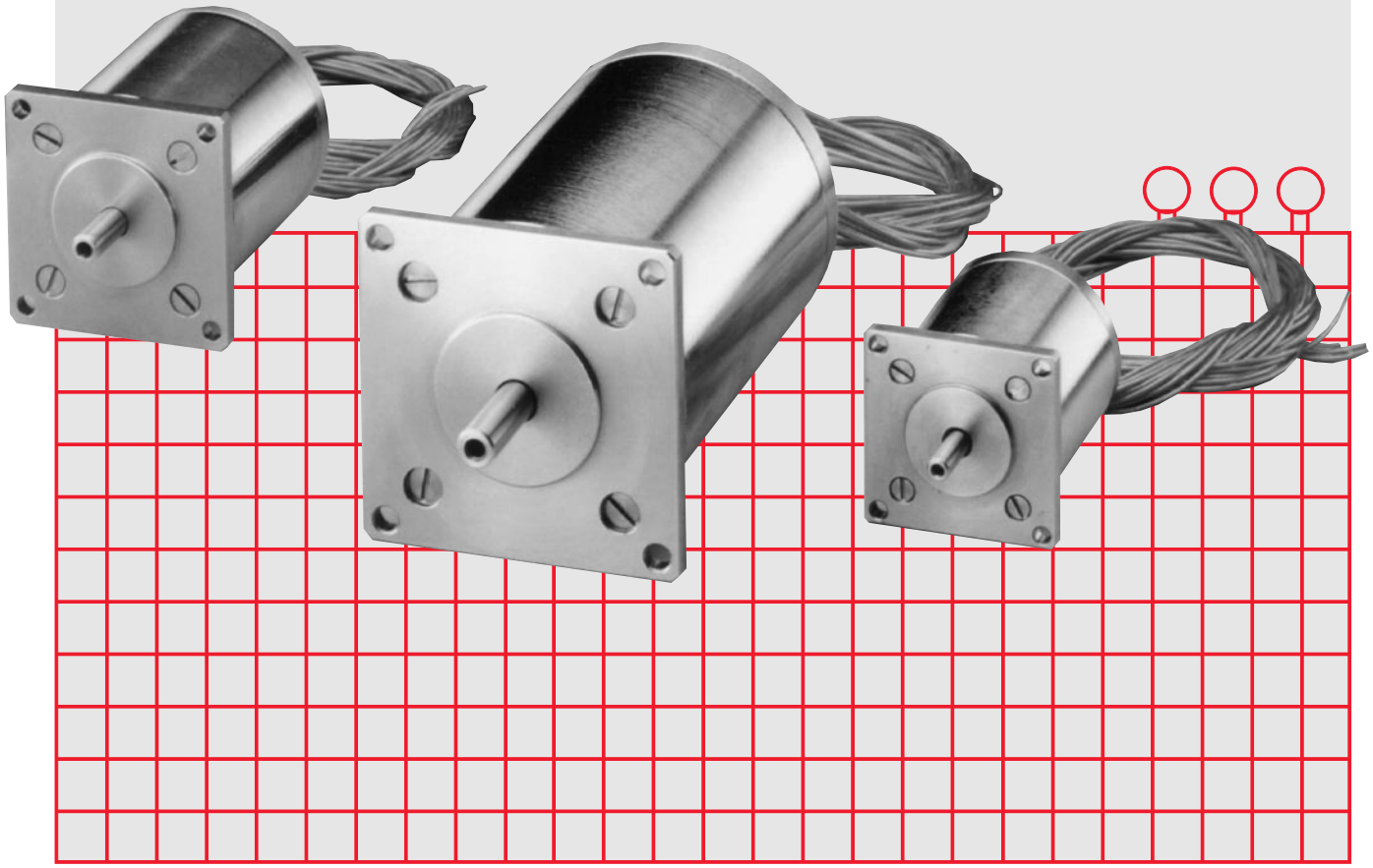
phytron

VSS
Extreme Environment Stepping Motors

Vacuum to 10^{-11} Torr
Temperature -270°C to +300°C
Radiation hardened to 10^{8} Rad
Space



phytron

Extreme Environment Stepping Motors

- Vacuum to 10^{-11} Torr
- Temperature -270°C to +300°C
- Radiation hardened to 10^{8} Rad
- Space

Catalog EXTREME ENVIRONMENT STEPPING MOTORS AND GEARED STEPPING MOTORS

Due to the various operating conditions and applications of the products in this catalog, the user is solely responsible for making the final selection of the products and assuring that all performance, safety and warning requirements are met.

