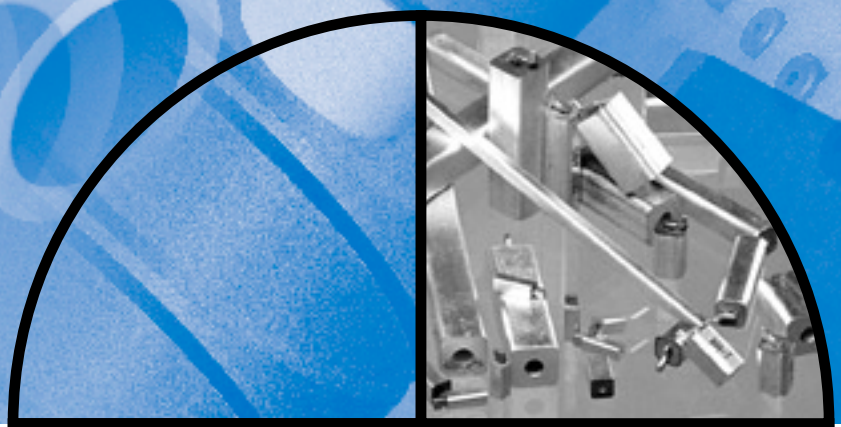
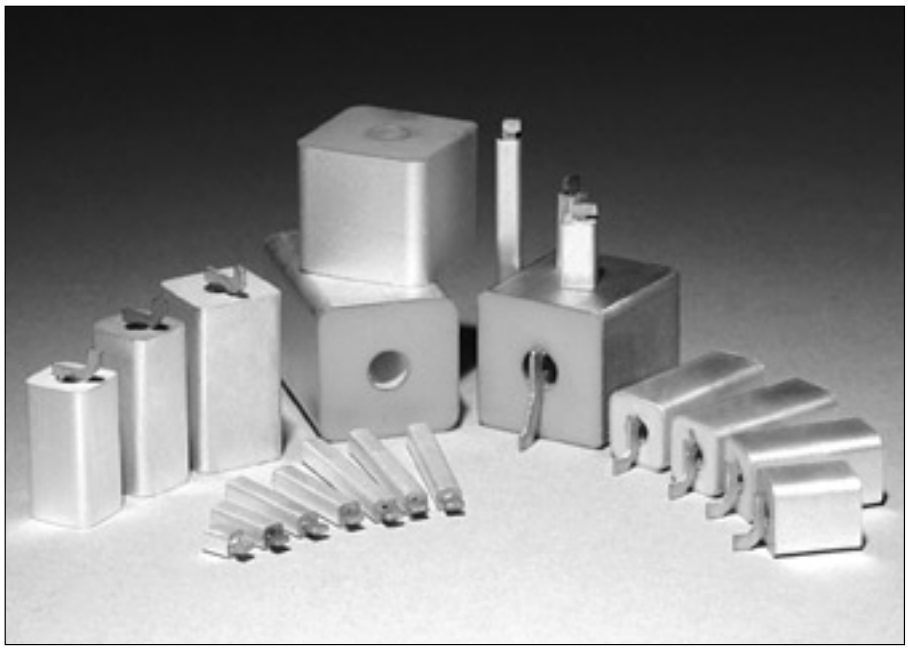
COAXIAL RESONATORS 2



An Overview of Coaxial Resonators & Inductors for Use in RF Filter & VCO Applications.

Introduction & Applications for Coaxial Resonators & Inductors (300 MHz - 6.0 GHz)



Features

- Frequency tuned to 0.5% and 1%
- High dielectric constant
- Rugged construction
- Low loss silver
- Act as parallel resonant circuit or a high quality inductor

Benefits

- Circuit miniaturization
- Eliminate microphonics
- Repeatability of design
- Negligible aging effects
- Excellent solderability
- Improved circuit Q
- High resonant impedance
- Automation compatible

Introduction

Trans-Tech offers ceramic coaxial line elements in seven sizes and four dielectric constants to span applications from 300 MHz to 6 GHz. The VHF/UHF frequency bands are traditionally awkward for realizing discrete inductors and capacitors. Metallized ceramics provide an attractive alternative, since the wireless communication market now forces a continuous trade-off between performance and miniaturization.

