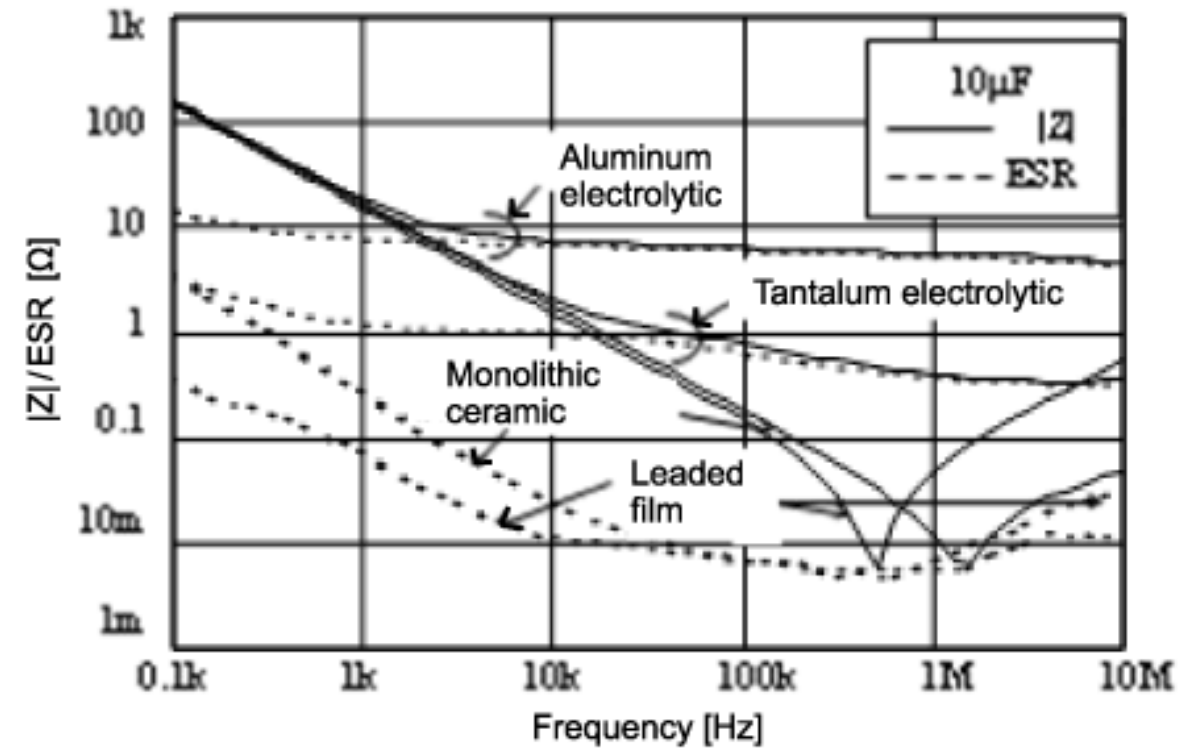
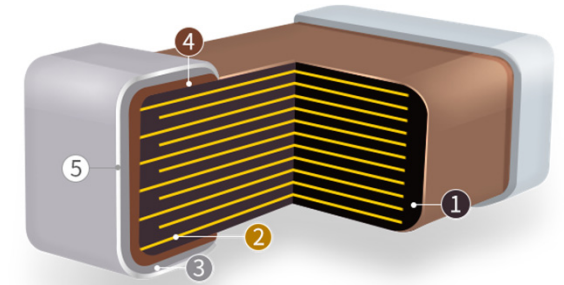
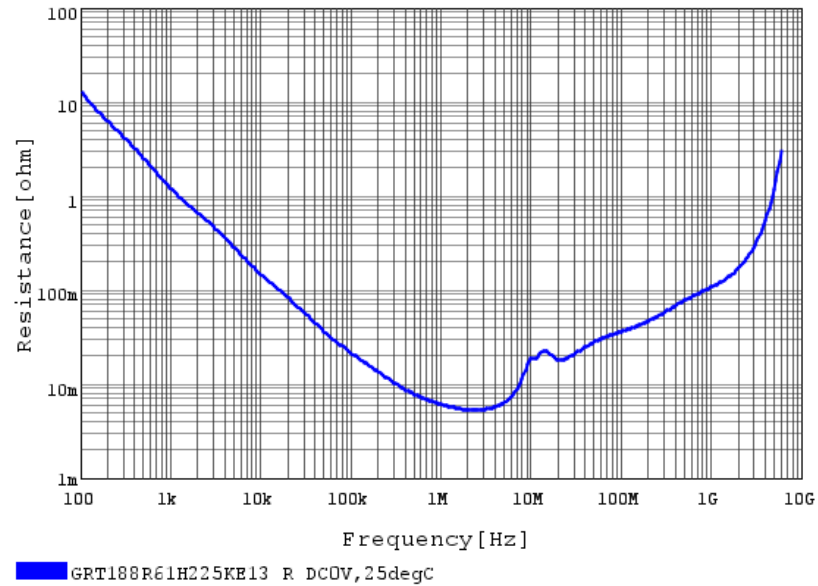
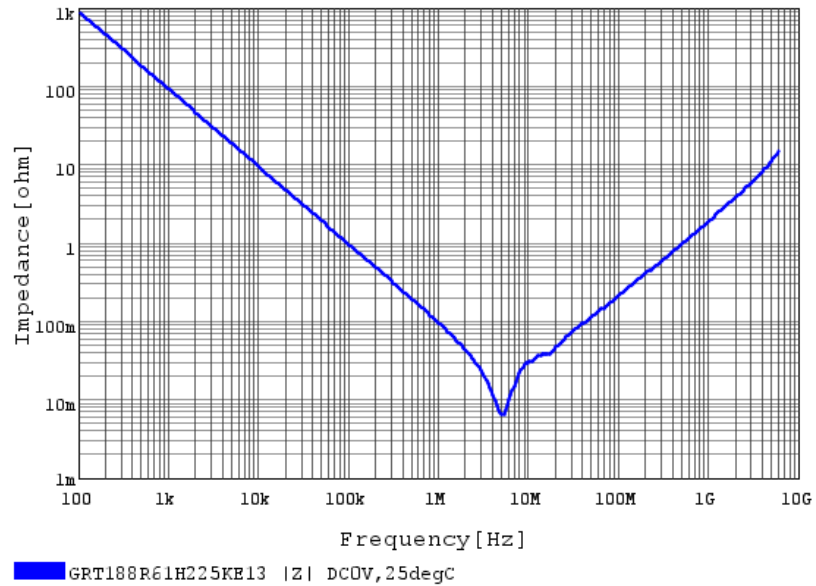