The products described herein are subject to change by Phytron, Inc. at any time without notice. Errors and technical modifications reserved.

This version cancels the validity of all previous catalogs.

Extreme Environment Stepping Motors

- Vacuum to 10^{-11} Torr
- Temperature -270°C to +300°C
- Radiation hardened to 10^{8} Rad
- Space

Environments

Phytron offers 5 different grades of extreme environment stepping motors.

VSS – FV

Vacuum to 10^{-3} Torr
Temperature range -40°C to 150°C

VSS – HV

Vacuum to 10^{-7} Torr
Temperature range -40°C to 200°C

VSS – UHV

Vacuum to 10^{-11} Torr
Temperature range -40°C to 300°C
Radiation Hardened to 10^{8} Rad

VSS – UHVC

Vacuum up to 10^{-11} Torr
Temperature range -270°C to 40°C
Radiation Hardened to 10^{8} Rad

VSS – Space

High shock and vibration loads
Vacuum up to 10^{-11} Torr
Temperature range -270°C to 300°C
Radiation Hardened to 10^{8} Rad
Quality Assurance documentation

About VSS Stepping Motors

- Two-phase hybrid stepping motors
- Holding torque from 0.34 to 990 Ncm (0.49 to 1414 oz-in)
- Diameters from 19 to 125 mm (0.75” to 4.9”)
- Standard number of steps: 200
  Optional : 72, 500
- Step accuracy 3% for 1.8° step motor and 5% for 0.72° step motor
- Design voltage
  size 19-57 < 100V
  size 65-125 < 200V
- Protection class:
  IP 00 for vacuum version
  IP 40 for non-vacuum (temperature and radiation only)
- Standard number of leads 4
  optional: 5, 6 or 8
- Outgassing holes to avoid pockets of trapped gas

Options

- Double shaft
- GPL Low backlash planetary gearing
- K type thermocouple to monitor winding temperature
- Heat sinks (details upon request)

Preparing the VSS stepping motors

VSS series of stepping motors are designed to be used inside vacuum chambers. This eliminates the use of motion feed throughs that generate particulates.

Since the stepping motor is relatively simple in design, it can be adapted to operate in extreme physical environments with a few modifications. Under normal operating conditions, only the bearings are subject to wear.

For extreme environment applications, special windings, bearings and lubricants are used, as well as special insulating material and special adhesive.

To accommodate most extreme environmental conditions, Phytron VSS stepping motors are offered in five grades. Each grade covers a vacuum rating, a temperature range and radiation level.

Assembly, cleaning and conditioning of the Phytron VSS stepping motors result in a low outgassing rate which makes Phytron the reliable choice for all extreme environment applications.

Ordering Information

VSS 42 . 200 . 2.5 - E - VGPL 42 / 20 - HV - KTC

- Stepping Motor Series (VSS/VSH)
- Size (19 – 125) represent outside diameter in mm
- Steps per revolution (72 / 200 / 500)
- Winding (Bipolar, parallel Amps/phase)
- Options (Double shaft: E)
- Gearing / Reduction ratio
- Environment (FV / HV / UHV / UHVC / Space)
- Options (Thermocouple “KTC”, Heat sink “K1 or K2”, Special “X”)

phytron

Extreme Environment Stepping Motors

- Vacuum to 10^{-11} Torr
- Temperature -270°C to +300°C
- Radiation hardened to 10^{8} Rad
- Space

