VOLTAGE V
	A	B	C	D/E			
	MAX. TOL. + 0.1 (+ 0.004) MIN. TOL. - 0.1 (- 0.004)	MAX. TOL. + 0.1 (+ 0.004) MIN. TOL. - 0.1 (- 0.004)	MAX. TOL. + 0.127 (+ 0.005) MIN. TOL. - 0.127 (- 0.005)	MIN.	MAX.		
02016	0.48 (0.020)	0.39 (0.016)	0.42 (0.02) ⁽¹⁾	0.11 (0.004)	0.15 (0.008)	30	30
0402	1.00 (0.040)	0.6 (0.023)	0.5 (0.02)	0.15 (0.006)	0.35 (0.014)	50	37
0603	1.52 (0.060)	0.75 (0.030)	0.5 (0.02)	0.25 (0.010)	0.51 (0.020)	125	50

Note

⁽¹⁾ + or - 0.07 mm

** Please see document "Vishay Material Category Policy": www.vishay.com/doc?999902

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"

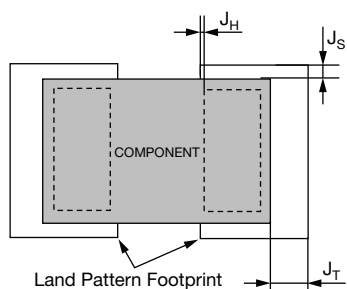
Example of land pattern: Fabrication allowance, assembly location and min. or max. level density board are not included in the example below.

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

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

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

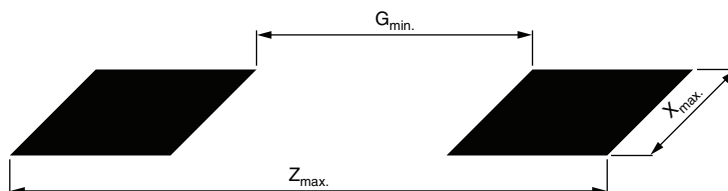
$$X_{max.} = B_{min.} + 2J_S + \sqrt{(C_B^2 + F^2 + P^2)} \quad \text{and P: "Diameter of true position placement accuracy to the center of land pattern".}$$



For rectangular component Flip-Chip mounting, we suggest:

J _T (TOE)	0 mm
J _H (HELL)	0 mm
J _S (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	$10\ \Omega \leq R < 50\ \Omega$	$50\ \Omega \leq R < 100\ \Omega$	$100\ \Omega \leq R \leq 500\ \Omega$ ⁽¹⁾
TOLERANCE	5 %, 10 %	2 %, 5 %, 10 %	1 %, 2 %, 5 %, 10 %

Note

⁽¹⁾ Best tolerance for 100 Ω to 500 Ω in 02016 is 2 %

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, 250 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. Paper tape for size 02016.

Plastic tape and reel is available for 0402 and 0603 (low conductivity) or paper tape under request.

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

GLOBAL PART NUMBER INFORMATION

New Global Part Numbering: CH0402-50RJF T

GLOBAL MODEL	SIZE	OHMIC VALUE	TOLERANCE	TERMINATION ⁽¹⁾	PACKAGING ⁽²⁾
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): ⁽³⁾ Gold bonding pads G (W/A): Gold (except 02016)	T = Tape and reel PT = Paper tape Leave blank for waffle pack

Historical Part Number example: CH 0402 50R 5 % P e2 (will continue to be accepted)

CH	0402	50R	5 %	P	e2
HISTORICAL MODEL	SIZE	OHMIC VALUE	TOLERANCE	TERMINATION	LEAD (Pb)-FREE VERSION
					e2: Tin/silver e4: Gold

Global Part Number Ordering design kits:

CHKIT-02016

CHKIT-0402

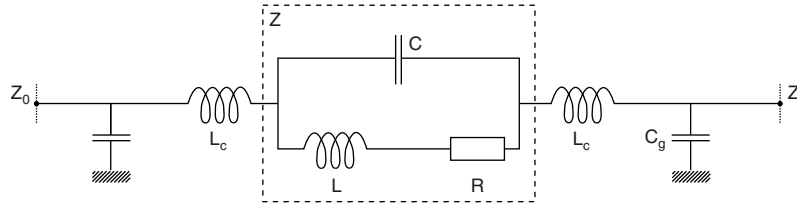
Notes

⁽¹⁾ 02016 not available with N and G termination

⁽²⁾ 02016 paper tape only available

⁽³⁾ Gold termination for application in hermetic package

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

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 $R = \sqrt{\frac{L}{C}}$. 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 $\frac{|Z|}{R}$ 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.

