

Attenuators

Programmable and Manual Step

Step Attenuator Selection Guide

	Step Size	Attenuation Range	Frequency Range				
			dc to 1000 MHz	dc to 4 GHz	dc to 18 GHz	dc to 26.5 GHz	dc to 40 GHz
Manual	1 dB	0 to 11 dB		8494A	8494B		
		0 to 12 dB	355C				
	10 dB	0 to 70 dB		8495A	8495B	8495D	
		0 to 110 dB 0 to 120 dB	355D	8496A	8496B		
Programmable	1 dB	0 to 11 dB		8494G	8494H	84904K	84904L
		0 to 12 dB	355E				
	10 dB	0 to 70 dB		8495G	8495H	8495K 84907K	84907L
		0 to 90 dB				8497K	
		0 to 110 dB		8496G	8496H	84906K	84906L
		0 to 120 dB	355F				

HP 355 Series Specifications

Manual	HP 355C	(0 to 12 dB, 1 dB steps)
	HP 355D	(0 to 120 dB, 10 dB steps)
Programmable	HP 355E	(0 to 12 dB, 1 dB steps)
	HP 355F	(0 to 120 dB, 1 dB steps)



HP 355C,D

The manual and programmable HP 355 series attenuators offer exceptional attenuation accuracy to 1 GHz; 0.1 dB to 1 kHz, 0.25 dB to 500 MHz, 0.35 dB to 1 GHz. They feature BNC (f) RF connectors, with optional type-N (Option 001) and TNC (Option 005) also available. To achieve 1 dB steps up to a range of 132 dB, serially connect two attenuators using a standard UG-491A/U BNC (m)-to-BNC (m) adapter. Programmable HP 355E,F models feature a 7-pin connector. To protect your transistor driver against transients during the switching cycle, order Option 007 to install a protective diode between each solenoid and driver.

Attenuators

Programmable and Manual Step

HP 84904L



HP 8494/95/96A,B,D



HP 8494/95/96G,H,K



HP 84904/906/907 Series

This family of programmable step attenuators offers unmatched attenuation performance to 40 GHz. The K models brings superior accuracy and reliability to 26.5 GHz, and the L models offers unparalleled performance to 40 GHz.

HP step attenuators consist of 3 or 4 cascaded sections of specific attenuation values, e.g., 1, 2, 4, or 10, 20, 30 or 40 dB. Both families offer the selection, performance, accuracy and reliability expected from HP: attenuation ranges of 11, 70, or 90 dB, 1 dB, and 10 dB step sizes, 5 million cycles per section and better than 0.03 dB repeatability. RF connector choices include precision 3.5 mm on the 26.5 GHz K models, and precision 2.4 mm or 2.92 mm on the L models. While the 2.92-mm connector format is compatible with both 3.5-mm and SMA connectors, Hewlett-Packard recommends the more rugged 2.4-mm connectors.

HP programmable step attenuators feature electro-mechanical designs that achieve 20 milliseconds switching time, including settling time. The permanent magnet latching allows automatic interruption of the dc drive voltage to cut power consumption and simplify circuit design. They are equipped with 10-pin DIP sockets (m) and have optional interconnect cables available.

Attenuators

Programmable and Manual Step

HP 8494/95/96/97 Series

This family of manual step attenuators offers fast, precise signal level control in three frequency ranges, dc to 4 GHz, dc to 18 GHz and dc to 26.5 GHz. They feature exceptional repeatability and reliability in a wide range of frequency, attenuation and connector options.

Attenuation repeatability is specified to be less than 0.03 dB (0.05 dB, 18 to 26.5 GHz) for 5 million cycles per section. This assures low measurement uncertainty when designed into automatic test systems.

Electromechanical step attenuators offer low SWR, low insertion loss and high accuracy required by high-performance test and measurement equipment.