Trans-Tech's ceramic solution offers advantages of high Q, reduced size, better shielding, and temperature performance superior to that obtainable from conventional L-C circuits or microstrip construction.

Two types of coaxial resonators are offered by Trans-Tech, a quarter-wave short ($\lambda/4$) and a half-wave open ($\lambda/2$). The quarter-wave has thick-film silver applied to one end. The half-wave has both ends un-metallized.

Trans-Tech's four dielectric materials are briefly summarized in **Figure 2.1** along with their recommended frequencies of use. The Material Properties Chart **(Figure 2.2)** can be used to determine the optimum material necessary for an application.

Typical Applications

- Low Phase Noise VCO's
- DRO/VCO Oscillators
- Narrow band filters
- Nationwide pagers
- Duplexers
- Global positioning systems
- UHF tuned potential amplifiers
- Wireless communications
- Tuned Oscillators

Material Selection Chart

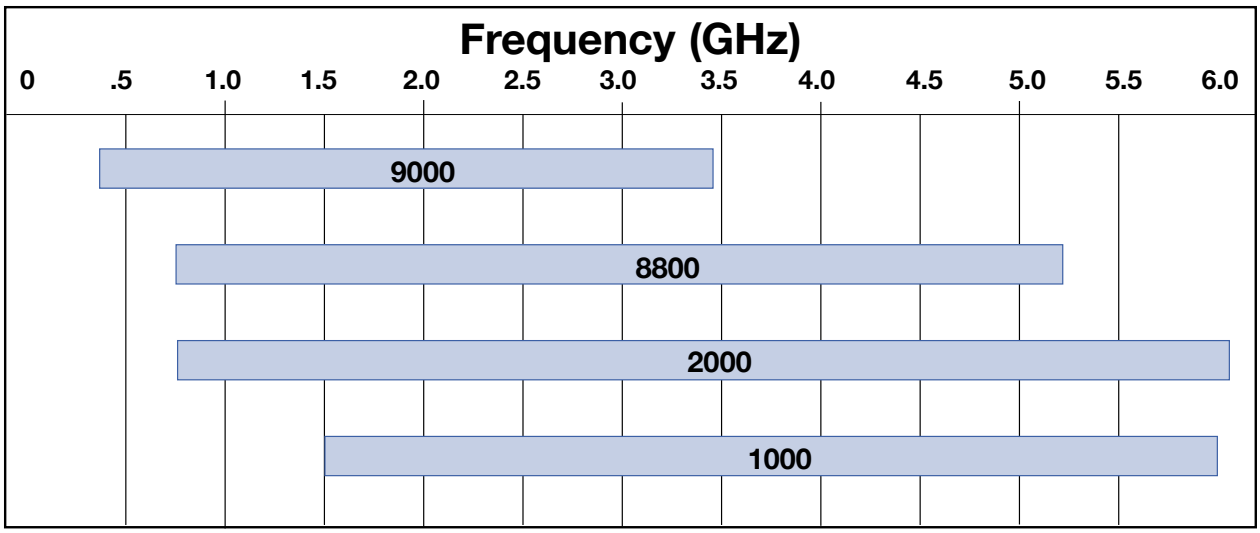


Figure 2.1 - Frequency Chart of Coaxial Resonator Applications

Material Properties

	Material Type			
	1000	2000	8800	9000
Dielectric Constant	10.5 ± 0.5	20.6 ± 1.0	39 ± 1.5	90 ± 3
Temperature Coefficient of Resonant Frequency τ_f (ppm°C)	0 ±10	0 ±10	+4 ± 2	0 ± 10

Figure 2.2 - Material Properties

Properties given for the ceramic materials used to produce the coaxial line elements are measured for internal quality control purposes. The electrical quality factor (Q) of the coaxial line elements is determined primarily by the metallization. Typical properties of the coaxial line elements are listed on pages 2-39 and 2-40.