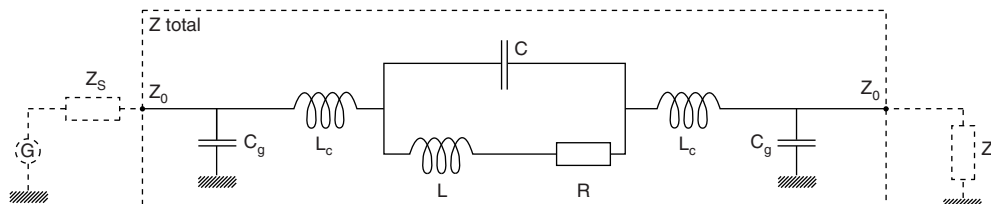
It is important to notice that after assembly the external reactance of L_c and C_g will be combined to internal reactance of L and C. This combination can upgrade or downgrade the HF behaviour of the component.

This is why we are displaying two sets of data:

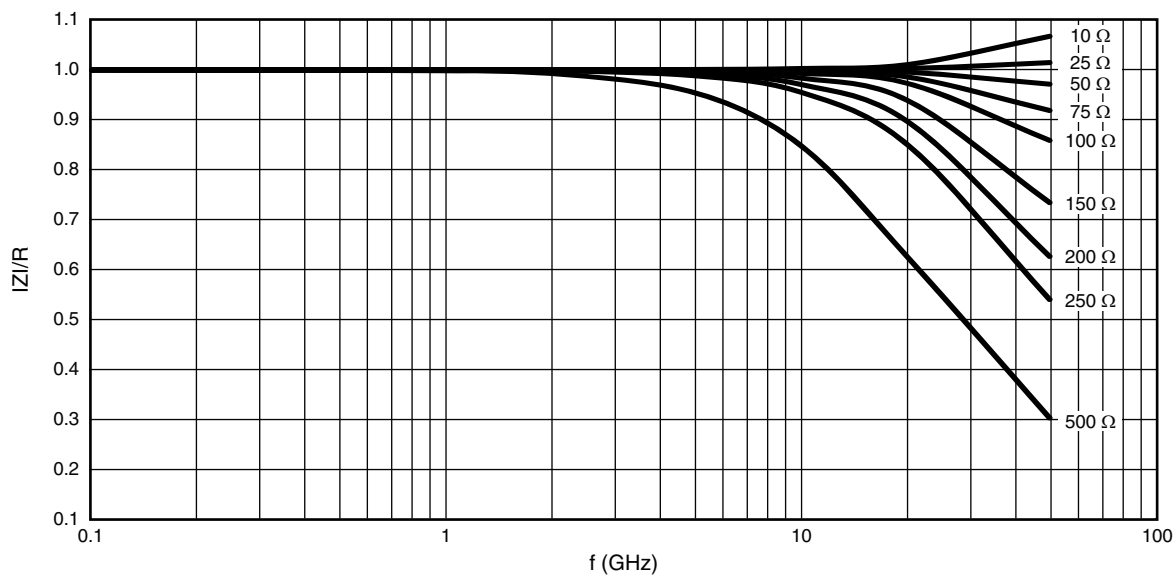
- $\frac{|Z|}{R}$ versus frequency curves which aims to show at a glance the intrinsic HF performance of a given chip resistor
- S-parameters versus frequency curves relevant to chip resistor when assembled on ideal Z₀ impedance transmission line

These lines are terminated with adapted source and load impedance respectively Z_s and Z_L with Z₀ = Z_L = Z_s (for others configurations please consult us).