Precision plated leaf-spring contacts insert/remove attenuator sections (miniature tantalum nitride thin-film T-pads on sapphire and alumina substrates) from the signal path. Unique process controls and material selection ensure unmatched life and contact repeatability.

Programmable Models

Miniature drive solenoids in the programmable models keep switching time, including settling, down to less than 20 milliseconds. Once switched, strong permanent magnets hold the solenoids (and attenuation value) in place. Current interrupts automatically disconnect solenoid current, simplifying driver circuit design and minimizing heat dissipation. Programming is done through a 12-pin Viking socket or optional ribbon cables with DIP plugs. Automatic drive control is easy using the HP-IB compatible HP 11713A or 87130A attenuator/switch driver and an external controller.

Programmable Driver Instruments

Programmable drive options for step attenuators include the HP 11713A attenuator/switch driver, which permits users to easily integrate the attenuator into HP-IB compatible automatic test systems. Also, see page 110 for product descriptions of the HP 87130A and 70611A (MMS) attenuator/switch drivers.

Interconnect cable selections include various connector and ribbon cable configurations to match user applications. Standard interconnect cables are described in the Attenuator Cables table on page 47.

Manual Models

These models provide excellent performance with the simplicity and convenience of positive manual switching. A low torque camshaft activates the insertion and removal of the attenuation sections. Positive detents and an attenuation level indicator ensures quick and accurate control.














Attenuator Interconnecting Kits

To achieve 1 dB step resolution up to 81 dB, 101 dB or 121 dB, combine the HP 8494 with 8495/96/97 using the HP 11716A,B,C interconnect kits to cascade attenuators in series. The HP 11717A attenuator/switch rack mount support kit allows easy rack mounting (See page 47).

Attenuators

Programmable and Manual Step

Specifications

HP Model (Switching Mode)	Frequency Range (GHz)	Attenuation Range	Insertion Loss @ 0 dB	Maximum SWR	Repeatability ¹ Life	Maximum RF Input Power	Shipping Weight
 355C (Manual)	dc to 1	0 to 12 dB 1 dB steps	↑ 0.2 dB + 2.3 dB/GHz ↓	↑ 1.2 to 250 MHz 1.3 to 500 MHz 1.5 to 1 GHz ↓	↑ 0.03 dB max 0.5 million cycles per section ↓	↑ 0.5 W avg. 350 W peak ² (10 μs max.) ↓	↑ 1.4 kg (3 lb) ↓
355E (Programmable)	dc to 1	0 to 12 dB 1 dB steps					
 355D (Manual)	dc to 1	0 to 120 dB 10 dB steps					
355F (Programmable)	dc to 1	0 to 120 dB 10 dB steps					
 8494A (Manual)	dc to 4	0 to 11 dB 1 dB steps	↑ 0.6 dB + 0.09 dB/GHz ↓	1.5 1.5 to 8 GHz 1.6 to 12.4 GHz 1.9 to 18 GHz	↑ 0.03 dB max 5 million cycles per section ↓	↑ 1 W avg. 100 W peak ² (10 μs max.) ↓	↑ 0.9 kg (2 lb) ↓
 8494G (Programmable)	dc to 4	0 to 11 dB 1 dB steps					
 8494B (Manual)	dc to 18	0 to 11 dB 1 dB steps					
8494H (Programmable)	dc to 18	0 to 11 dB 1 dB steps	↑ 0.4 dB + 0.07 dB/GHz ↓	1.35 1.35 to 8 GHz 1.5 to 12.4 GHz 1.7 to 18 GHz	↑ 0.03 dB max 5 million cycles per section ↓	↑ 0.5 W avg. 100 W peak ² (10 μs max.) ↓	↑ 0.9 kg (2 lb) ↓
 8495A (Manual)	dc to 4	0 to 70 dB 10 dB steps					
 8495G (Programmable)	dc to 4	0 to 70 dB 10 dB steps					
 8495B (Manual)	dc to 18	0 to 70 dB 10 dB steps					
8495H (Programmable)	dc to 18	0 to 70 dB 10 dB steps	↑ 0.6 dB + 0.09 dB/GHz ↓	1.5 1.5 to 8 GHz 1.6 to 12.4 GHz 1.9 to 18 GHz	↑ 0.03 dB max 5 million cycles per section ↓	↑ 0.5 W avg. 100 W peak ² (10 μs max.) ↓	↑ 0.9 kg (2 lb) ↓
 8495D (Manual)	dc to 26.5	0 to 70 dB 10 dB steps					
 8495K (Programmable)	dc to 26.5	0 to 70 dB 10 dB steps					
 8496A (Manual)	dc to 4	0 to 110 dB 10 dB steps	↑ 0.6 dB + 0.09 dB/GHz ↓	1.5 1.5 to 8 GHz 1.6 to 12.4 GHz 1.9 to 18 GHz	↑ 0.03 dB max 5 million cycles per section ↓	↑ 0.5 W avg. 100 W peak ² (10 μs max.) ↓	↑ 0.9 kg (2 lb) ↓
 8496G (Programmable)	dc to 4	0 to 110 dB 10 dB steps					
 8496B (Manual)	dc to 18	0 to 110 dB 10 dB steps					
8496H (Programmable)	dc to 18	0 to 110 dB 10 dB steps					
8497K (Programmable)	dc to 26.5	0 to 90 dB 10 dB steps	0.6 dB + 0.09 dB/GHz	1.25 to 6 GHz 1.45 to 12.4 GHz 1.6 to 18 GHz 1.8 to 26.5 GHz	0.03 dB max to 18 GHz 0.05 dB max to 26.5 GHz 5 million cycles per section	0.5 W avg. 100 W peak ² (10 μs max.)	0.9 kg (2 lb)



