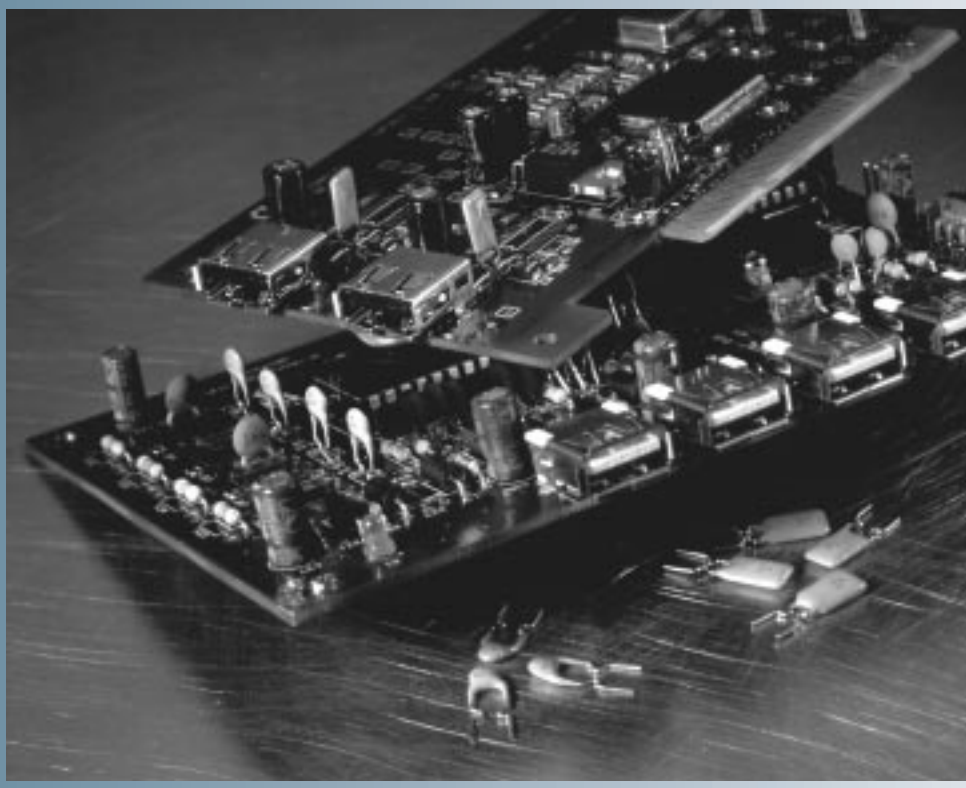
Raychem

PolySwitch Resettable Fuses

New RUSB products provide lower resistance and faster trip times



PolySwitch RUSB devices designed to meet all USB overcurrent requirements

New PolySwitch RUSB devices are designed to meet USB and safety agency requirements. The RUSB family of leaded resettable fuses offers overcurrent protection for USB applications.

The low resistance, fast trip times, and tight trip-to-hold ratio of these devices provide flexibility for designers. The RUSB product family is available in a range of currents, from 0.75 to 2.5 amps and has a 6-volt/40-amp rating.

Features
- Low resistance
- Fast trip times
- Tighter trip-to-hold ratio

Benefits
- Meets voltage droop requirements
- Meets voltage-output limits
- Suitable in low- and high-wattage power supplies
- Suitable for self-powered and bus-powered hub port protection.

ISO 9001

USB requirements

Overcurrent protection

The USB Specification 1.0 states that overcurrent protection is required to prevent damage in the event of:

- catastrophic device failure
- software error
- user action, such as shorting of pins

Section 7.2.1 of the specification delineates the following USB overcurrent protection requirements:

- The host and all self-powered hubs must implement overcurrent protection for safety reasons.
- The overcurrent value cannot exceed 5 A.
- The host and all self-powered hubs must have a way to detect an overcurrent condition and report it to the hub controller.