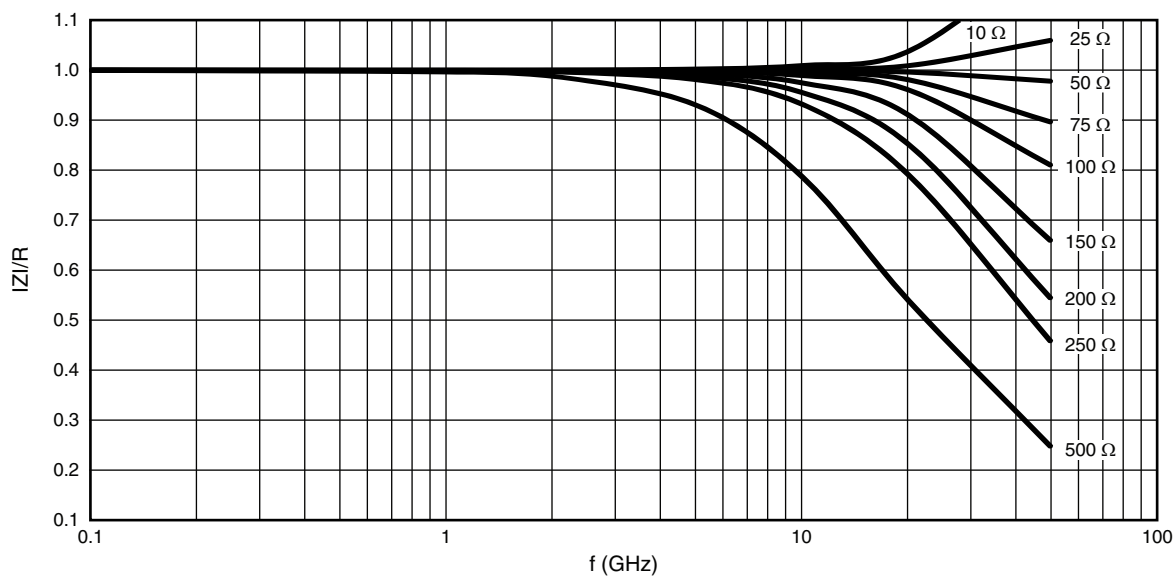
Equivalent circuit for S-parameters:



S-parameters are computed taking into account all the resistive, inductive and capacitive elements (Z total) and Z₀ = Z_L = Z_s = R.