Indicates QuickShip availability. Available on HP 355 C,E standard models only. Available on HP 849X A,B,G,H models with Option 001 only. Available on HP 849X D,K models with Option 004 only. Contact HP Direct or your local HP sales representative to confirm QuickShip.

¹ Measured at 25 °C.

² Not to exceed average power.

Attenuators

Programmable and Manual Step Attenuators

HP 355 Series Options

	Std.	Opt. 001	Opt. 005
RF Connectors	BNC (f)	N (f)	TNC (f)
Drive Circuit Protection	Opt. 007: Protection diodes for HP 355E,F		

HP 8494/95/96/97 Series Options

	Std.	Opt. 011	Opt. 015
Supply Voltage			
Supply Voltage Range	20 to 30 Vdc	4.5 to 7 Vdc	13 to 22 Vdc
Supply Voltage (nom)	24 Vdc	5 Vdc	15 Vdc
RF Connectors			
A,B,G,H models	Opt. 001: N (f)	Opt. 002: SMA (f)	Opt. 003: APC-7
K,L models	Opt. 004: 3.5 mm (f)		
DC Connectors			
G,H,K models	Std: 12-pin Viking connector Opt. 008: 8-inch ribbon cable with 14-pin DIP plug Opt. 016: 16-inch ribbon cable with 14-pin DIP plug		
Calibration Documentation	See ordering information		

Attenuators

Programmable and Manual Step

Specifications

HP Model (Switching Mode)	Frequency Range (GHz)	Attenuation Range	Insertion Loss (dB)	Maximum SWR Std. (Opt. 006)	Repeatability ¹ Life	Maximum RF Input Power	Shipping Weight
84904K (Programmable)	dc to 26.5	0 to 11 dB 1 dB steps	0.8 dB + 0.04 dB/GHz	1.3 (1.5) to 12.4 GHz	0.03 dB max. 5 million cycles per section	1 W avg. 100 W peak ² (10 µs max)	0.29 kg (10.32 oz)
84904L (Programmable)	dc to 40			1.7 (1.9) to 34 GHz 1.8 (2.0) to 40 GHz			
84906K (Programmable)	dc to 26.5	0 to 90 dB 10 dB steps	0.8 dB + 0.04 dB/GHz	1.3 (1.5) to 12.4 GHz			0.29 kg (10.32 oz)
84906L (Programmable)	dc to 40			1.7 (1.9) to 34 GHz 1.8 (2.0) to 40 GHz			
84907K (Programmable)	dc to 26.5	0 to 70 dB 10 dB steps	0.6 dB + 0.03 dB/GHz	1.25 (1.4) to 12.4 GHz			0.23 kg (8.1 oz)
84907L (Programmable)	dc to 40			1.5 (1.7) to 34 GHz 1.7 (1.9) to 40 GHz			