Types of Capacitors



Ceramic Capacitor Impedance and Resistance



- * Internal Cu electrode is only applied to limited products.
<https://m.samsungsem.com/global/product/passive-component/mlcc.do>

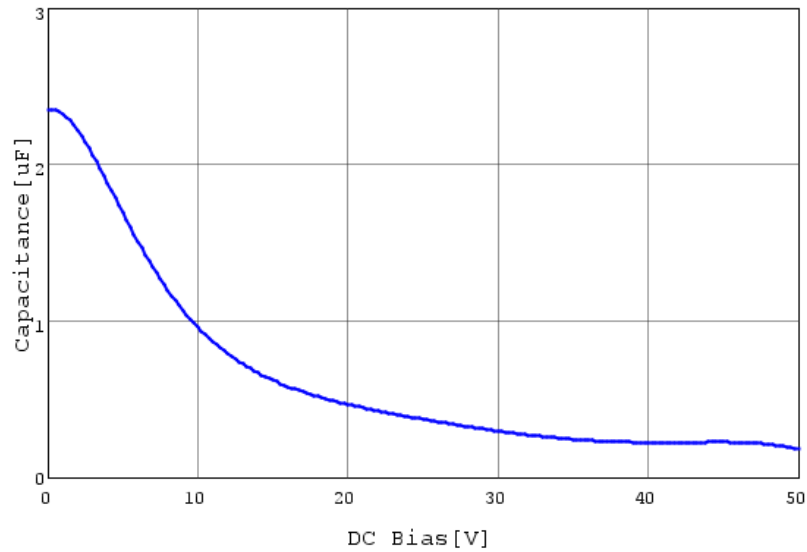
Capacitor data sources

- Murata Simsurfing
- TDK SEAT

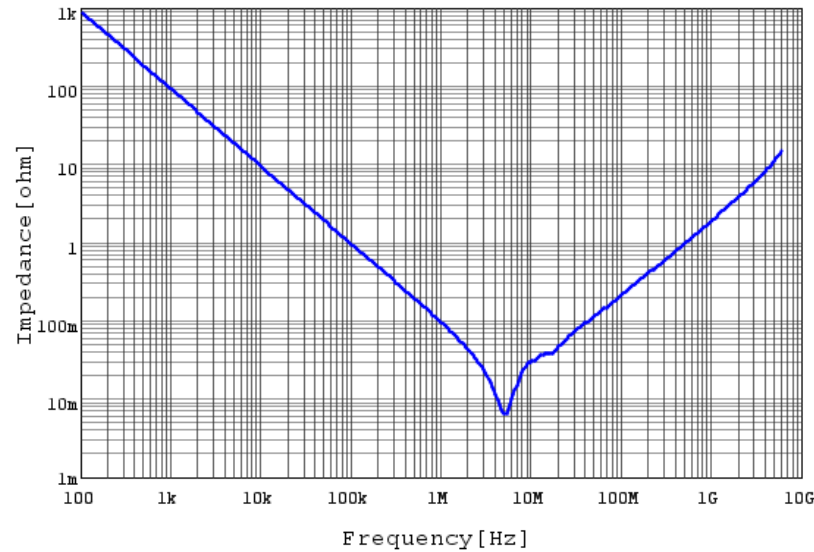
MLCC

- Capacitor codes, e.g. X7R or C0G standardized to define stability over temperature
 - **Class-II:** Codes begin with X, Y, or Z (e.g. X7R, Y5V)
 - **Class-I:** Codes begin with [CBLAMPRSTVU] (e.g. C0G, NPO)