		Electrical									Mechanical					
		Parallel (4-leads)[5]			Series (4-leads)[6]			Unipolar (5 or 6 leads)[6]			Torque[4]			Loads		Mass
Size[7]	Standard part number (200 steps/rev.)	I/ph[1]	R/ph[2]	L/ph[3]	I/ph[1]	R/ph[2]	L/ph[3]	I/ph[1]	R/ph[2]	L/ph[3]	holding	detent	inertia	axial	radial	
		A	Ω	mH	A	Ω	mH	A	Ω	mH	mNm (oz-in)	mNm (oz-in)	kg-cm² (oz-in²)	N (lb_f)	N (lb_f)	kg (lb_m)
19	VSS 19.200.0.3	0.3	6	2.2	0.15	24	8.8	0.21	12	2.2	3.4 (0.49)	0.9 (0.13)	0.0009 (0.005)	3 (0.67)	3 (0.67)	0.05 (0.11)
	VSS 19.200.0.6	**0.6**	**2.1**	**0.55**	0.3	8.4	2.2	0.42	4.2	0.55						
	VSS 19.200.1.2	1.2	0.625	0.15	0.6	2.5	0.6	0.84	1.25	0.15						
25	VSS 25.200.0.3	0.3	12	6	0.15	48	24	0.21	24	6	12 (1.71)	2 (0.29)	0.002 (0.01)	5 (1.13)	5 (1.13)	0.08 (0.18)
	VSS 25.200.0.6	0.6	3.25	1.5	0.3	13	6	0.42	6.5	1.5						
	VSS 25.200.1.2	**1.2**	**0.95**	**0.4**	0.6	3.8	1.6	0.84	1.9	0.4						
32	VSS 32.200.0.6	0.6	4.65	5.3	0.3	18.6	21.2	0.42	9.3	5.3	45 (6.43)	3 (0.43)	0.01 (0.05)	5 (1.13)	15 (3.38)	0.17 (0.37)
	VSS 32.200.1.2	**1.2**	**1.3**	**1.2**	0.6	5.2	4.8	0.84	2.6	1.2						
	VSS 32.200.2.5	2.5	0.3	0.3	1.25	1.2	1.2	1.75	0.6	0.3						
	VSS 33.200.0.6	0.6	7.5	9.3	0.3	30	37.2	0.42	15	9.3	68 (9.71)	3.3 (0.47)	0.018 (0.09)	5 (1.13)	15 (3.38)	0.39 (0.86)
	VSS 33.200.1.2	**1.2**	**1.75**	**2.2**	0.6	7	8.8	0.84	3.5	2.2						
	VSS 33.200.2.5	2.5	0.47	0.6	1.25	1.88	2.4	1.75	0.94	0.6						
42	VSS 42.200.0.6	0.6	7.25	11	0.3	29	44	0.42	14.5	11	130 (18.57)	5 (0.71)	0.045 (0.25)	20 (4.5)	40 (9.0)	0.35 (0.77)
	VSS 42.200.1.2	1.2	1.6	3	0.6	6.4	12	0.84	3.2	3						
	VSS 42.200.2.5	**2.5**	**0.35**	**0.7**	1.25	1.4	2.8	1.75	0.7	0.7						
	VSS 43.200.0.6	0.6	9.5	22.9	0.3	38	91.6	0.42	19	22.9	235 (33.57)	7 (1.00)	0.077 (0.42)	20 (4.5)	40 (9.0)	0.52 (1.15)
	VSS 43.200.1.2	1.2	2.6	5.2	0.6	10.4	20.8	0.84	5.2	5.2						
	VSS 43.200.2.5	2.5	0.5	1.2	1.25	2	4.8	1.75	1	1.2						
52	VSS 52.200.1.2	1.2	2.65	7	0.6	10.6	28	0.84	5.3	7	405 (57.86)	13 (1.86)	0.15 (0.82)	25 (5.63)	70 (15.77)	0.72 (1.59)
	VSS 52.200.2.5	2.5	0.6	1.6	1.25	2.4	6.4	1.75	1.2	1.6						
	VSS 52.200.5.0	**5**	**0.165**	**0.4**	2.5	0.66	1.6	3.5	0.33	0.4						
57	VSS 57.200.1.2	1.2	3.9	9.5	0.6	15.6	38	0.84	7.8	9.5	630 (90)	50 (7.14)	0.24 (1.31)	40 (9.00)	80 (18.02)	0.99 (2.18)
	VSS 57.200.2.5	**2.5**	**0.8**	**2.4**	1.25	3.2	9.6	1.75	1.6	2.4						
	VSS 57.200.5.0	5	0.25	0.8	2.5	1	3.2	3.5	0.5	0.8						

1) I/ph: Phase current

2) R/ph: Phase resistance

3) L/ph: Phase inductance

4) Holding torque in bipolar mode with 2 phases ON at nominal current

5) Standard wiring at delivery

6) Upon request

7) Size represents motor diameter in mm (1 in ≃ 25.4 mm)