¹ Measured at 25 °C.

² Not to exceed average power.

HP 84904/906/907 Series Options

	Std.	Opt. 011	Opt. 015
Supply Voltage			
Supply Voltage Range	20 to 30 Vdc	4.5 to 7 Vdc	13 to 22 Vdc
Supply Voltage (nom)	24 Vdc	5 Vdc	15 Vdc
RF Connectors			
K models	Std.: 3.5 mm (f)	Opt. 104: 3.5 mm (f) ³ 3.5 mm (m) ⁴	
L models	Std.: 3.5 mm (f)	Opt. 006: 2.92 mm (f)	Opt. 100: 2.4 mm (f) ³ 2.4 mm (m) ⁴ Opt. 106: 2.92 mm (f) ³ 2.92 mm (m) ⁴
DC Connectors			
G,H,K models	Opt. 008: 8-inch ribbon cable with 14-pin DIP plug Opt. 016: 16-inch ribbon cable with 14-pin DIP plug		
Calibration Documentation	See ordering information		

³ Drive cable end.

⁴ End opposite to drive cable.

Some HP attenuators are available as OEM equivalents to standard models.
This table shows the corresponding model numbers.

HP Model Number	OEM Model Number	HP Model Number	OEM Model Number
8494A	33320A	8496H	33322H
8494B	33320B	8497K	33323K
8494G	33320G	84904K	33324K
8494H	33320H	84904L	33324L
8495G	33321G	84906K	33326K
8495H	33321H	84906L	33326L
8495K	33321K	84907K	33327K
8496G	33322G	84907L	33327L

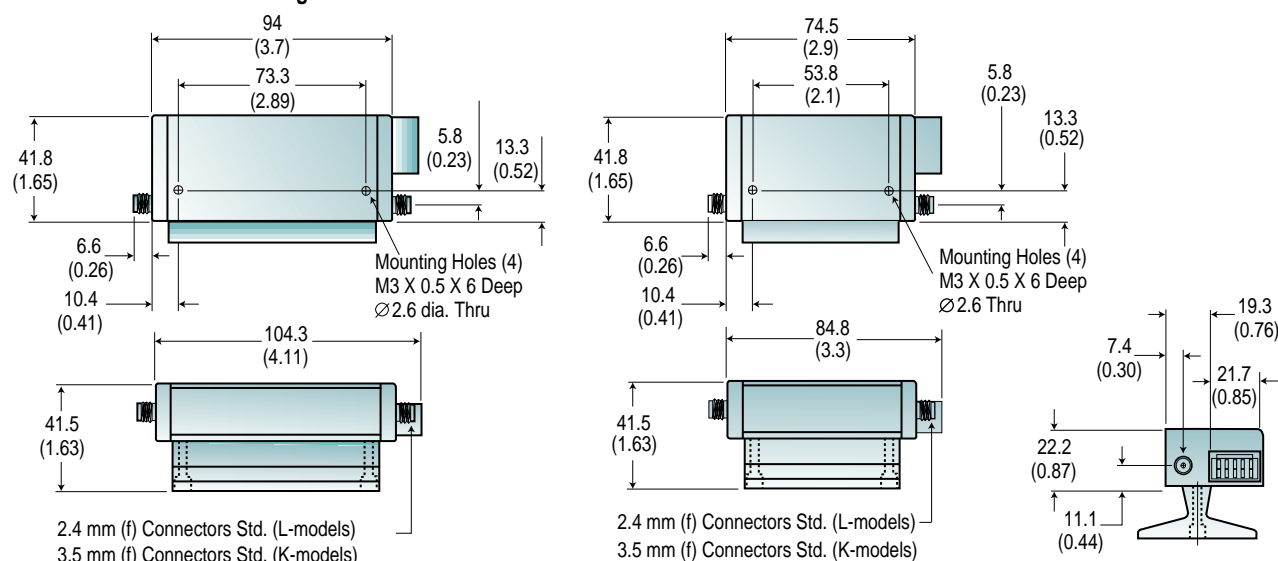
OEM models of step attenuators are furnished without a base.

