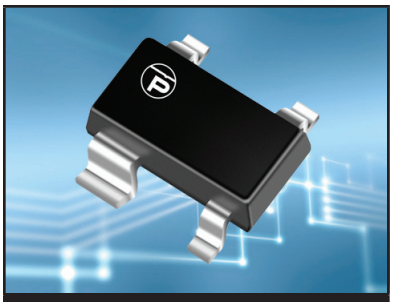
USB0403 - USB0424C

350 WATT LOW CAPACITANCE TVS ARRAY



SOT-143 PACKAGE

DESCRIPTION

The USB04xx and USBxxC Series of devices are low capacitance TVS arrays available in a SOT-143 package. These devices are designed to protect Ethernet data I/O ports against the damaging effects of ESD and EFT transient threats.

The USB04xx series are unidirectional devices used for common mode protection from line to ground. The USB04xxC series are bidirectional devices typically used for differential mode on balanced lines.

Voltages range from 3.3 to 24 volts for both configurations. Each series provides ESD protection to > 25 kilovolts with a peak pulse power rating of 350 Watts for an 8/20µs waveshape. The USB04xx and USBxxC series are designed to meet and exceed the IEC 61000-4-2 and IEC 61000-4-4 requirements.

FEATURES

- Compatible with IEC 61000-4-2 (ESD): Air 15kV, Contact 8kV
- Compatible with IEC 61000-4-4 (EFT): 40A, 5/50ns
- Compatible with IEC 61000-4-5 (Surge): 12A, 8/20µs - Level 1(Line-Gnd) & Level 2(Line-Line)
- 350 Watts Peak Pulse Power per Line (tp = 8/20µs)
- Unidirectional and Bidirectional Configurations
- Available in Multiple Voltages Ranging from 3V to 24V
- Protects 1 Line
- Low Leakage Current
- Low Capacitance: 5pF per Line Pair
- RoHS Compliant
- REACH Compliant

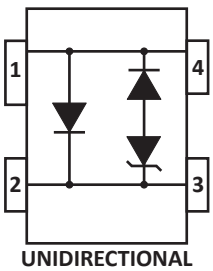
APPLICATIONS

- Ethernet - 10/100/1000 Base T
- Cellular Phones
- Audio/Video Inputs
- FireWire, SCSI & USB Interfaces

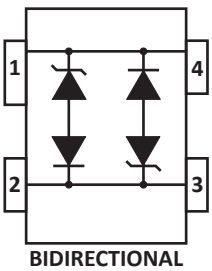
MECHANICAL CHARACTERISTICS

- Molded JEDEC SOT-143 Package
- Approximate Weight: 9 milligrams
- Lead-Free Pure-Tin Plating (Annealed)
- Solder Reflow Temperature:
  Pure-Tin - Sn, 100: 260-270°C
- 8mm Tape and Reel Per EIA Standard 481
- Flammability Rating UL 94V-0

PIN CONFIGURATIONS



UNIDIRECTIONAL



BIDIRECTIONAL

TYPICAL DEVICE CHARACTERISTICS

MAXIMUM RATINGS @ 25°C Unless Otherwise Specified			
PARAMETER	SYMBOL	VALUE	UNITS
Operating Temperature	T_L	-55 to 150	°C
Storage Temperature	T_{STG}	-55 to 150	°C
Peak Pulse Power (tp = 8/20µs) - See Figure 1	P_{PP}	350	Watts