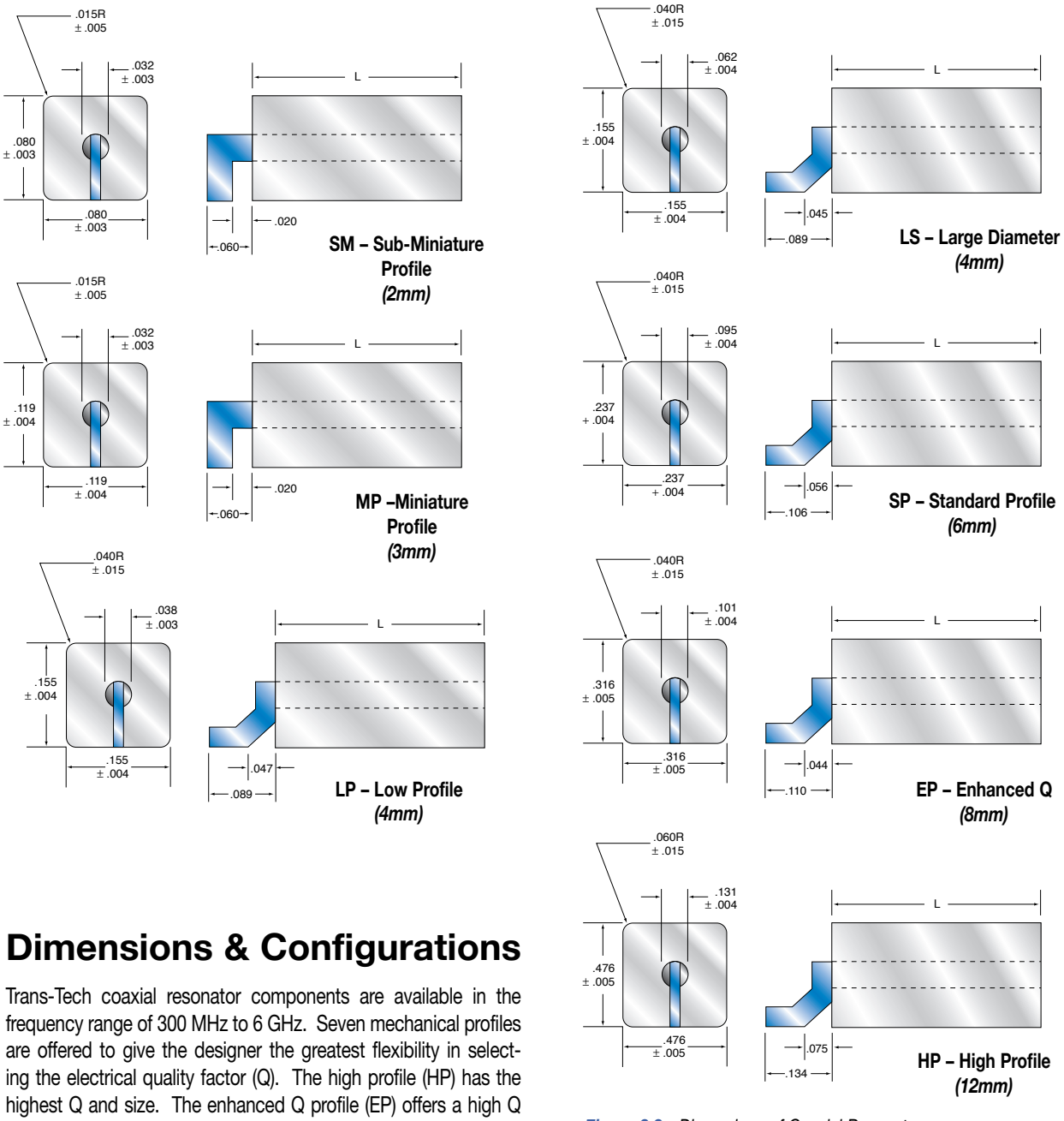


Figure 2.3 - Dimensions of Coaxial Resonators

Dimensions & Configurations

Trans-Tech coaxial resonator components are available in the frequency range of 300 MHz to 6 GHz. Seven mechanical profiles are offered to give the designer the greatest flexibility in selecting the electrical quality factor (Q). The high profile (HP) has the highest Q and size. The enhanced Q profile (EP) offers a high Q and wide frequency offering. The standard profile (SP) offers a compromise of electrical Q and size, and should be considered the component of choice for most applications.