Attenuators

Programmable and Manual Step

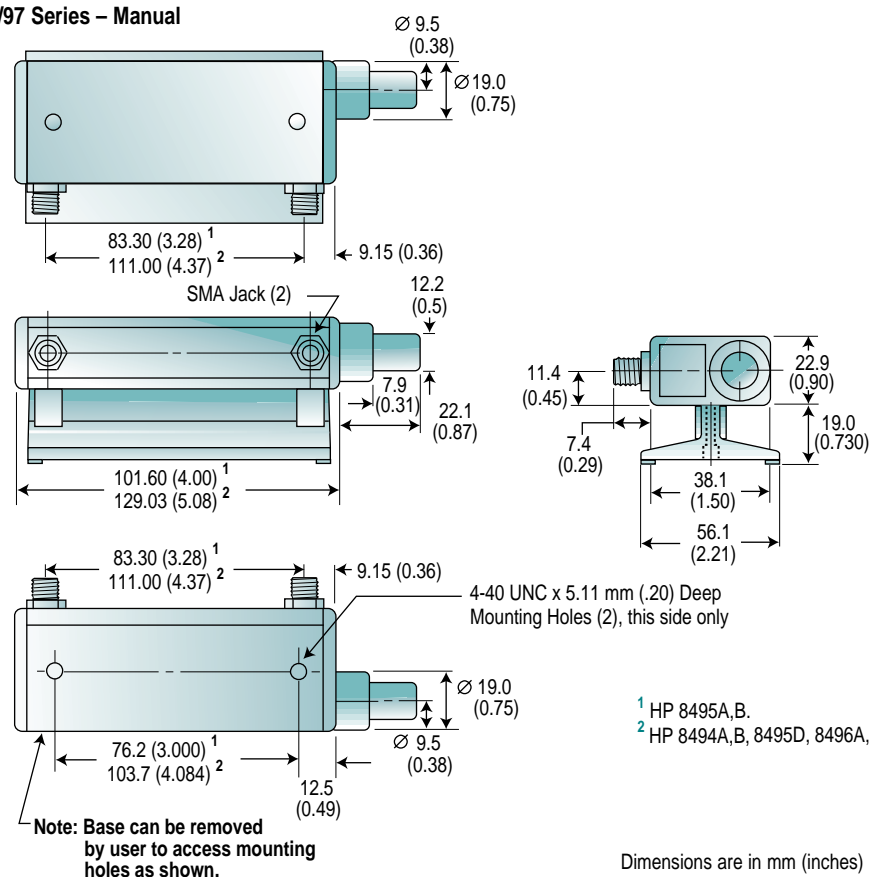
Outline Drawings

HP 84904/906/907 Series – Programmable



See ordering example for connector options

HP 8494/95/96/97 Series – Manual



¹ HP 8495A,B.

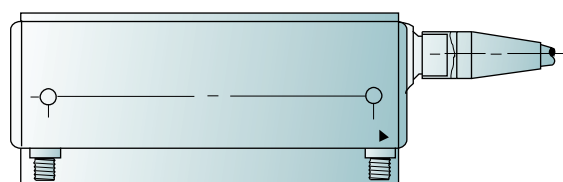
² HP 8494A,B, 8495D, 8496A,B.