ELECTRICAL CHARACTERISTICS PER LINE @ 25°C Unless Otherwise Specified

PART NUMBER (Notes 1 - 2)	DEVICE MARKING	RATED STAND-OFF VOLTAGE V_{WM} VOLTS	MINIMUM BREAKDOWN VOLTAGE @ 1mA $V_{(BR)}$ VOLTS	MAXIMUM CLAMPING VOLTAGE (Fig. 2) @ I_P = 5A V_C VOLTS	MAXIMUM CLAMPING VOLTAGE (See Fig. 2) @ 8/20µS V_C @ I_{PP} VOLTS	MAXIMUM LEAKAGE CURRENT @V_{WM} I_D µA	TYPICAL CAPACITANCE @0V, 1MHz C pF
USB0403	3U	3.3	4.0	9.0	19.0V @ 20.0A	125	5
USB0403C	3B	3.3	4.0	9.0	19.0V @ 20.0A	125	5
USB0405	5U	5.0	6.0	11.0	18.3V @ 17.0A	20	5
USB0405C	5B	5.0	6.0	11.0	18.3V @ 17.0A	20	5
USB0408	8U	8.0	8.5	16.6	18.5V @ 17.0A	10	5
USB0408C	8B	8.0	8.5	16.6	18.5V @ 17.0A	10	5
USB0412	12U	12.0	13.3	24.0	28.6V @ 11.0A	1	5
USB0412C	12B	12.0	13.3	24.0	28.6V @ 11.0A	1	5
USB0415	15U	15.0	16.6	30.0	31.8V @ 10.0A	1	5
USB0415C	15B	15.0	16.6	30.0	31.8V @ 10.0A	1	5
USB0424	24U	24.0	26.7	N/A	56.0V @ 6.0A	1	5
USB0424C	24B	24.0	26.7	N/A	56.0V @ 6.0A	1	5

NOTES
1. Part numbers with an additional "C" suffix are bidirectional devices, i.e., USB0405**C**.
2. *Unidirectional Only:* Positive potential is applied from pin 2 to 1 or pin 3 to 4.