All values given above were measured at room temperature of 25°C (77°F) and atmospheric pressure.
Bold letters = Preferred Types

Extreme Environment Stepping Motors

- Vacuum to 10^{-11} Torr
- Temperature -270°C to +300°C
- Radiation hardened to 10^{8} Rad
- Space

phytron

VSS 19 – 57 stepping motors

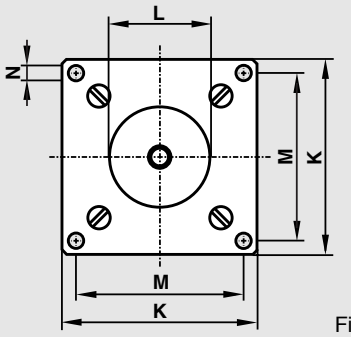


Fig. 1

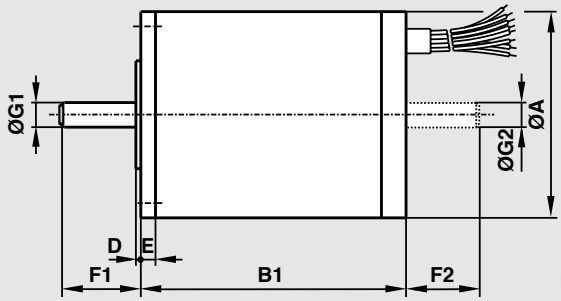
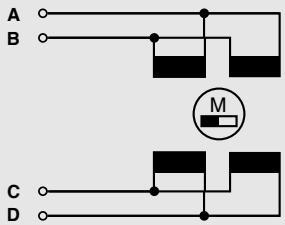


Fig. 2

		Dimensions in mm											
Size	Type	A	B1	D	E	F1	F2	$G1_{g5}$	$G2_{g5}$	K	L_{g6}	M	N
19	VSS 19	19	26.5	1	2	7.5	6.5	2.5	2.5	19	10	16	M2.5
25	VSS 25	25	31	1	2.5	9.5	8.5	3	3	25	14	21.5	2.2
32	VSS 32	32	38.5	1	3	11	10	4	4	32	18	27	2.8
	VSS 33	32	57.5	1	3	11	10	4	4	32	18	27	2.8
42	VSS 42	42	54	1	3	16	15	5	4	42	22	36	3.2
	VSS 43	42	69	1	3	16	15	5	4	42	22	36	3.2
52	VSS 52	52	65	1.5	3.5	17.5	16	6	4	52	28	44	4.3
57	VSS 57	56.4	73.5	1.5	4.5	20.5	20.5	6.35	6.35	60	38.1	47.15	5.2

Wiring Diagram

For bipolar control:



4-lead/parallel winding connection

Fig. 3

Bipolar

Phytron Standard VSS stepping motors are delivered with 4 leads for bipolar control (Fig. 3).

Unipolar

Per customer's request, the VSS stepping motors can be delivered with 5 or 6 leads for unipolar control.

unipolar torque = bipolar torque x .7

Lead Insulation / Labeling

- VSS – FV are Teflon (PTFE) insulated and colored.
- VSS – HV / UHV / UHVC are Kapton insulated with removable identity tags (A, B, C, D).

Lead Length

Standard lead length is 500 mm, shorter or longer length per request.

Thermocouple

- For winding temperature monitoring
- K-type, 2 leads, 500 mm long
- Located between the 2 motor phases for 1 or 2 phase ON temperature monitoring.
- Kapton insulated

Lead Location

Standard lead exit is out the back, sideways per request.

phytron

Extreme Environment Stepping Motors

- Vacuum to 10^{-11} Torr
- Temperature -270°C to +300°C
- Radiation hardened to 10^{8} Rad
- Space

VSH 65-125

The VSH series of larger stepping motors represent diameters from 65 to 125 mm (2.56" to 4.92") with holding torque of 0.86 Nm to 9.9 Nm (123 to 1410 oz-in). Standard step angle is 1.8° (200 steps/rev.).