Trans-Tech offers four smaller profiles for occasions when available space is restricted. The low profile (LP), large profile (LS), miniature profile (MP), and sub-miniature profile (SM) provide the designer with a trade-off between electrical Q and compact size. Trans-Tech's low profile (LP) and large profile (LS) both have the same outer physical dimensions. They differ in the dimension of the inner diameter, which allows for different characteristic impedances, and increases the options available to designers. Overall comparisons can be determined from the given Q curves or by utilizing Trans-Tech's COAX Program.

These components are available in square configurations with dimensions shown in **Figure 2.3**.

Frequency Specifications

The various profiles, materials and types available for the Trans-Tech coaxial TEM mode resonators are summarized in the *Selection Charts* below and on page 2-37. You have a choice of two types, four materials and seven profiles. This range of component variables should meet most circuit design requirements. While the component is manufactured to frequency, a formula is given so that the approximate length can be determined. The selected resonant frequency is available with two standard frequency tolerances of ± 0.5% and ± 1.0%. The minimum tolerance is ± 2MHz. Please note that the ordered value of f_o will be set according to our measurement procedure (see page 2-42). The f_o in your circuit may vary due to stray reactance. This offset can be corrected by changing the ordered value of f_o.

Recommended Frequencies 1000 Series

εr = 10.5 +/- .5 **Tf = 0 +/- 10**

Type	Profile	Recommended Range f_o (MHz)	Nominal Length (inches) +/- 0.030in.	Nominal Length Range (inches)	Characteristic Impedance (Ω)
λ/4 Quarter Wave length	HP	1150 to 1800	L = 911 / f_o(MHz)	0.506 to 0.792	25.3
	EP	1150 to 2500		0.364 to 0.792	22.5
	SP	1150 to 3100		0.294 to 0.792	18.3
	LS	1150 to 4600		0.198 to 0.792	18.4
	LP	1150 to 4100		0.222 to 0.792	27.4
	MP	1150 to 5100		0.179 to 0.792	25.7
	SM	1150 to 5100		0.179 to 0.792	18.4
λ/2 Half Wave length	HP	2300 to 3400	L = 1821 / f_o(MHz)	0.536 to 0.792	25.3
	EP	2300 to 5000		0.364 to 0.792	22.5
	SP	2300 to 6000		0.304 to 0.792	18.3
	LS	2300 to 6000		0.304 to 0.792	18.4
	LP	2300 to 6000		0.304 to 0.792	27.4
	MP	2300 to 6000		0.304 to 0.792	25.7
	SM	2300 to 6000		0.304 to 0.792	18.4

1000 Series Selection Chart

Recommended Frequencies 2000 Series

εr = 20.6 +/- 1 **Tf = 0 +/- 10**

Type	Profile	Recommended Range f_o (MHz)	Nominal Length (inches) +/- 0.030in.	Nominal Length Range (inches)	Characteristic Impedance (Ω)
λ/4 Quarter Wave length	HP	800 to 1200	L = 650 / f_o(MHz)	0.542 to 0.813	18.1
	EP	800 to 1700		0.382 to 0.813	16.1
	SP	800 to 2200		0.296 to 0.813	13.1
	LS	800 to 3200		0.203 to 0.813	13.1
	LP	800 to 2900		0.224 to 0.813	19.6
	MP	800 to 3600		0.181 to 0.813	18.4
	SM	800 to 3600		0.181 to 0.813	13.1
λ/2 Half Wave length	HP	1600 to 2500	L = 1300 / f_o(MHz)	0.520 to 0.813	18.1
	EP	1600 to 3500		0.372 to 0.813	16.1
	SP	1600 to 4500		0.289 to 0.813	13.1
	LS	1600 to 6000		0.217 to 0.813	13.1
	LP	1600 to 6000		0.217 to 0.813	19.6
	MP	1600 to 6000		0.217 to 0.813	18.4
	SM	1600 to 6000		0.217 to 0.813	13.1