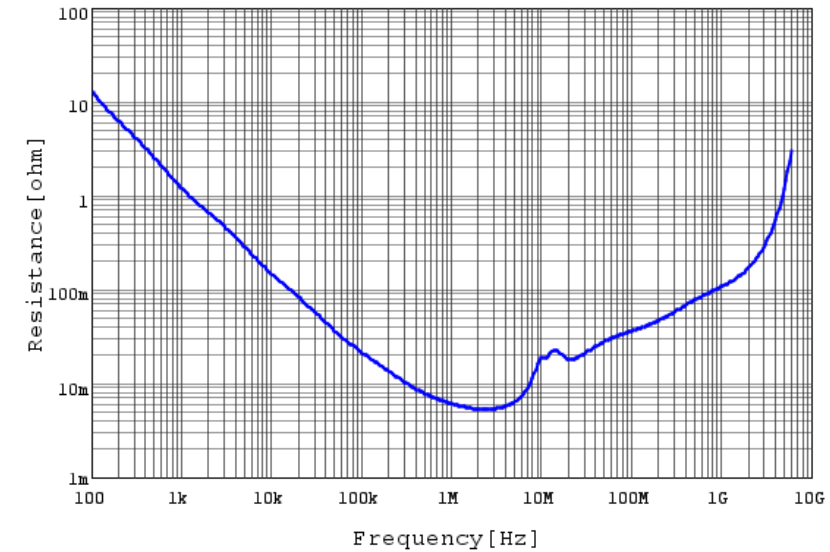
2.2 μ F, 50V X7R (Class-II) 0603 footprint