TYPICAL DEVICE CHARACTERISTICS

FIGURE 1
PEAK PULSE POWER VS PULSE TIME

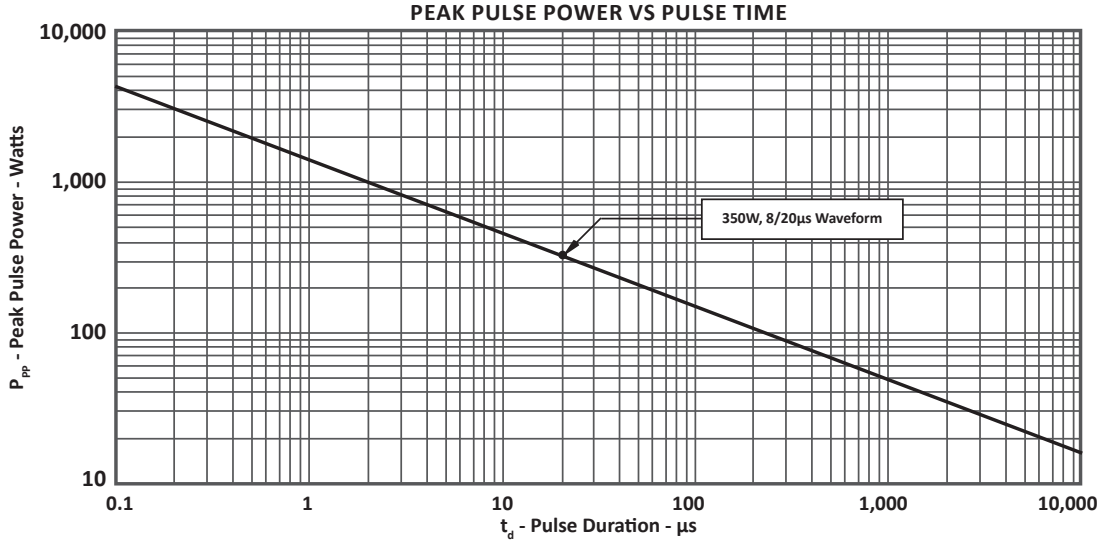


FIGURE 2
PULSE WAVE FORM

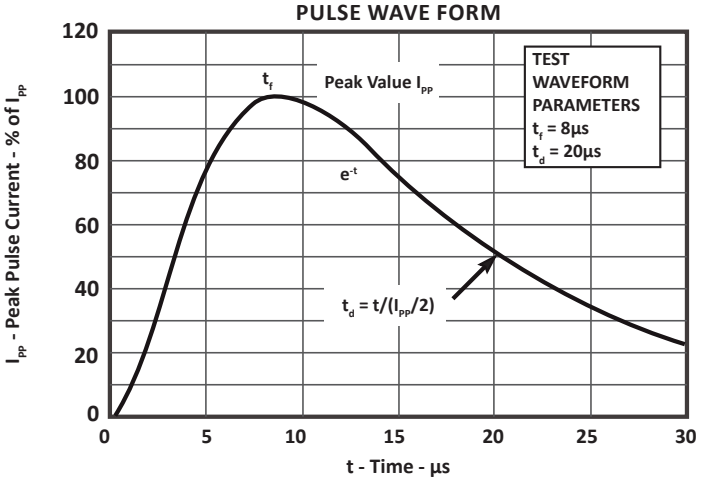
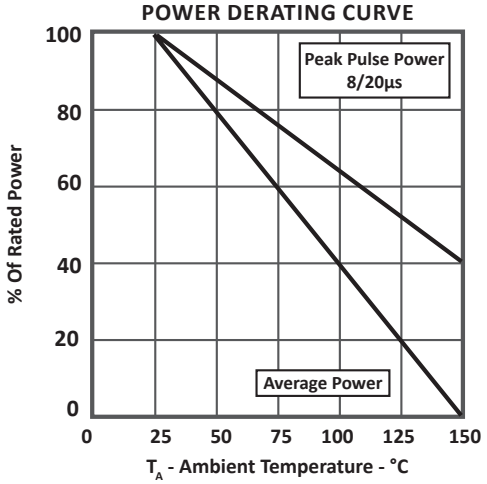
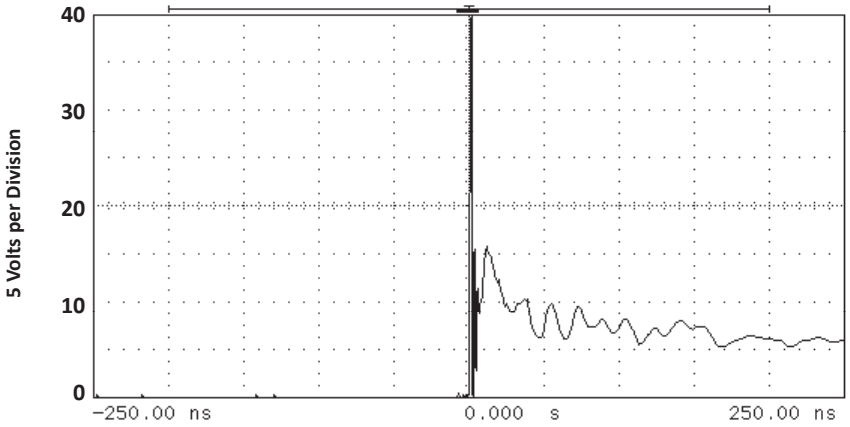