2000 Series Selection Chart

Recommended Frequencies 8800 Series

εr = 39 +/- 1.5 Tf = 4 +/- 2

Type	Profile	Recommended Range f_o (MHz)	Nominal Length (inches) +/- 0.030	Nominal Length Range (inches)	Characteristic Impedance (Ω)
λ/4 Quarter Wave length	HP	600 to 900	L = 472 / f_o(MHZ)	0.525 to 0.787	13.1
	EP	600 to 1200		0.394 to 0.787	11.7
	SP	600 to 1600		0.295 to 0.787	9.5
	LS	600 to 2300		0.205 to 0.787	9.5
	LP	600 to 2100		0.225 to 0.787	14.2
	MP	600 to 2600		0.182 to 0.787	13.3
	SM	600 to 2600		0.182 to 0.787	9.5
λ/2 Half Wave length	HP	1200 to 1900	L = 945 / f_o(MHZ)	0.497 to 0.787	13.1
	EP	1200 to 2500		0.378 to 0.787	11.7
	SP	1200 to 3200		0.295 to 0.787	9.5
	LS	1200 to 4700		0.201 to 0.787	9.5
	LP	1200 to 4300		0.220 to 0.787	14.2
	MP	1200 to 5200		0.182 to 0.787	13.3
	SM	1200 to 5200		0.182 to 0.787	9.5

8800 Series Selection Chart

Recommended Frequencies 9000 Series

εr = 90 +/- 3 Tf = 0 +/- 10

Type	Profile	Recommended Range f_o (MHz)	Nominal Length (inches) +/- 0.030	Nominal Length Range (inches)	Characteristic Impedance (Ω)
λ/4 Quarter Wave length	HP	400 to 600	L = 311 / f_o(MHZ)	0.518 to 0.778	8.6
	EP	300 to 800		0.389 to 1.037	7.7
	SP	300 to 1000		0.311 to 1.037	6.3
	LS	300 to 1500		0.207 to 1.037	6.3
	LP	300 to 1400		0.222 to 1.037	9.4
	MP	400 to 1700		0.183 to 0.778	8.8
	SM	400 to 1700		0.183 to 0.778	6.3
λ/2 Half Wave length	HP	800 to 1200	L = 622 / f_o(MHZ)	0.518 to 0.778	8.6
	EP	800 to 1700		0.366 to 0.778	7.7
	SP	800 to 2100		0.296 to 0.778	6.3
	LS	800 to 3100		0.201 to 0.778	6.3
	LP	800 to 2800		0.222 to 0.778	9.4
	MP	800 to 3400		0.183 to 0.778	8.8
	SM	800 to 3400		0.183 to 0.778	6.3

9000 Series Selection Chart

Coaxial Resonator Order Information

An Order Example:

SR 8800 SP Q 1300 B Y

Tab: Y = Yes N = No

Frequency Tolerance: B = +1.0% A = .5%

Resonant Frequency: state in MHz

Type: Q for λ/4 H for λ/2

Profile: HP, EP, SP, LP, LS, MP, SM

Material: 8800, 9000, 1000, 2000

Product Code: SR - square coaxial resonator

Specifications

Quality Factor (Q) Specification - 1000 & 2000

The quality factors for various resonator profiles are shown in **Figure 2.4a and 2.4b**. The resonators are grouped by wavelength type (λ/4 & λ/2), material (1000 & 2000), and profile (HP, EQ, SP, LS, MP, SM). The listed Q value on each curve is the value guaranteed for the lowest operating frequency of each component type. The Q increases approximately as the square-root of increasing frequency. Typical Q's are 10% to 15% higher.