		Electrical Characteristics									Mechanical Characteristics				
Size[6]	Type	Coil 1[5]			Coil 2[5]			Coil 3[5]			Torque[4]			Loads	
		I/ph[1]	R/ph[2]	L/ph[3]	I/ph[1]	R/ph[2]	L/ph[3]	I/ph[1]	R/ph[2]	L/ph[3]	holding	detent	inertia	axial	radial
		A	Ω	mH	A	Ω	mH	A	Ω	mH	Nm (oz-in)	Nm (oz-in)	kg-cm² (oz-in²)	N (lb_f)	N (lb_f)
65	VSH 65	1.2	4.3	16.1	2.5	1.05	4	**5**	**0.29**	**1.1**	0.86 (122.8)	0.05 (7.1)	0.41 (2.24)	40 (9.0)	120 (27.1)
80	VSH 80	5	0.4	2.3	7.5	0.2	2	**10**	**0.1**	**0.9**	2 (285.7)	0.12 (17.1)	1.24 (6.78)	50 (11.3)	180 (40.5)
100	VSH 100	7.5	0.3	6.5	**10**	**0.15**	**2.1**	15	0.08	0.8	4.3 (614.3)	0.14 (20)	4.4 (24.06)	70 (15.8)	300 (67.6)
125	VSH 125	7.5	0.4	6	**10**	**0.23**	**3**	15	0.1	1.9	9.9 (1414.3)	0.25 (35.7)	11.4 (62.33)	150 (33.8)	700 (157.7)

1) I/ph: Phase current 2) R/ph: Phase resistance 3) L/ph: Phase inductance
4) Holding torque in bipolar mode with 2 phases ON at nominal current 5) 4 leads connected in parallel for bipolar control
6) Size represents diameter in mm (1 in ≃ 25.4 mm)
Bold letters = Preferred Types

VSH 65-125 stepping motor

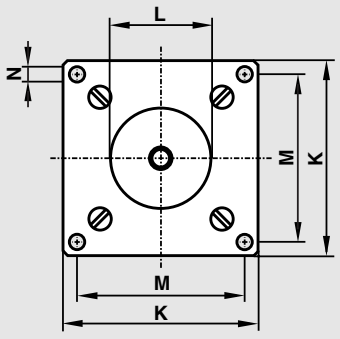


Fig. 4

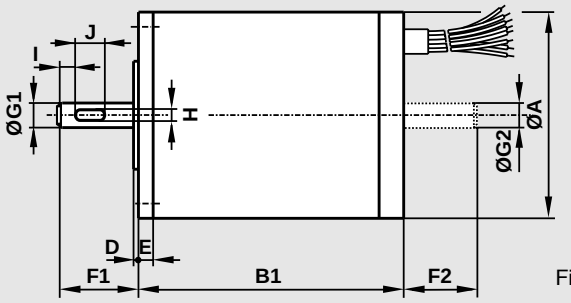


Fig. 5

Dimensions in mm																Mass
Size	Type	A	B1	D	E	F1	F2	G1	G2	H	I	J	K	L	M	N	kg (lb_m)
65	VSH 65	65	81	1.5	5.5	23.5	22	8	7	2	3	14	65	40	55	5.2	1.4 (3.09)
80	VSH 80	80	100	2	7.5	27	25	10	9	3	2.5	20	80	50	68	6.4	2.8 (6.17)
100	VSH 100	100	125.5	2	8	32	30	12	12	4	3	22	100	60	86	6.4	4.5 (9.92)
125	VSH 125	125	156	3	9.5	34	31	14	14	5	3.5	22	125	60	108	8.4	9.4 (20.73)

Extreme Environment Geared Stepping Motors

- Vacuum to 10^{-11} Torr
- Temperature -270°C to +300°C
- Radiation hardened to 10^{8} Rad
- Space

phytron

Planetary Geared VSS Stepping Motors (for motor size 19 to 57)