GRT188R61H225KE13 C-DC bias capacitance, 25.0degC, AC1Vrms



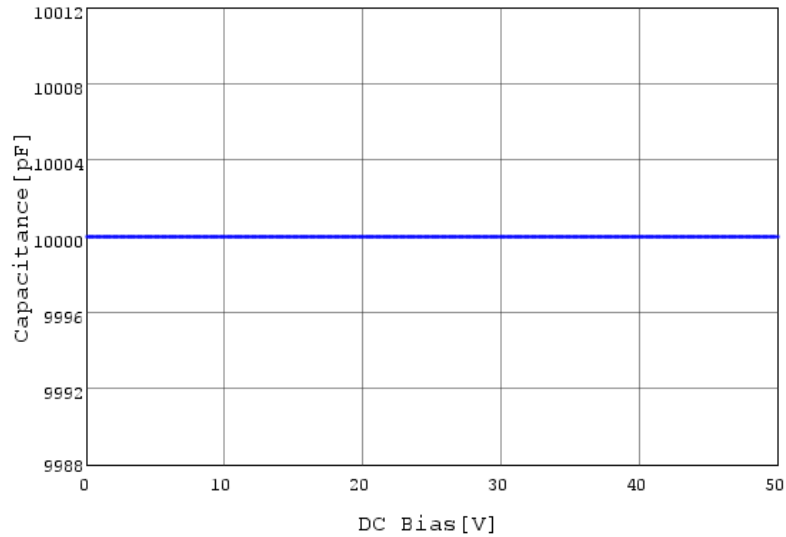
GRT188R61H225KE13 |Z| DCOV,25degC



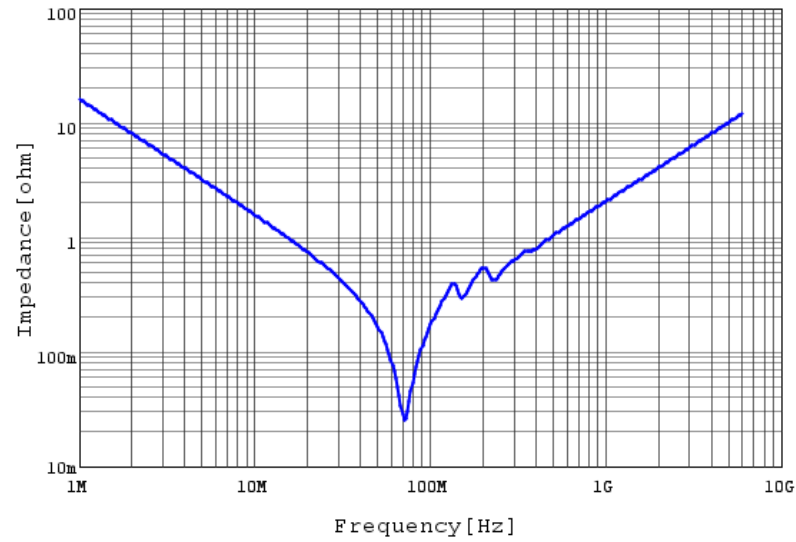
GRT188R61H225KE13 R DCOV,25degC

Remaining: 7.2% at full voltage

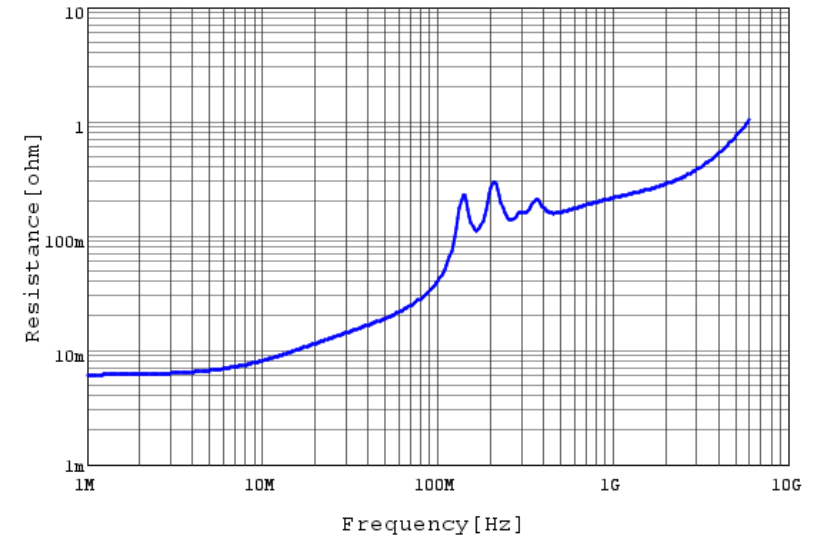
10nF, 50V C0G (Class-I) 0603 footprint



GRT1885C1H103JA02 C-DC bias capacitance, 25.0degC, AC1Vrms

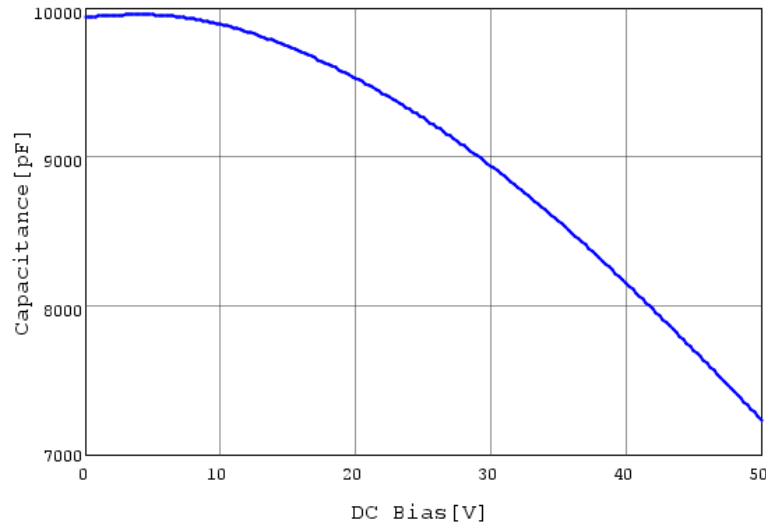


GRT1885C1H103JA02 |Z| DCOV, 25degC