1000 Series Q Curves

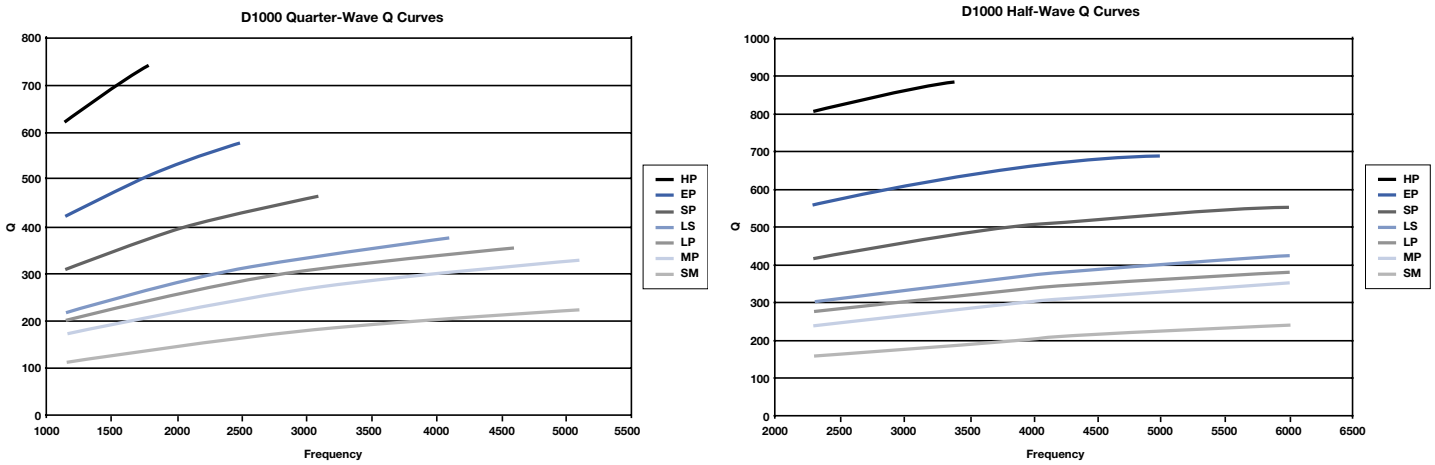


Figure 2.4a

2000 Series Q Curves

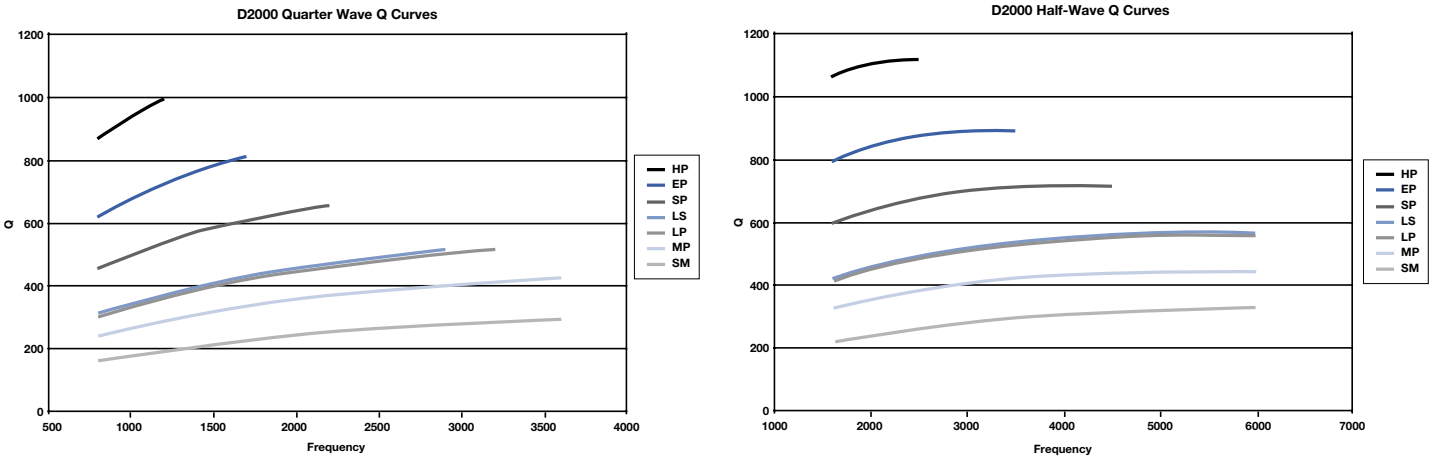


Figure 2.4b

Quality Factor (Q) Specification - 8800 & 9000

The specified quality factors of the various resonator components offered are shown in **Figure 2.4c and 2.4d**. the resonators are grouped by wavelength type (λ/4 & λ/2), material (8800 & 9000), and profile (HP, EP, SP, LP, LS, MP, SM). The listed Q value on each curve is the minimum value for the lowest operating frequency of each component type. The Q increases approximately as the square-root of increasing frequency. Typical Q's are 10% to 15% higher.