Voltage output

The USB Specification requires a minimum port output voltage (V_{OUT}) in two locations on the bus: 4.75 V out of a self-powered hub port and 4.40 V out of a bus-powered hub port. The two following tables show how typical designs meet USB voltage-drop requirements.

Self-Powered Hub *(individual port protection)*		
Power supply		5.000 V
Trace	20 mΩ x 0.5 A =	0.010
Ferrite bead	5 mΩ x 0.5 A =	0.003
RUSB120	80 mΩ x 0.5 A =	0.040
V_{OUT}		4.947 V

Bus-Powered Hub *(individual port protection)*		
Upstream V_{MIN}		4.750 V
Cable/connectors	500 mΩ x 0.5 A =	0.250
Trace	5 mΩ x (0.5 A & 0.1 A) =	0.002
Ferrite bead	5 mΩ x 0.1 A =	0.001
FET	80 mΩ x 0.4 A =	0.032
RUSB075	150 mΩ x 0.1 A =	0.015
V_{OUT}		4.450 V

Voltage droop

Voltage droop occurs during a hot-plug event resulting from the connection of a peripheral and its uncharged input bulk capacitance to a USB port. Test results (shown below) on a range of devices demonstrate that PolySwitch devices meet the USB Specification's voltage droop requirement of 0.330 V maximum for host/self-powered hubs and bus-powered hubs.

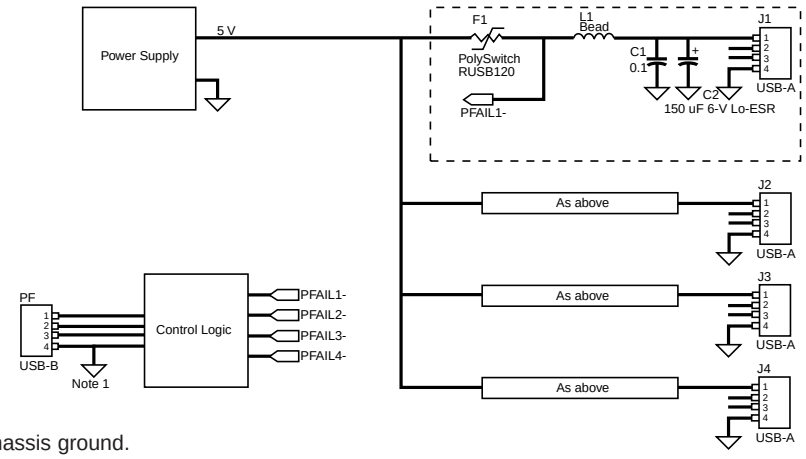
Device	Vdroop (V)	Powered hub	Port protection
RUSB075	0.116	Self or bus	Individual
RUSB120	0.140	Self	Individual
RUSB250	0.196	Self	Ganged

PolySwitch RUSB family advantages

- Conformity with USB Specification 1.0
- Compliance with:
  —UL1950/IEC950 safety requirements
  —Windows 95 and PC98 standards
- Resettable protection
- UL recognized safety device
- Highest reliability
- Lowest-cost solution

Hub designs using PolySwitch devices

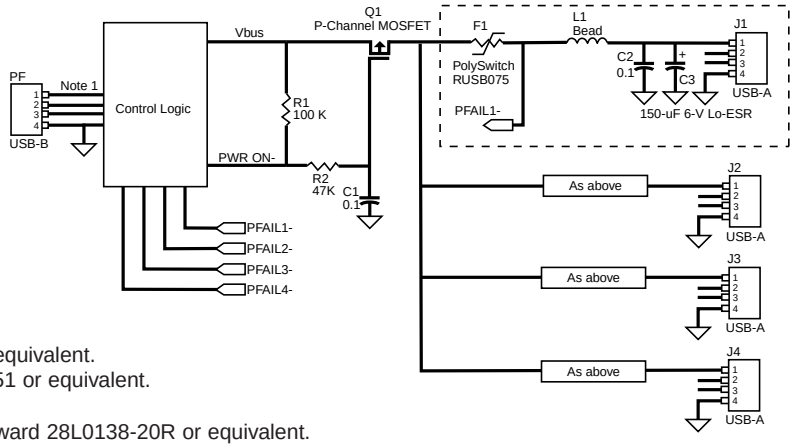
Self-powered hub design



Note 1: Ground is common power/signal ground, not host chassis ground.
Ground is referred to host Vbus cable ground only.
Note 2: Only Vbus power connections shown.