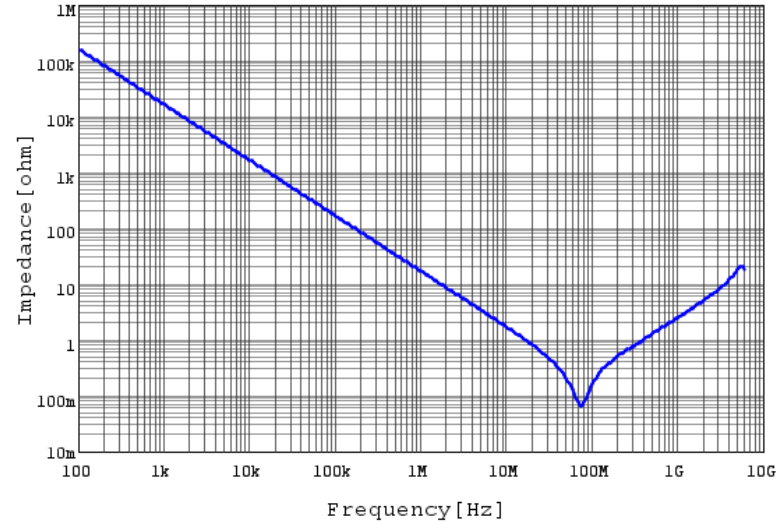


GRT1885C1H103JA02 R DCOV, 25degC

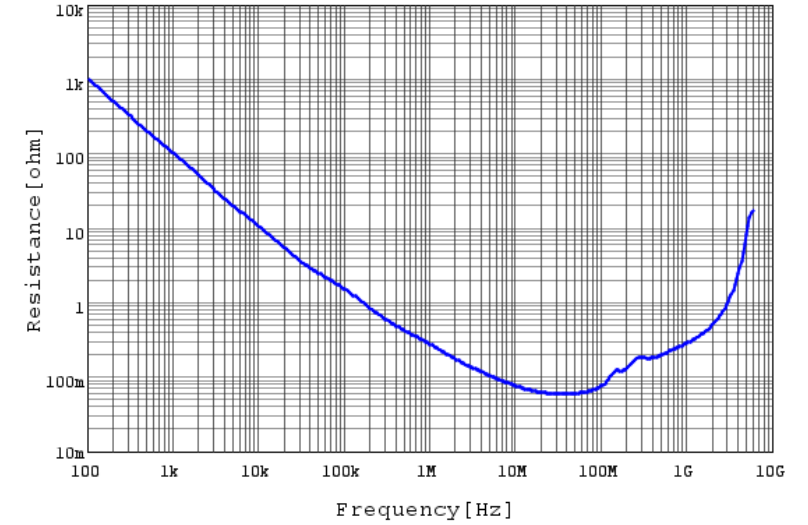
10nF, 50V X7R (Class-II) 0603 footprint



GRM188R71H103MA01 C-DC bias capacitance, 25.0degC, AC1.0Vrms

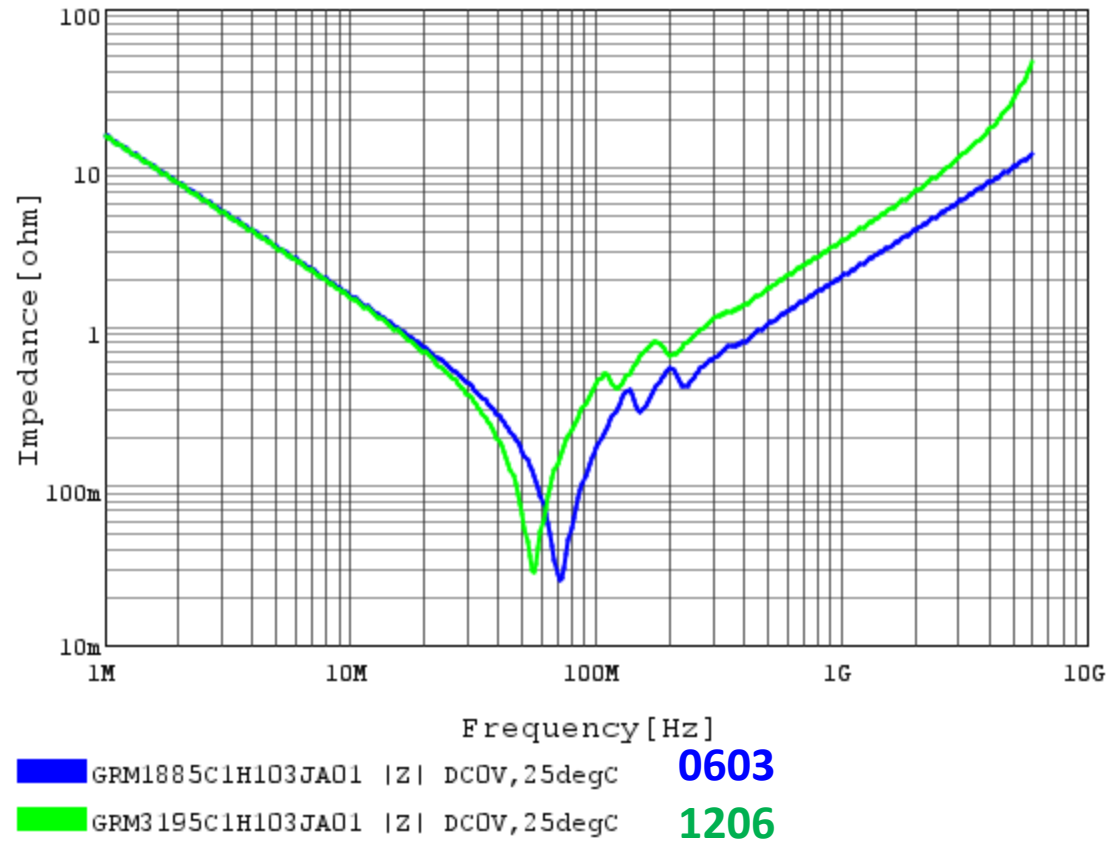


GRM188R71H103MA01 |Z| DCOV,25degC

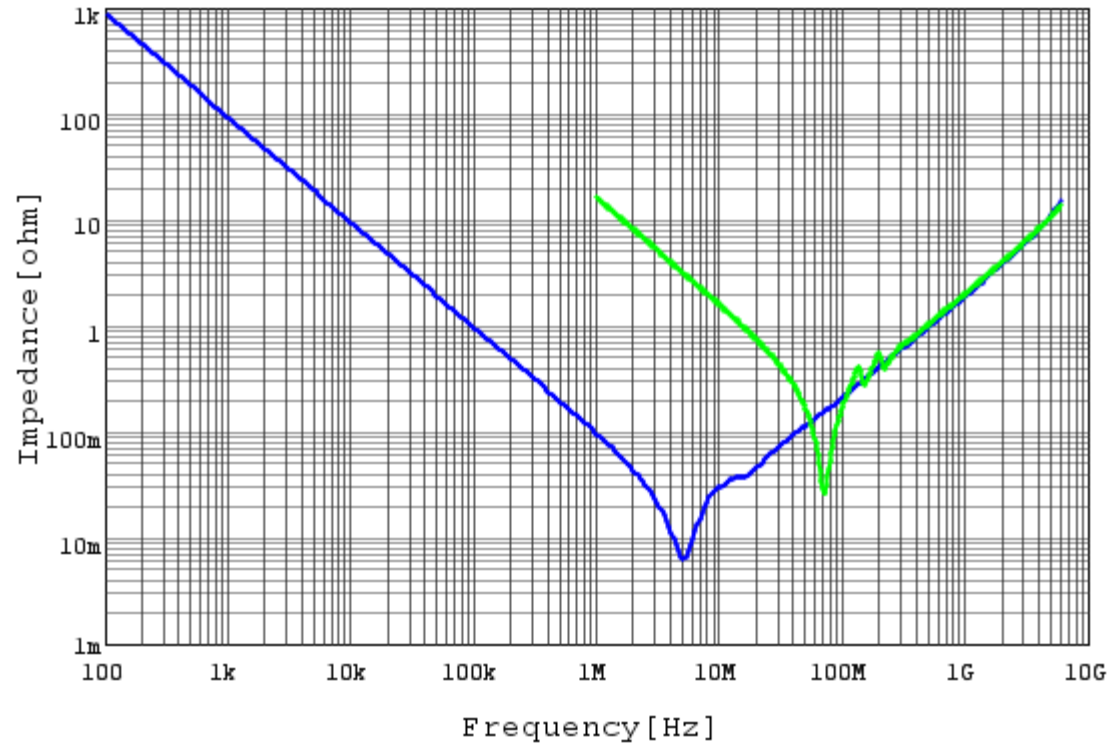


GRM188R71H103MA01 R DCOV,25degC

10nF, 50V C0G (Class-I) varied footprint



Same 0603 Footprint



2.2µF X5R
GRT188R61H225KE13 |Z| DCOV,25degC

10nF C0G
GCM1885C1H103GA16 |Z| DCOV,25degC

Class-II Capacitor Hysteresis Loss

TABLE II
EMPLOYED COMPONENTS

Component	Dielectric	Manufacturer	Part Number	V_n	C_n	N(parallel)	C_{tot}	DF
C_{cal}	C0G	TDK	CAA572C0G2J204J640LH	650 V	200 nF	2	400 nF	< 0.02 %
C_{ref}	C0G	TDK	C5750C0G2A154J230KE	100 V	150 nF	32	4.8 μ F	< 0.03 %
C_{DUT}	X7R	Knowles Syfer	2220Y1K00474KETWS2	1 kV	470 nF	1	470 nF	> 0.71 %