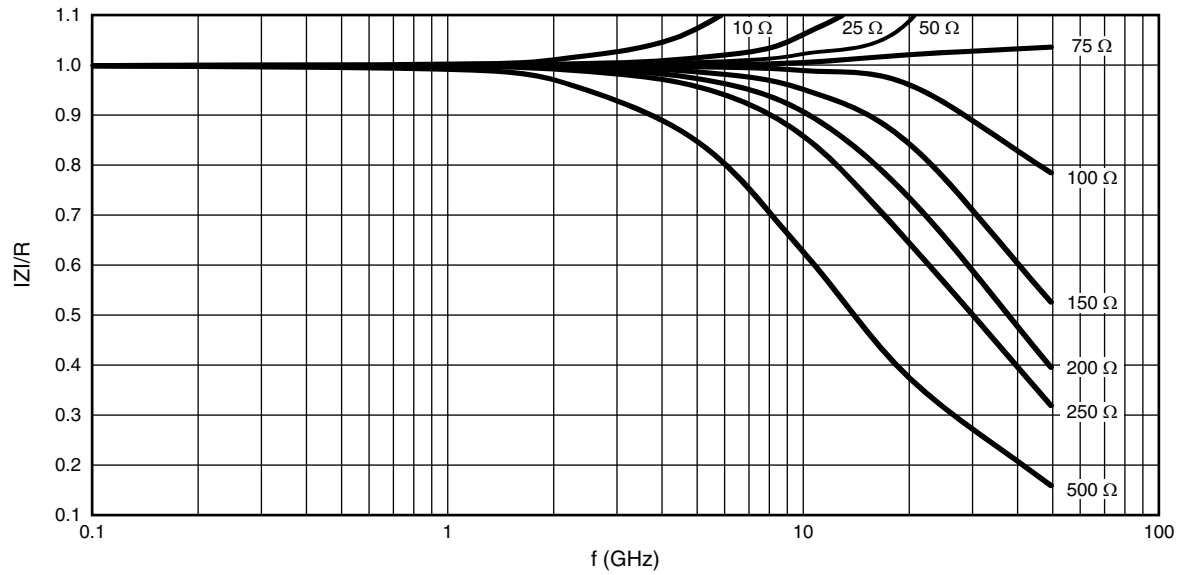
INTERNAL IMPEDANCE CURVES

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

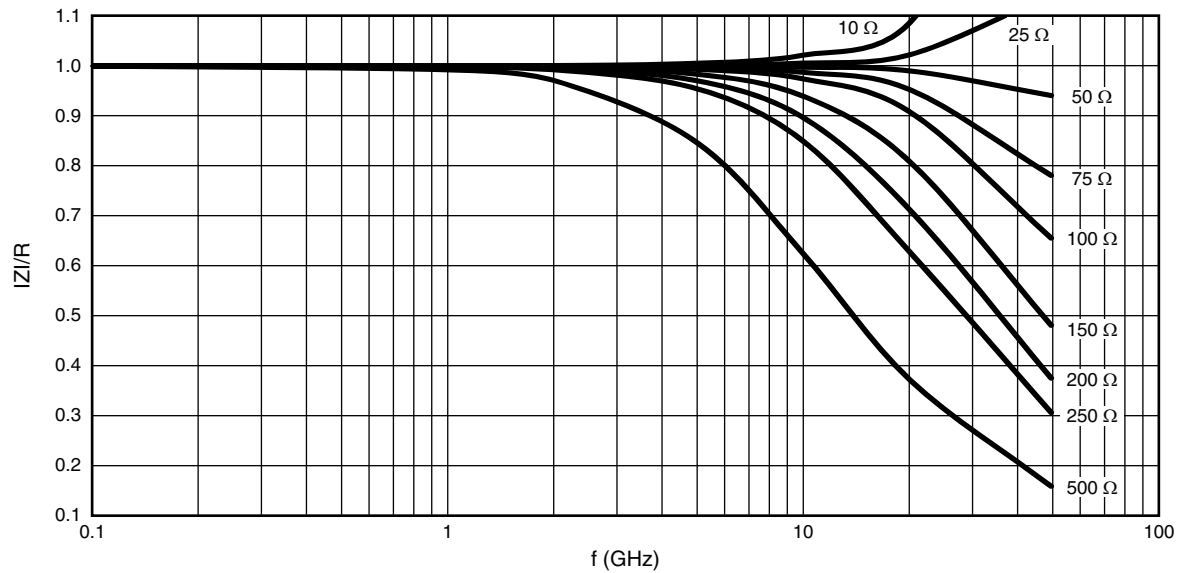


Internal impedance curve for 0402 size (F and P terminations)

INTERNAL IMPEDANCE CURVES

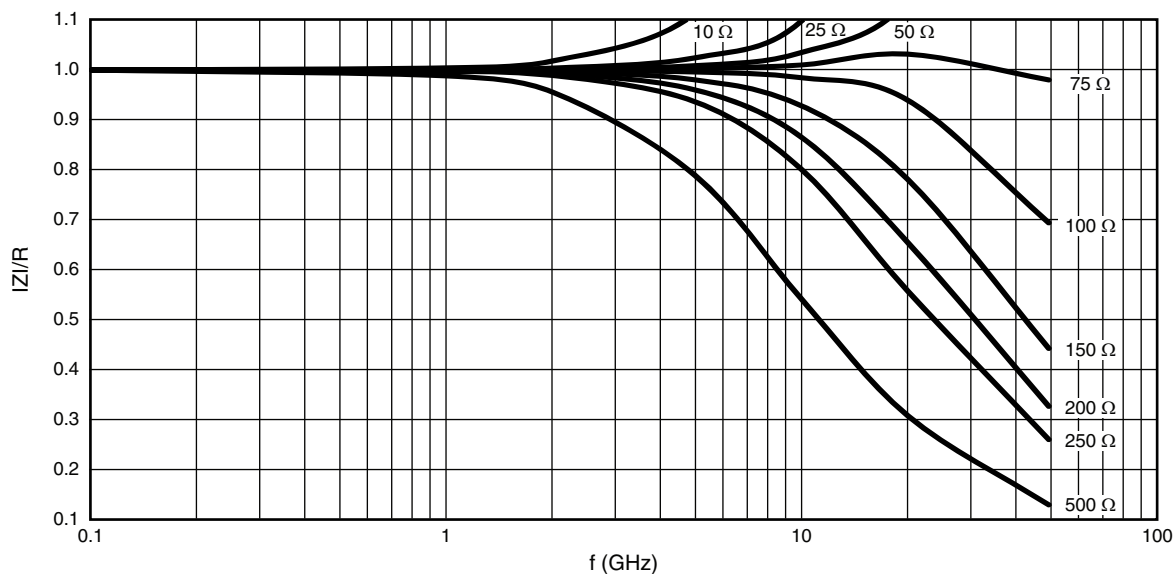


Internal impedance curve for 0402 size (N and G terminations)