C1, C2, C5, C7	Panasonic ECUS1J104MEA or equivalent.
C2, C4, C6, C8	150-µF Lo-ESR Panasonic EEUFA1V151 or equivalent.
F1, F2, F3, F4	Raychem RUSB120 PolySwitch device.
L1, L2, L3, L4	Ferrite bead >50 ohms at 100-MHz Steward 28L0138-20R or equivalent.

Bus-powered hub design



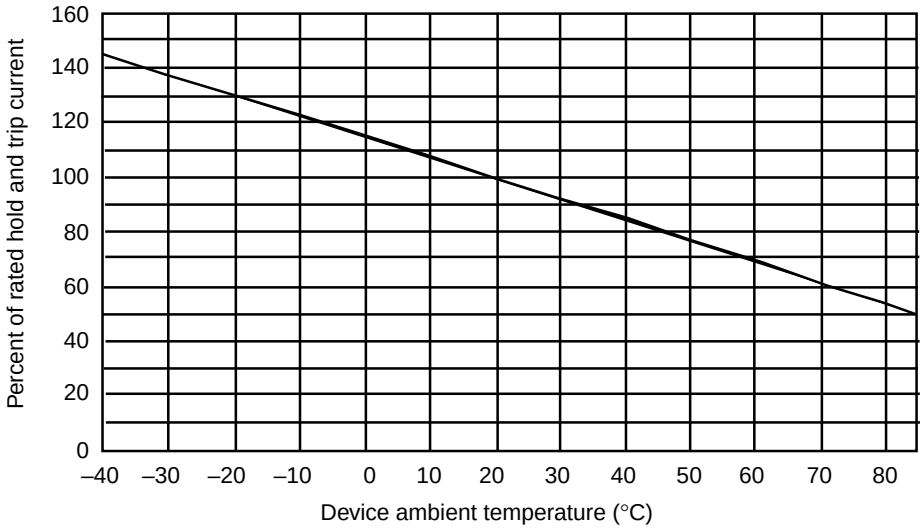
R1	100 K 1/8 W 10%
R2	47K 1/8 W 10%
C1, C2, C4, C6, C8	0.1 µF Panasonic ECUS1J104MEA or equivalent.
C3, C5, C7, C9	150-µF Lo-ESR Panasonic EEUFA1V151 or equivalent.
F1, F2, F3, F4	Raychem RUSB075 PolySwitch device.
L1, L2, L3, L4	Ferrite bead >50 ohms at 100-MHz Steward 28L0138-20R or equivalent.
Q1	P-channel logic MOSFET Temic Si9434DY or equivalent.

RUSB product data

This section provides the following product data for RUSB devices:

- Thermal derating curve
- Product dimensions
- Electrical characteristics
- Time-to-trip curve
- Physical characteristics
- Environmental characteristics
- Ordering information
- Part numbering system
- Part marking system

RUSB thermal derating curve



Product dimensions (millimeters/*inches*)

Operating/storage temperature range: –40°C to 85°C
Device surface temperature in the tripped state: 125°C

Figure 1

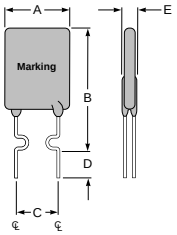
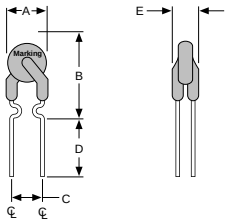