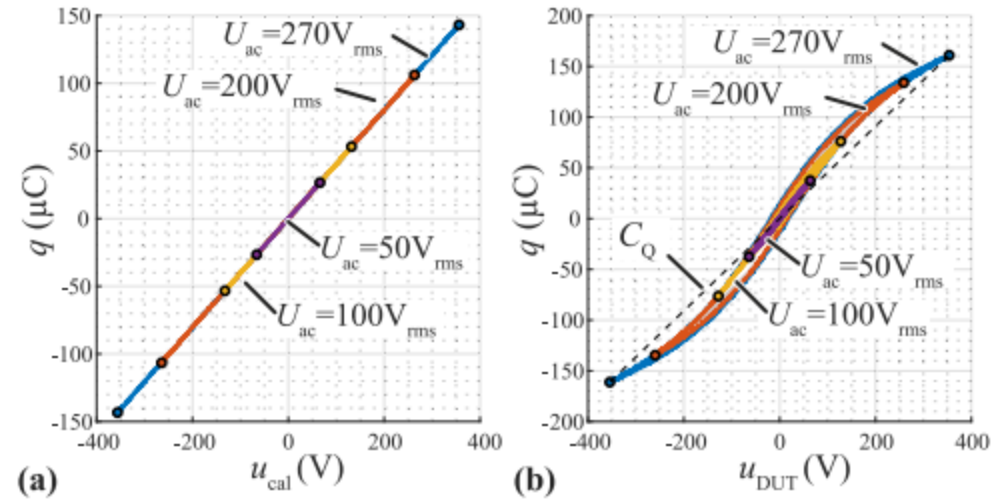


Fig. 6. $U - Q$ hysteresis recorded at 50 Hz for a range of excitation voltages for (a) the calibration capacitor, which shows no hysteresis and has a constant $C_Q = C_d$ at all voltages, and (b) the DUT, which exhibits increasing hysteresis and losses with increasing excitation voltage. C_Q highlighted for $U_{ac} = 270$ V_{rms}. Measured $U - Q$ curves are identical at 50 Hz and 100 Hz.