FIGURE 3
POWER DERATING CURVE



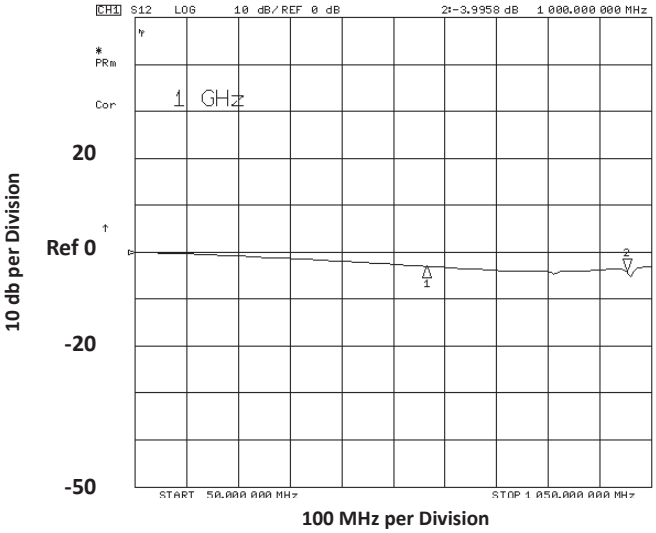
TYPICAL DEVICE CHARACTERISTICS

FIGURE 4
OVERSHOOT & CLAMPING VOLTAGE FOR USB0405C



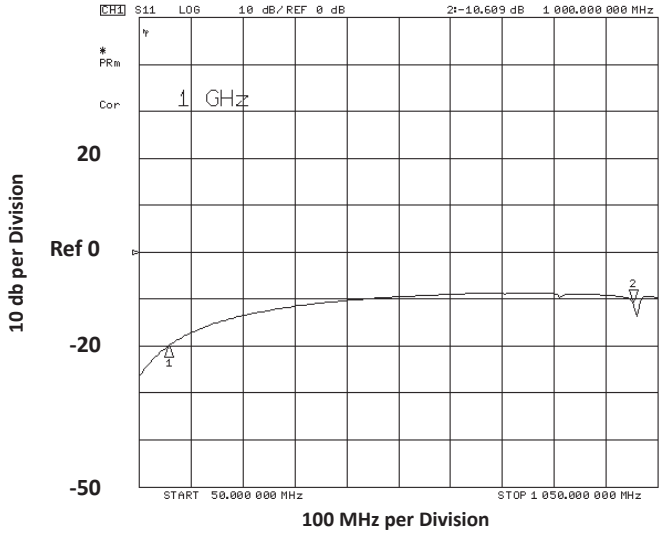
ESD Test Pulse - 5 kilovolt, 1/30ns (Waveshape)

FIGURE 5
INSERTION LOSS - USB0405C



100 MHz per Division

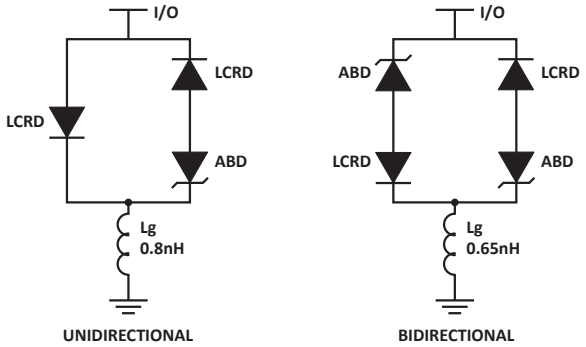
FIGURE 6
RETURN LOSS - USB0405C



100 MHz per Division

SPICE MODEL

FIGURE 1
SPICE MODEL



ABD - Avalanche Breakdown Diode (TVS)
LCRD: Low Capacitance Rectifier Diode
Lg - Lead Inductance

TABLE 1 - SPICE PARAMETERS

PARAMETER	UNIT	ABD(TVS)	LCRD
BV	V	See Table 2	200
IBV	µA	1	0.01
C_{jo}	pF	See Table 2	5
I_S	A	See Table 2	1E-13
Vj	V	0.6	0.6
M	-	0.33	0.33
N	-	1	1
R_S	Ohms	See Table 2	0.31
TT	s	1E-8	1E-9
EG	eV	1.11	1.11

TABLE 2 - ABD SPECIFIC SPICE PARAMETERS

PART NUMBER	B_V(VOLTS)	C_{jo}(pF)	I_S (AMPS)	Rs(OHMS)
USB0403	4.5	200	1E-11	0.22
USB0405	6.0	140	1E-11	0.18
USB0408	8.5	67	1E-11	0.12
USB0412	13.3	55	1E-13	1.10
USB0415	16.7	47	1E-13	1.43
USB0424	26.7	28	1E-13	4.24
USB0403C	4.5	200	1E-11	0.22
USB0405C	6.0	140	1E-11	0.18
USB0408C	8.5	67	1E-11	0.12
USB0412C	13.3	55	1E-13	1.10
USB0415C	16.7	47	1E-13	1.43
USB0424C	26.7	28	1E-13	4.24

APPLICATION INFORMATION

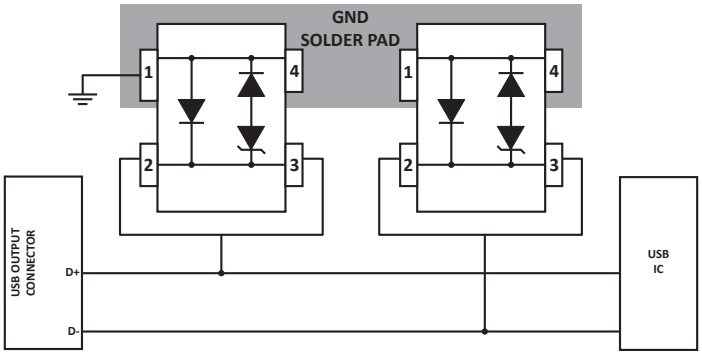


FIGURE 1 - USB PROTECTION

Two USB04xx (Unidirectional) in a Common-Mode configuration. Circuit connectivity is as follows:
- Device 1: Line 1(D+) is connected to pins 2 and 3.
- Device 2: Line 2(D-) is connected to pins 2 and 3.
- Device 1 and 2: Pins 1 and 4 connected to ground