Dimensions are in mm (inches) nominal, unless otherwise specified.

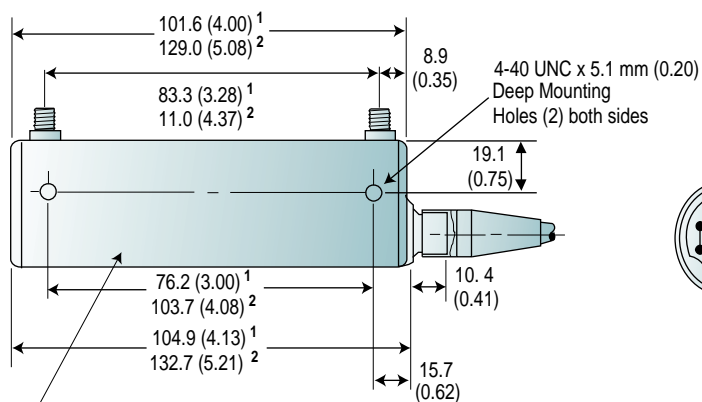
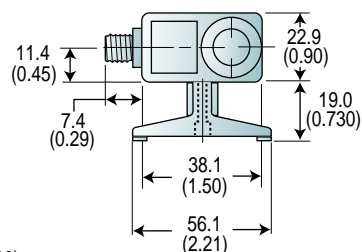
Attenuators

Programmable and Manual Step

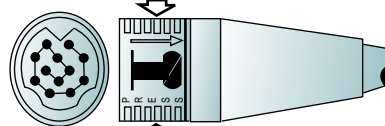
HP 8494/95/96/97 Series – Programmable



Solenoid Drive Plug and 5 ft. cable supplied, 6.3 (0.25) dia.



Solenoid Drive Plug Detail

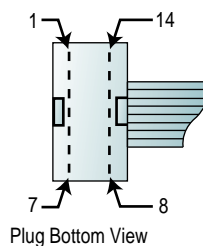
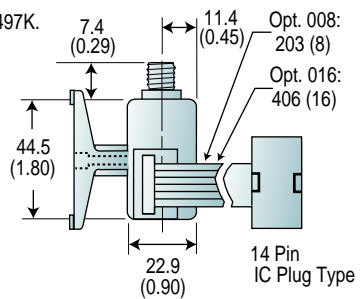


To Remove: Press at arrows with thumb and finger; pull to detach. Caution: Do not twist.

Note: Base can be removed by user to access mounting holes as shown above.

¹ HP 8495G,H.

² HP 8494G,H, 8495K, 8496G,H, 8497K.



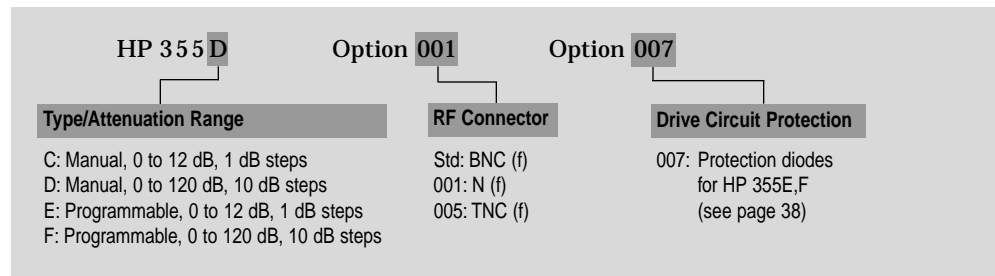
Dimensions are in mm (inches) nominal, unless otherwise specified.