C_{oss} Hysteresis

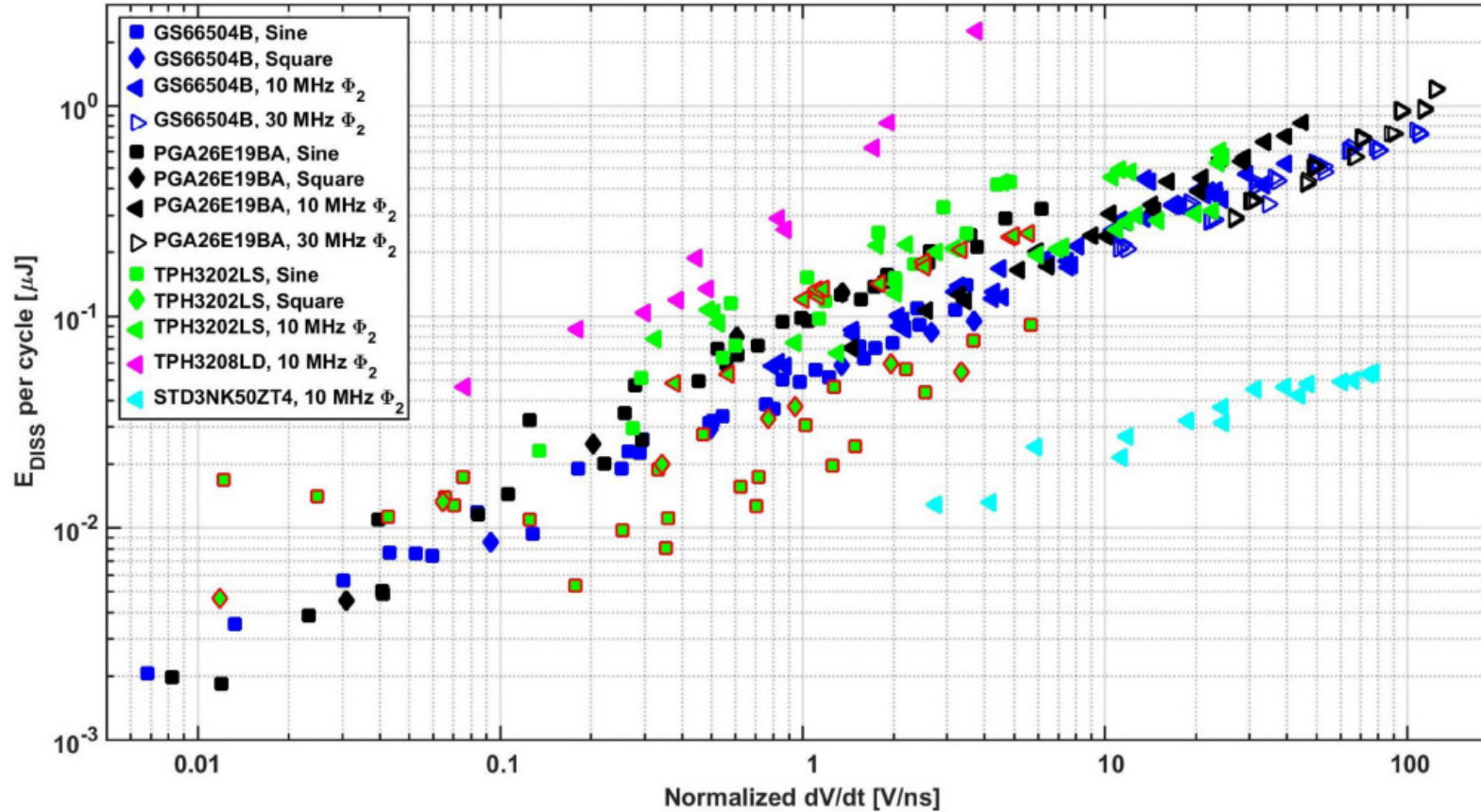


Fig. 15. Losses per cycle versus normalized, by (8), dV/dt for the three studied devices and two additional “extreme performance” devices. The red outline around the TPH3202LS results indicates applied voltages under 300 V and $\beta = 1.46$ in (8). All recorded measurements are included here. There are no measurements for the TPH3202LS 30 MHz Φ_2 , as the Φ_2 wave generator could not be tuned to maintain ZVS with the TPH3202LS device and C_{REF} in parallel.

Transistor Structure and Material

SiC

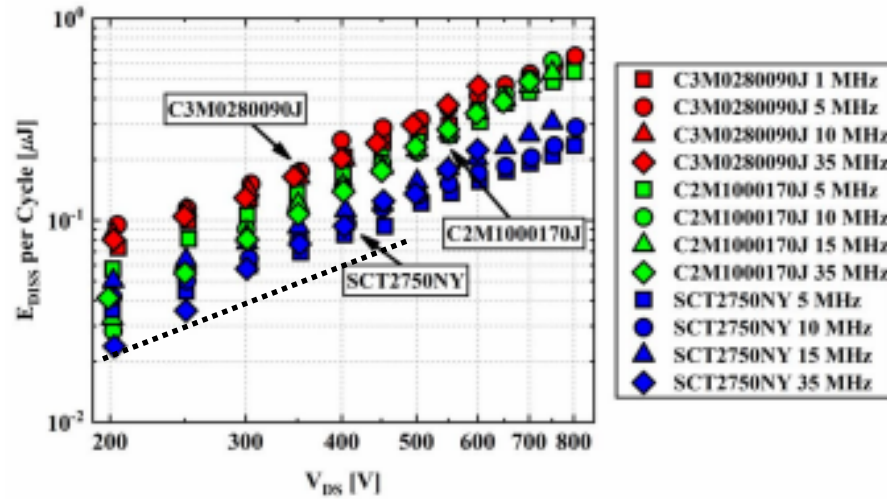
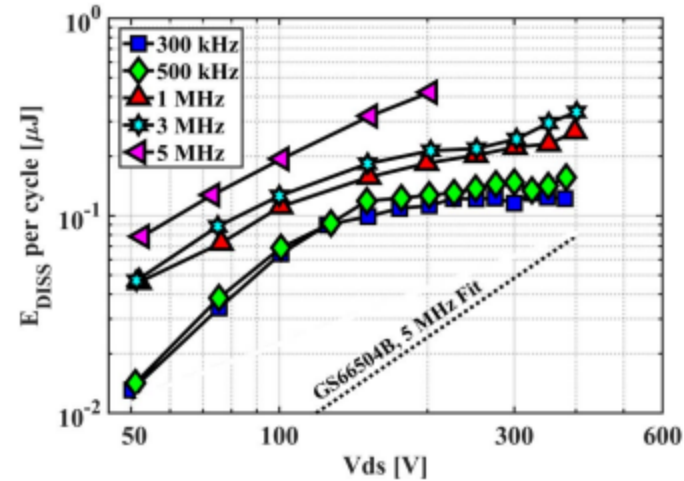


Fig. 4: C_{OSS} losses for three devices from 1-35 MHz.

Si Superjunction



(b) High-frequency C_{OSS} losses for the R6011KNTJL device.

Fig. 6: Silicon superjunction C_{OSS} loss data.

Si

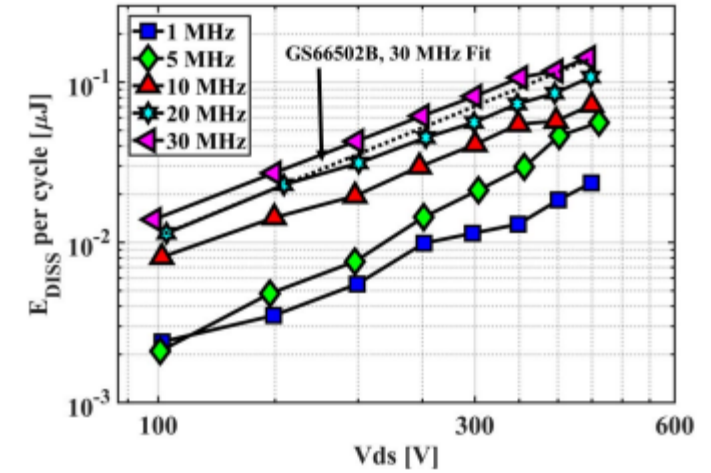


Fig. 7: C_{OSS} losses for STD3NK50ZT4.