8800 Series Q Curves

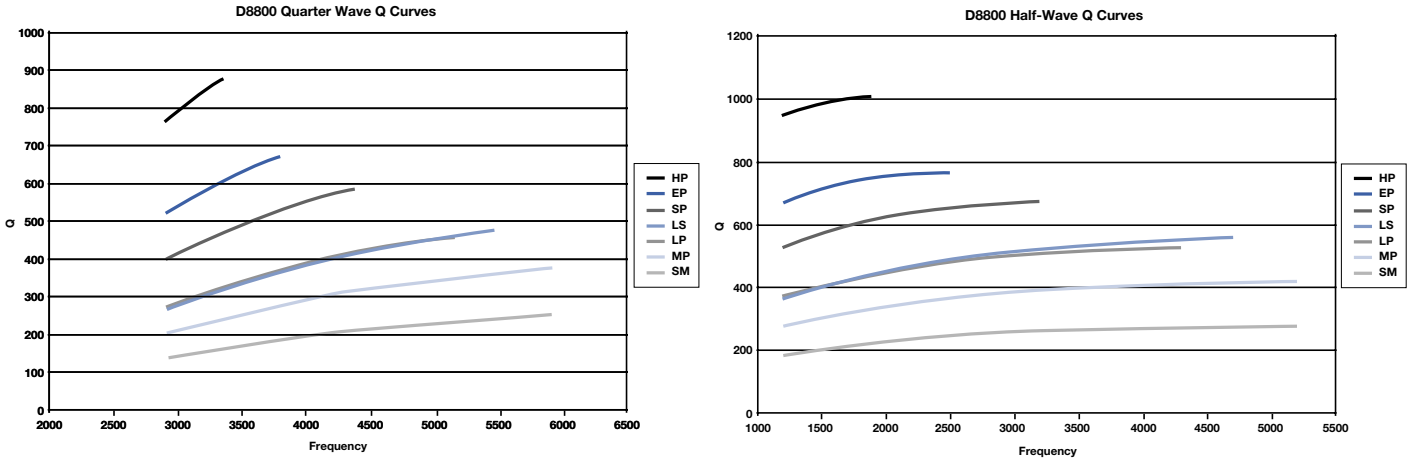


Figure 2.4c

9000 Series Q Curves

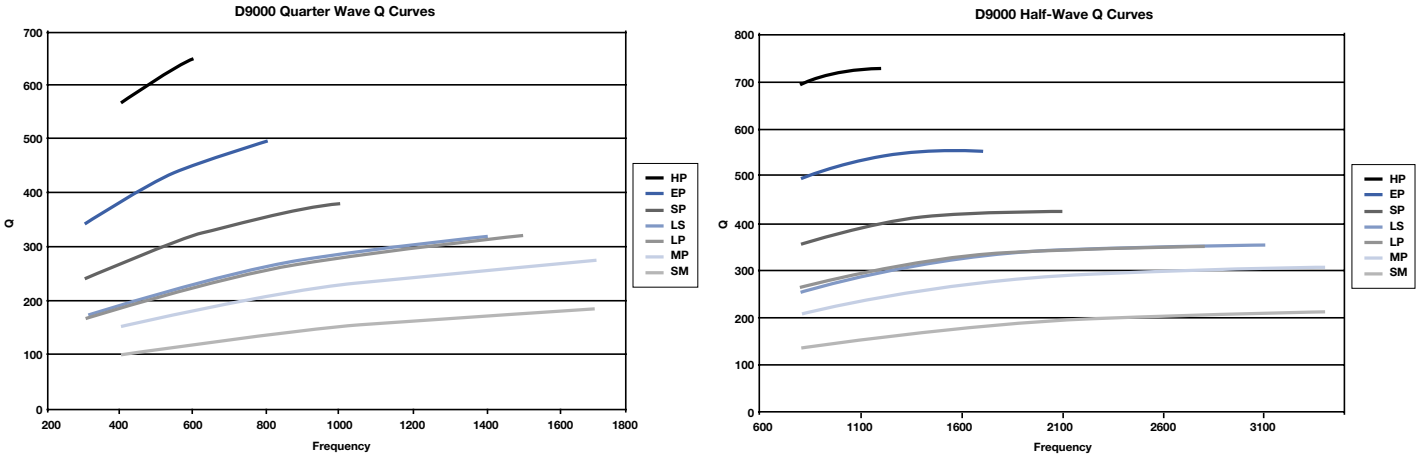


Figure 2.4d