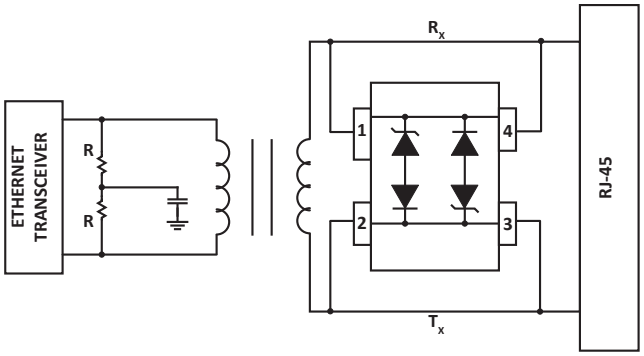


FIGURE 2 - ETHERNET PROTECTION

One USB04xxC (Bidirectional) in a Differential-Mode configuration. Circuit connectivity is as follow:
- Line 1 (R_x) is connected to pins 1 and 4.
- Line 2 (T_x) is connected to pins 2 and 3.

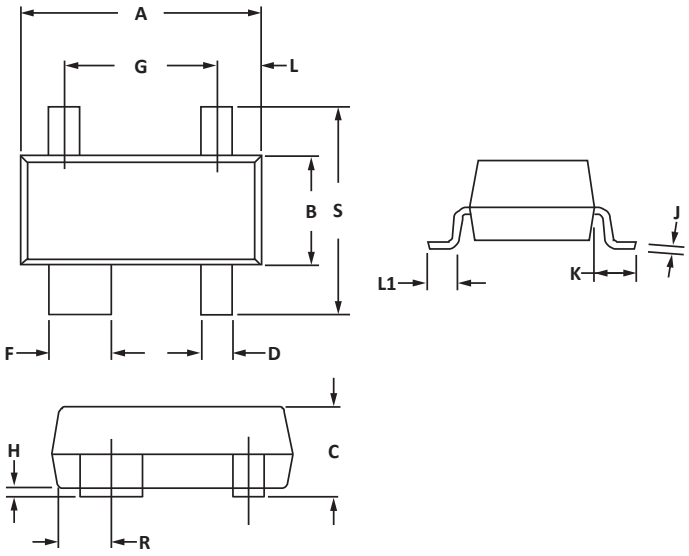
CIRCUIT BOARD RECOMMENDATIONS

Circuit board layout is critical for electromagnetic compatibility protection. The following guidelines are recommended:
- The protection device should be placed near the input terminals or connectors, the device will divert the transient current immediately before it can be coupled into the nearby traces.
- The path length between the TVS device and the protected line should be minimized.
- All conductive loops including power and ground loops should be minimized.
- The transient current return path to ground should be kept as short as possible to reduce parasitic inductance.
- Ground planes should be used whenever possible. For multilayer PCBs, use ground vias.

SOT-143 PACKAGE INFORMATION

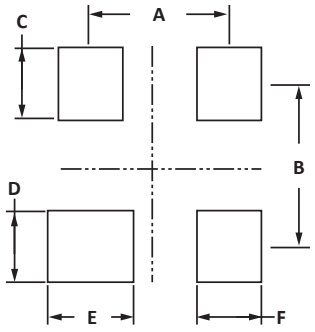
OUTLINE DIMENSIONS				
DIM	MILLIMETERS		INCHES	
	MIN	MAX	MIN	MAX
A	2.80	3.04	0.110	0.120
B	1.20	1.39	0.047	0.055
C	0.84	1.14	0.033	0.045
D	0.39	0.50	0.015	0.020
F	0.79	0.93	0.031	0.037
G	1.78	2.03	0.070	0.080
J	0.08	0.15	0.003	0.006
K	0.46	0.60	0.018	0.024
L	0.445	0.60	0.0175	0.024
L1	0.40	0.60	0.016	0.024
R	0.72	0.83	0.028	0.033
S	2.11	2.48	0.083	0.098

NOTES
1. Dimensioning and tolerances per ANSI Y14.M, 1985.
2. Controlling dimension: inches.
3. Dimensions are exclusive of mold flash and metal burrs.