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

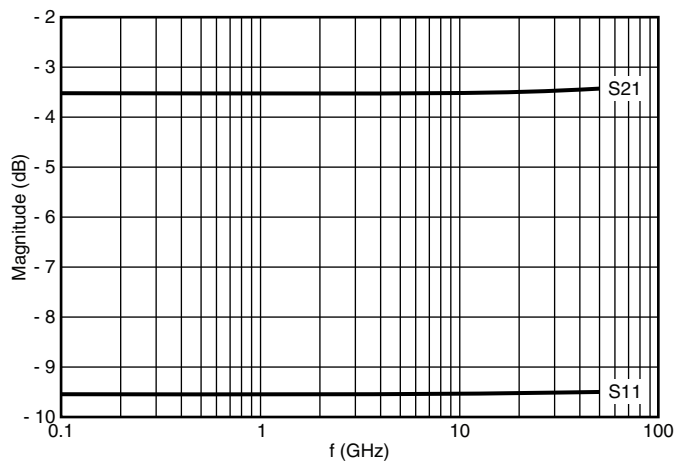
INTERNAL IMPEDANCE CURVES



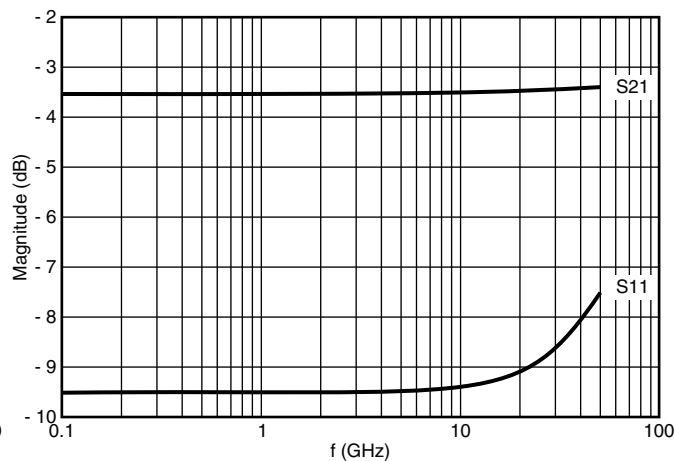
Internal impedance curve for 0603 size (N and G terminations)

S PARAMETER

CH02016 (F and P Terminations)



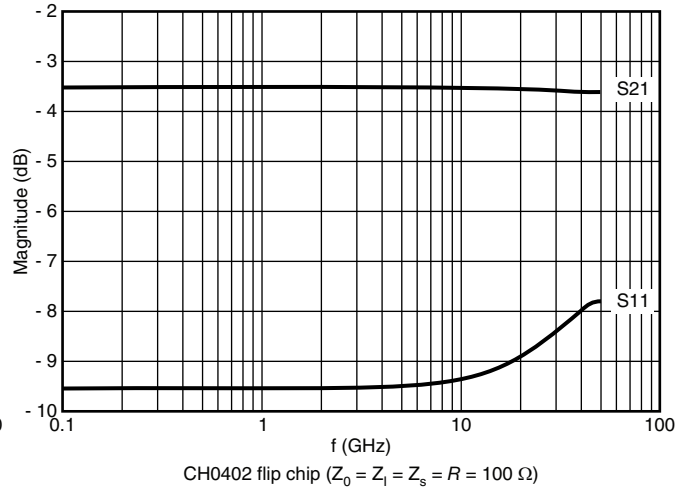
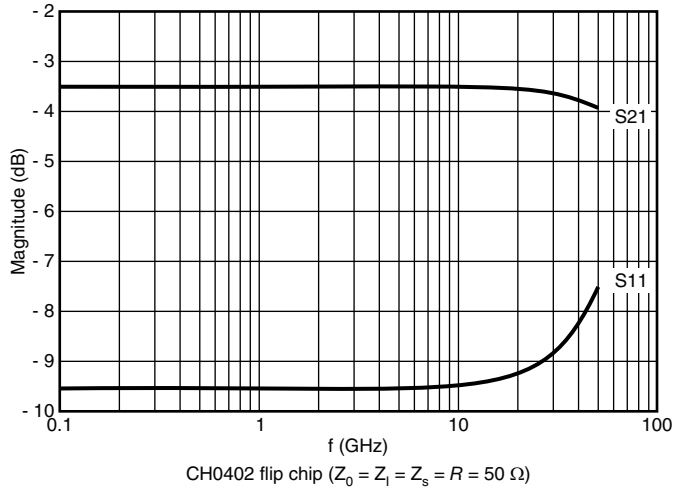
CH02016 flip chip ($Z_0 = Z_1 = Z_s = R = 50 \Omega$)