Figure 2



	A	B	C		D	E	
	max.	max.	min.	max.	min.	max.	Fig.
RUSB075	6.9 *(0.27)*	11.4 *(0.45)*	4.3 *(0.17)*	5.9 *(0.23)*	7.6 *(0.30)*	3.1 (*0.12)*	2
RUSB090	7.4 *(0.29)*	12.2 *(0.48)*	4.3 *(0.17)*	5.9 *(0.23)*	7.6 *(0.30)*	3.1 (*0.12)*	1
RUSB110	7.4 *(0.29)*	14.2 *(0.56)*	4.3 *(0.17)*	5.9 *(0.23)*	7.6 *(0.30)*	3.1 (*0.12)*	1
RUSB120	6.9 *(0.27)*	11.7 *(0.46)*	4.3 *(0.17)*	5.9 *(0.23)*	7.6 *(0.30)*	3.1 (*0.12)*	2
RUSB135	8.9 *(0.35)*	13.5 *(0.53)*	4.3 *(0.17)*	5.9 *(0.23)*	7.6 *(0.30)*	3.1 (*0.12)*	1
RUSB160	8.9 *(0.35)*	15.2 *(0.60)*	4.3 *(0.17)*	5.9 *(0.23)*	7.6 *(0.30)*	3.1 (*0.12)*	1
RUSB185	10.2 *(0.40)*	15.7 *(0.62)*	4.3 *(0.17)*	5.9 *(0.23)*	7.6 *(0.30)*	3.1 (*0.12)*	1
RUSB250	11.4 *(0.45)*	18.3 *(0.72)*	4.3 *(0.17)*	5.9 *(0.23)*	7.6 *(0.30)*	3.1 (*0.12)*	1

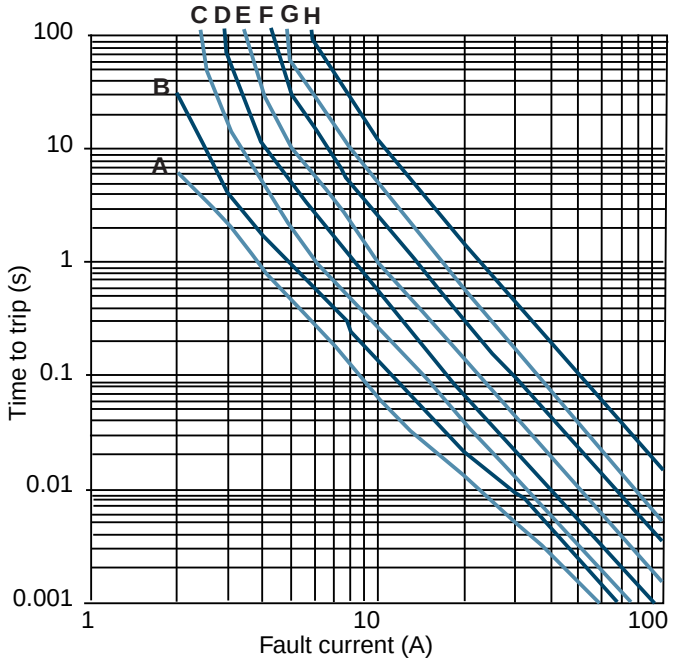
Electrical characteristics (20°C)

Part number	I_H (A)	I_T (A)	Initial resistance R typ. (Ω)	Initial resistance R max. (Ω)	Max. time to trip (s) 2A	3A	8A	P_d (W)
RUSB075	0.75	1.30	0.14	0.23	6.0	2.3	0.4	0.3
RUSB090	0.90	1.80	0.10	0.18	–	–	1.2	0.6
RUSB110	1.10	2.20	0.08	0.14	–	–	2.3	0.7
RUSB120	1.20	2.00	0.08	0.14	30.0	4.0	0.5	0.6
RUSB135	1.35	2.70	0.06	0.12	–	–	4.5	0.8
RUSB160	1.60	3.20	0.05	0.11	–	–	9.0	0.9
RUSB185	1.85	3.70	0.05	0.09	–	–	10.0	1.0
RUSB250	2.50	5.00	0.03	0.06	–	–	40.0	1.2

I_H = Hold current—maximum current at which the device will not trip at 20°C still air.
I_T = Trip current—minimum current at which the device will always trip at 20°C still air.
P_d = Typical power dissipation—typical amount of power dissipated by the device when in tripped state in 20°C still air environment.