Attenuators

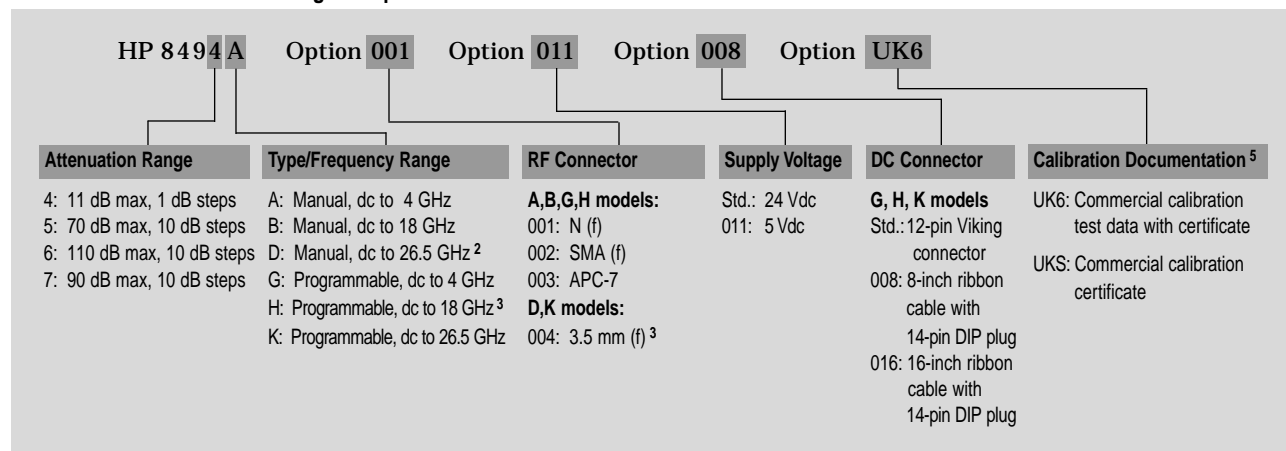
Programmable and Manual Step

Step Attenuator Ordering Information

HP 355 Series Ordering Example



HP 8494/95/96/97 Series Ordering Example

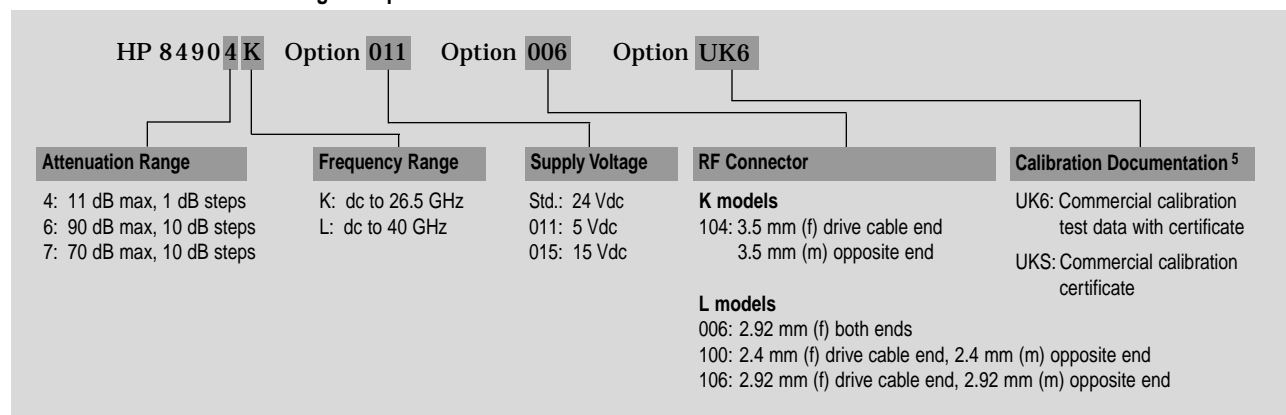


¹ Each order must include RF connector option.

² Available with HP 8495 only.

³ Available with HP 8495/97 only.

HP 84904/906/907 Series Ordering Example⁴



⁴ Drive cable not included. See Attenuator Cables table on next page.

⁵ Option UK6/UKS not available with Option 106.