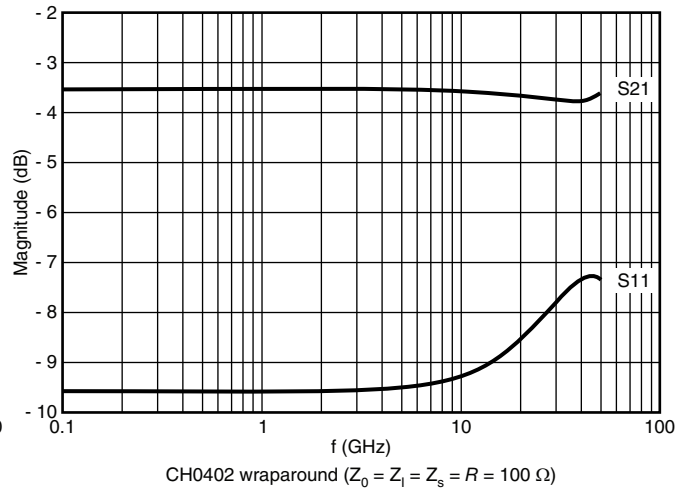
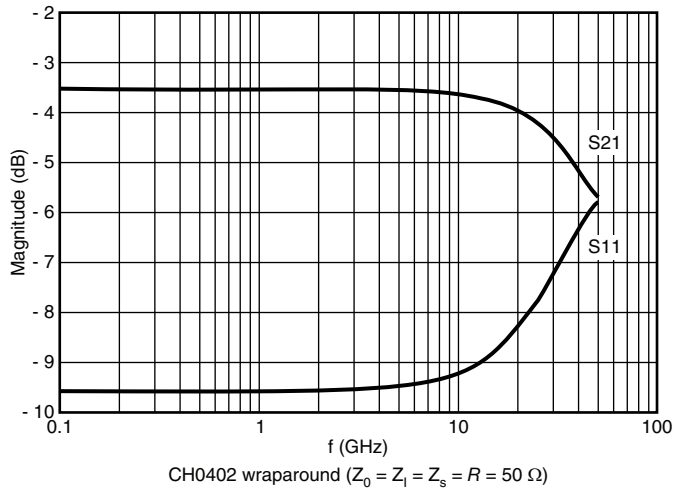
CH02016 flip chip ($Z_0 = Z_1 = Z_s = R = 100 \Omega$)