Typical time-to-trip curve (20°C)

A = RUSB075
B = RUSB120
C = RUSB090
D = RUSB110
E = RUSB135
F = RUSB160
G = RUSB185
H = RUSB250



Physical characteristics

Lead material	RUSB075: Tin/lead-plated nickel/copper alloy RUSB090-250: Tin/lead-plated copper-clad steel
Soldering characteristics	Solderability per ANSI/J-STD 002 Solder heat withstand per IEC 68-2-20 RUSB120: Test Tb, Method 1a, condition a; can withstand 5 seconds at 260˚C ±5˚C All others: Test Tb, Method 1a, condition b; can withstand 10 seconds at 260˚C ±5˚C
Insulating material	Cured, flame-retardant epoxy polymer; meets UL94V-0 requirements

Agency recognition

UL	File #E74889
CSA	Pending
TÜV	Pending

Environmental characteristics

Test	Test method	Conditions	Resistance change
Passive aging	Raychem PS300	–40°C, 1000 hours	± 10%
		85°C, 1000 hours	± 10%
Humidity aging	Raychem PS300	85°C, 85% R.H., 1000 hours	± 10%
Thermal shock	Raychem PS300	85°C, –40°C (10 times)	± 10%
Solvent resistance	Raychem PS300	MIL-STD-202, Method 215F	No change

Ordering information

Product description	Bag quantity	Tape and reel quantity	AMMO pack	Standard package
RUSB075	500			10,000
RUSB075-2		3000		15,000
RUSB075-AP			2000	10,000
RUSB090	500			10,000
RUSB090-2		3000		15,000
RUSB090-AP			2000	10,000
RUSB110	500			10,000
RUSB110-2		3000		15,000
RUSB110-AP			2000	10,000
RUSB120	500			10,000
RUSB120-2		3000		15,000
RUSB120-AP			2000	10,000
RUSB135	500			10,000
RUSB135-2		3000		15,000
RUSB135-AP			2000	10,000
RUSB160	500			10,000
RUSB160-2		3000		15,000
RUSB160-AP			2000	10,000
RUSB185	500			10,000
RUSB185-2		3000		15,000
RUSB185-AP			2000	10,000
RUSB250	500			10,000
RUSB250-2		3000		15,000
RUSB250-AP			2000	10,000

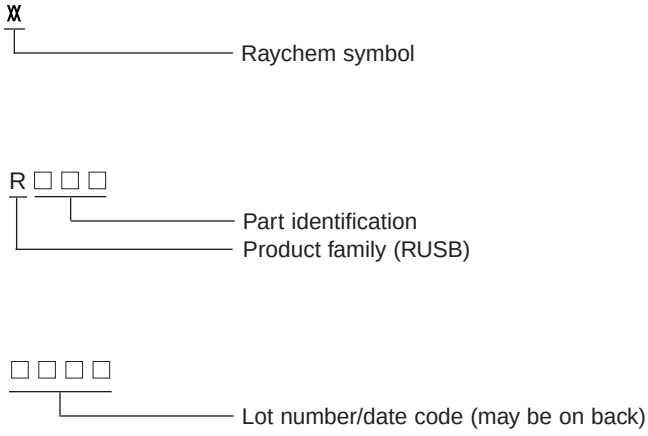
Part numbering system

RUSB □ □ □ suffix

- Blank = Packaged in bags
- -2 = Tape and reel
- -AP = AMMO pack

Current rating

Part marking system



WARNING!

- **Operation beyond maximum ratings or improper use may result in device damage and possible electrical arcing and flame.**
- **These devices are intended for protection against occasional overcurrent fault conditions and should not be used when repeated fault conditions are anticipated.**
- **Operation in circuits with inductive spikes can generate voltages above the rated voltage of the devices, so devices should be evaluated for suitablity of use in such circuits.**

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