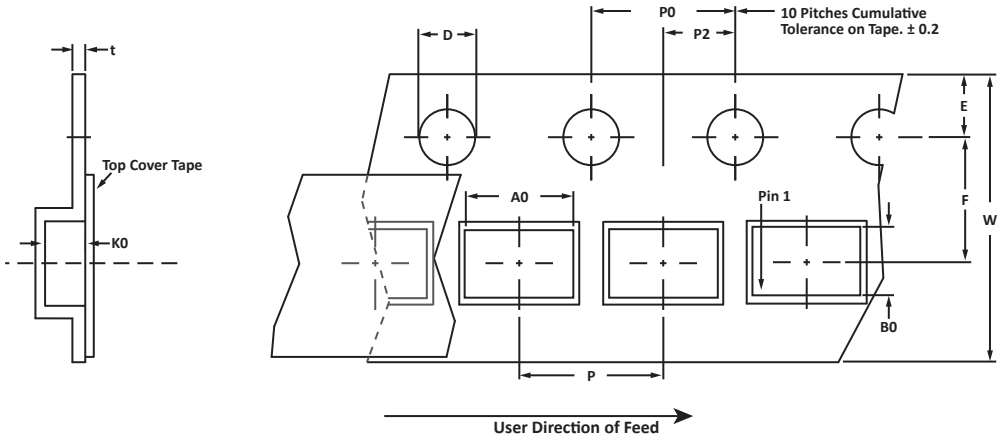


PAD LAYOUT DIMENSIONS				
DIM	MILLIMETERS		INCHES	
	MIN	MAX	MIN	MAX
A	1.88	2.13	0.074	0.084
B	1.80	2.06	0.071	0.081
C	0.71	0.97	0.028	0.038
D	0.76	1.02	0.030	0.040
E	1.07	1.32	0.042	0.052
F	0.71	0.97	0.028	0.038

NOTES
1. Controlling dimension: inches.



TAPE AND REEL



SPECIFICATIONS												
REEL DIA.	TAPE WIDTH	A0	B0	K0	D	E	F	W	P0	P2	P	tmax
178mm (7")	8mm	3.10 ± 0.10	2.70 ± 0.10	1.35 ± 0.10	1.50 ± 0.10	1.75 ± 0.10	3.50 ± 0.05	8.00 ± 0.30	4.00 ± 0.10	2.00 ± 0.05	4.00 ± 0.10	0.25

NOTES
1. Dimensions are in millimeters.
2. Surface mount product is taped and reeled in accordance with EIA-481.
3. Suffix - T7 = 7" Reel - 3,000 pieces per 8mm tape.
4. Suffix - T13 = 13" Reel - 10,000 pieces per 8mm tape.
5. Marking on Part - marking code (see page 2) and date code.

Package outline, pad layout and tape specifications per document number 06011.R4 8/10.

ORDERING INFORMATION					
BASE PART NUMBER (xx = Voltage)	LEADFREE SUFFIX	TAPE SUFFIX	QTY/REEL	REEL SIZE	TUBE QTY
USB04xx/USB04xxC	-LF	-T7	3000	7"	n/a
USB04xx/USB04xxC	-LF	-T13	10,000	13"	n/a

This device is only available in a Lead-Free configuration.

COMPANY INFORMATION

COMPANY PROFILE

In business more than 20 years, ProTek Devices™ is a privately-held company located in Tempe, Arizona, that offers a product line of transient voltage suppressors (TVS); avalanche breakdown diodes; steering diode TVS arrays and other surge suppressor component products. These TVS devices protect electronic systems from the effects of lightning, electrostatic discharge (ESD), nuclear electromagnetic pulses (NEMP), inductive switching and EMI / RFI. ProTek Devices also offers high performance interface and linear products that include analog switches; multiplexers; LED drivers; audio control ICs; RF and related high frequency products. The analog devices work in a host of consumer; industrial; automotive and other applications.

CONTACT US

Corporate Headquarters
2929 South Fair Lane
Tempe, Arizona 85282
USA

By Telephone
General: 602-431-8101
Sales: & Marketing: 602-414-5109
Customer Service: 602-414-5114
Product Technical Support: 602-414-5107

By Fax
General: 602-431-2288

By E-mail:
Sales: sales@protekdevices.com
Customer Service: service@protekdevices.com
Technical Support: support@protekdevices.com

ProTek Devices (Asia Pacific) Pte. Ltd.
8 Ubi Road 2, #06-19
Zervex
Singapore - 408538
Tel: +65-67488312
Fax: +65-67488313

Web
www.protekdevices.com