S PARAMETER

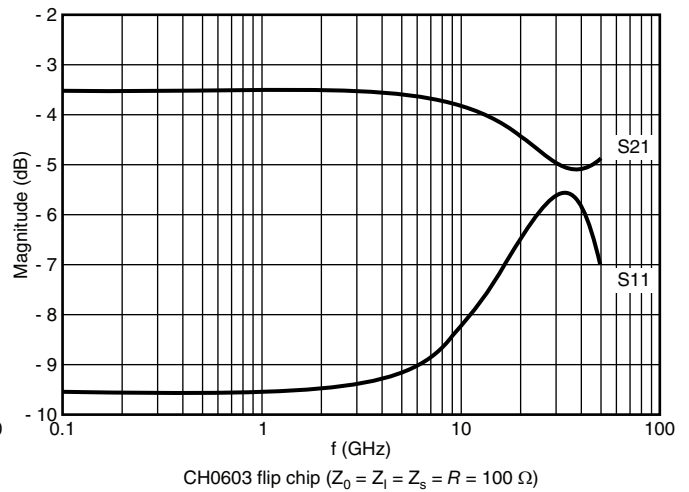
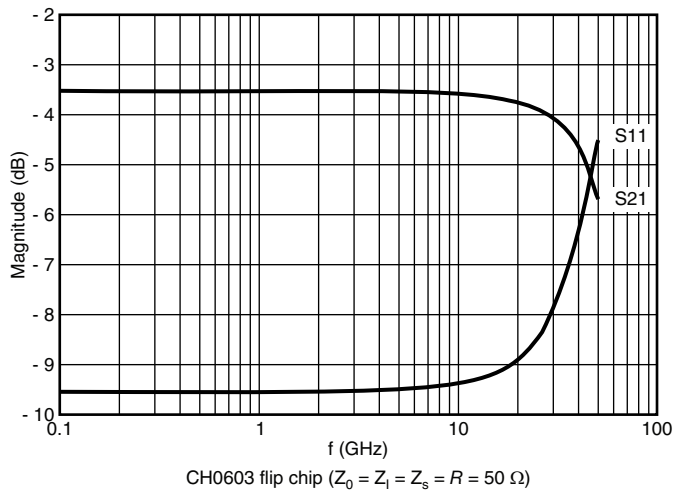
CH0402 (F and P Terminations)

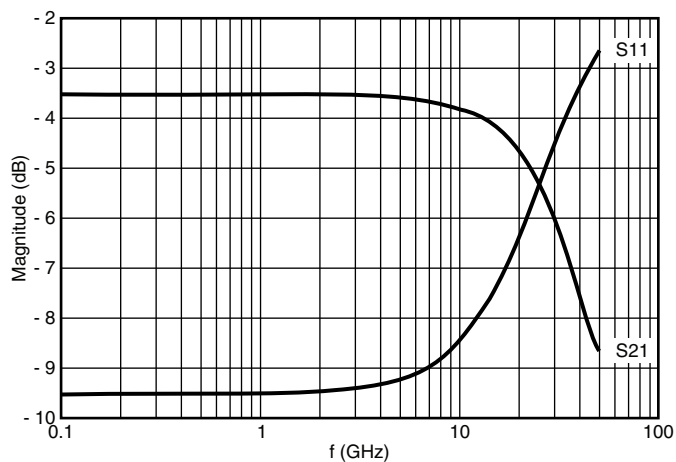
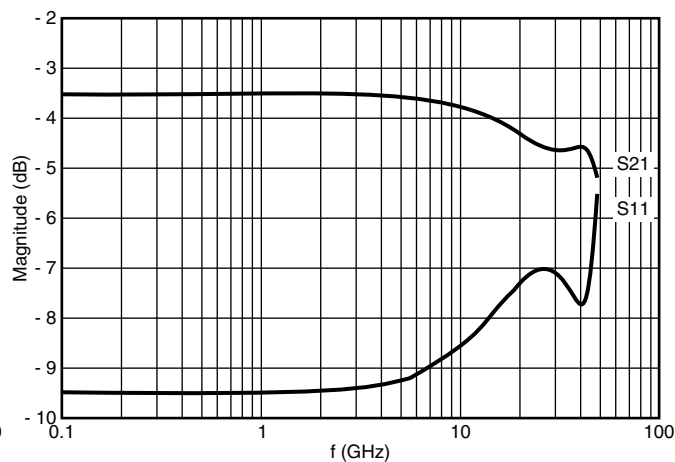


CH0402 (N and G Terminations)



CH0603 (F and P Terminations)



S PARAMETER**CH0603 (N and G Terminations)**CH0603 wraparound ($Z_0 = Z_1 = Z_s = R = 50 \Omega$)CH0603 wraparound ($Z_0 = Z_1 = Z_s = R = 100 \Omega$)



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 and agree to fully indemnify and hold Vishay and its distributors harmless from and against any and all claims, liabilities, expenses and damages arising or resulting in connection with such use or sale, including attorneys fees, even if such claim alleges that Vishay or its distributor was negligent regarding the design or manufacture of the part. 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.