Gear	Stepping[1] motor	Stages	Gear reduction ratios	Backlash[2]	Max. Torque	Gear Inertia	Efficiency	Permissible loads	
								radial[3]	axial
				arc-min	Nm (oz-in)	kg-cm² (oz-in²)	%	N (lb_f)	N (lb_f)
VGPL 22	VSS 19 VSS 25	1-stage	4:1, 5:1, 6:1	10'	0.1 (14.3)	0.005 (0.03)	94	30 (6.75)	24 (5.4)
		2-stage	16:1, 25:1, 46:1	20'	0.5 (71.4)	0.015 (0.08)	85		
		3-stage	70:1, 100:1, 279:1	30'	1.5 (214.3)	0.025 (0.14)	80		
VGPL 32	VSS 32 VSS 33	1-stage	4:1, 8:1	6'	0.4 (57.1)	0.025 (0.14)	94	80 (18.02)	65 (14.64)
		2-stage	16:1, 25:1, 50:1	12'	2 (285.7)	0.04 (0.22)	85		
		3-stage	72:1, 100:1, 200:1, 260:1	18'	6 (857.1)	0.06 (0.33)	80		
VGPL 42	VSS 42 VSS 43	1-stage	4:1, 6:1	6'	0.7 (100)	0.05 (0.27)	94	150 (33.78)	120 (27.03)
		2-stage	14:1, 20:1	12'	4 (571.4)	0.08 (0.44)	85		
		3-stage	56:1, 100:1, 184:1	18'	12 (1714.3)	0.12 (0.66)	80		
VGPL 52	VSS 52 VSS 57	1-stage	4:1, 8:1	6'	1.5 (214.3)	0.1 (0.55)	94	250 (56.31)	200 (45.05)
		2-stage	16:1, 25:1, 50:1	12'	10 (1428.5)	0.2 (1.09)	85		
		3-stage	72:1, 100:1, 200:1, 260:1	18'	30 (4285.7)	0.25 (1.37)	80		

1) For technical data, refer to motor data sheets 2) No load 3) Applied at center of shaft

Stepping motor with VGPL gear

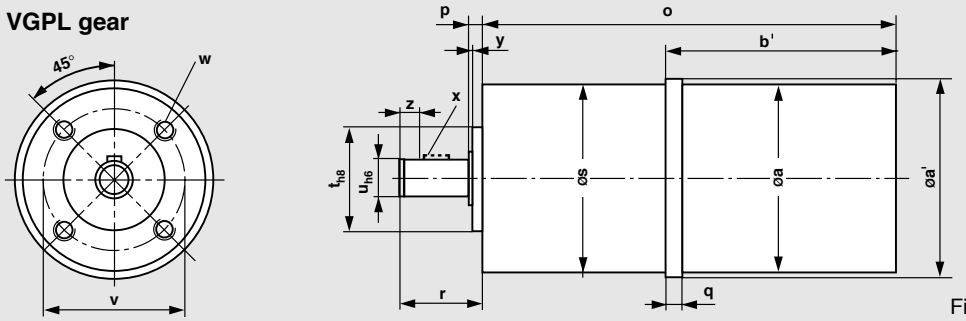


Fig. 6

Dimensions in mm (refer to pg. 3 for motor dimensions)

Gear	Stepping motor				Stages 1 2 3													Mass (kg) (motor & gear) for stages		
		a	a'	b'	o			p	q	r	s	t	u	v	w	x	y	z	1	2	3
VGPL 22	VSS 19	19	22	29	50	57	64	3	4.5	15	22	12	4	16	M2 x 4	-	1	-	0.1	0.13	0.15
	VSS 25	25	25.5	33.5	53.5	60.5	67.5	3	5	15	22	12	4	16			1	-	0.13	0.15	0.18
VGPL 32	VSS 32	32	33	40.5	69.5	78.5	87.5	4	5	20	32	20	6	26	M3 x 5	-	1	-	0.31	0.35	0.42
	VSS 33	32	33	59.5	88.5	97.5	106.5	4	5	20	32	20	6	26			1	-	0.53	0.57	0.64
VGPL 42	VSS 42	42	43	58	93	105.5	118	4	7	22.5	42	25	8	32	M4 x 8	3 x 3 x 14	1	2.25	0.63	0.7	0.8
	VSS 43	42	43	73	108	120.5	133	4	7	22.5	42	25	8	32			1	2.25	0.8	0.85	0.93
VGPL 52	VSS 52	52	53	68.5	109.5	124	138.5	4	6.7	24	52	32	12	40	M5 x 8	4 x 4 x 16	1	2	1.2	1.4	1.5
	VSS 57	56.4	57	78	119	133.5	148	4	7	24	52	32	12	40			1	2	1.4	1.5	1.6

phytron

USA
Phytron, Inc.
1345 Main Street
Waltham, MA 02451
Tel. 781-647-3581
Fax 781-647-3526
email: info@phytron.com
www.phytron.com

GERMANY
Phytron-Elektronik GmbH
Industriestraße 12/14
D-82194 Gröbenzell
Tel. 08142/503-0
Fax 08142/503-190
email: phytron@t-online.de
www.phytron.com