BOURNS®

Circuit Protection Products

TBU™ Products Application

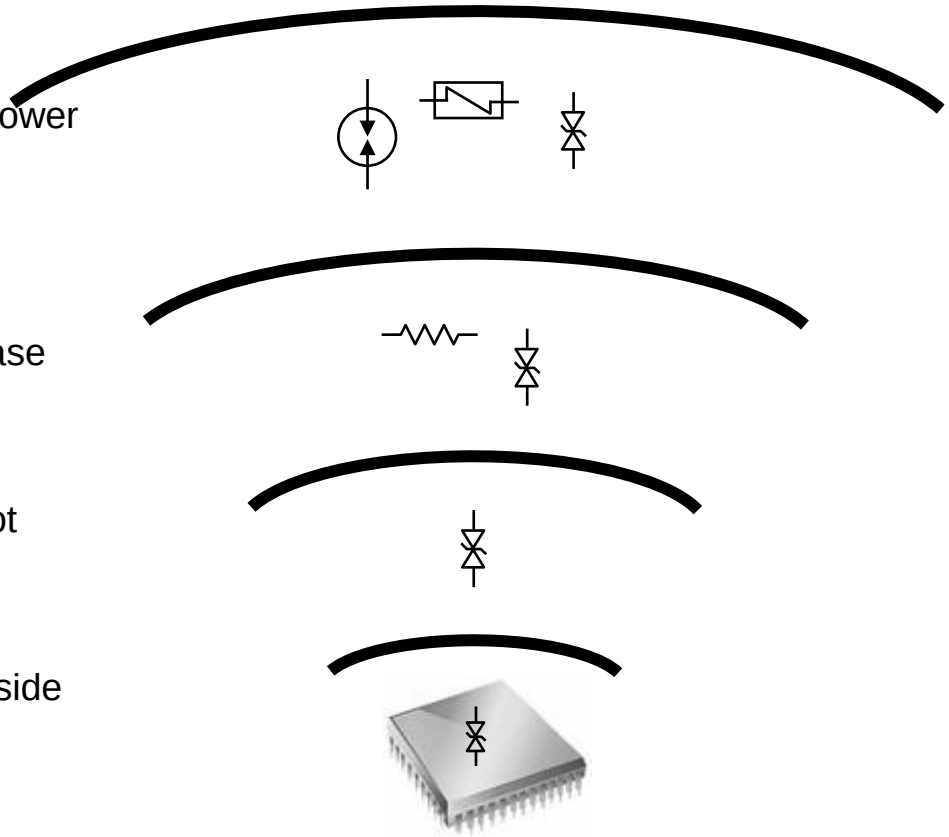
Overview

- **Founded in 1947, Bourns, Inc. is a leading provider of components and solutions for Motion Control, Circuit Protection and Circuit Conditioning**
- **Privately held company headquartered in Riverside, California**
- **Approximately 4200 employees with 12 worldwide manufacturing centers for electronic products**
- **All manufacturing centers are ISO 9001 and/or TS16949 certified**

Levels of Protection

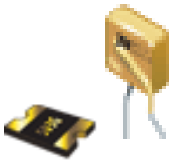
- **The TBU solution provides a higher level of protection**

- High Energy Surge Protection
  - Provides resistibility against lightning and power induced faults
- Moderate Energy Surge Protection
  - Typically need to add components to increase energy resistibility
- Low Energy Surge Protection
  - Basic ESD protection if IC structures are not adequate
- Protected IC
  - Sometimes contains sufficient protection inside the chip for low energy surges



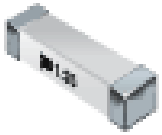
Bourns® Protection Device

Multifuse®



CPTC

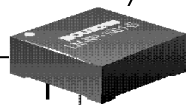
Telefuse™



SinglFuse™

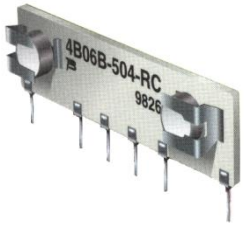
Over Current Protection

Over Voltage Protection



Magnetics

LSP



TBU™

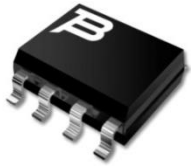
LPM

TCS™

OSP

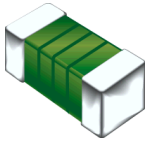
MOV

GDT



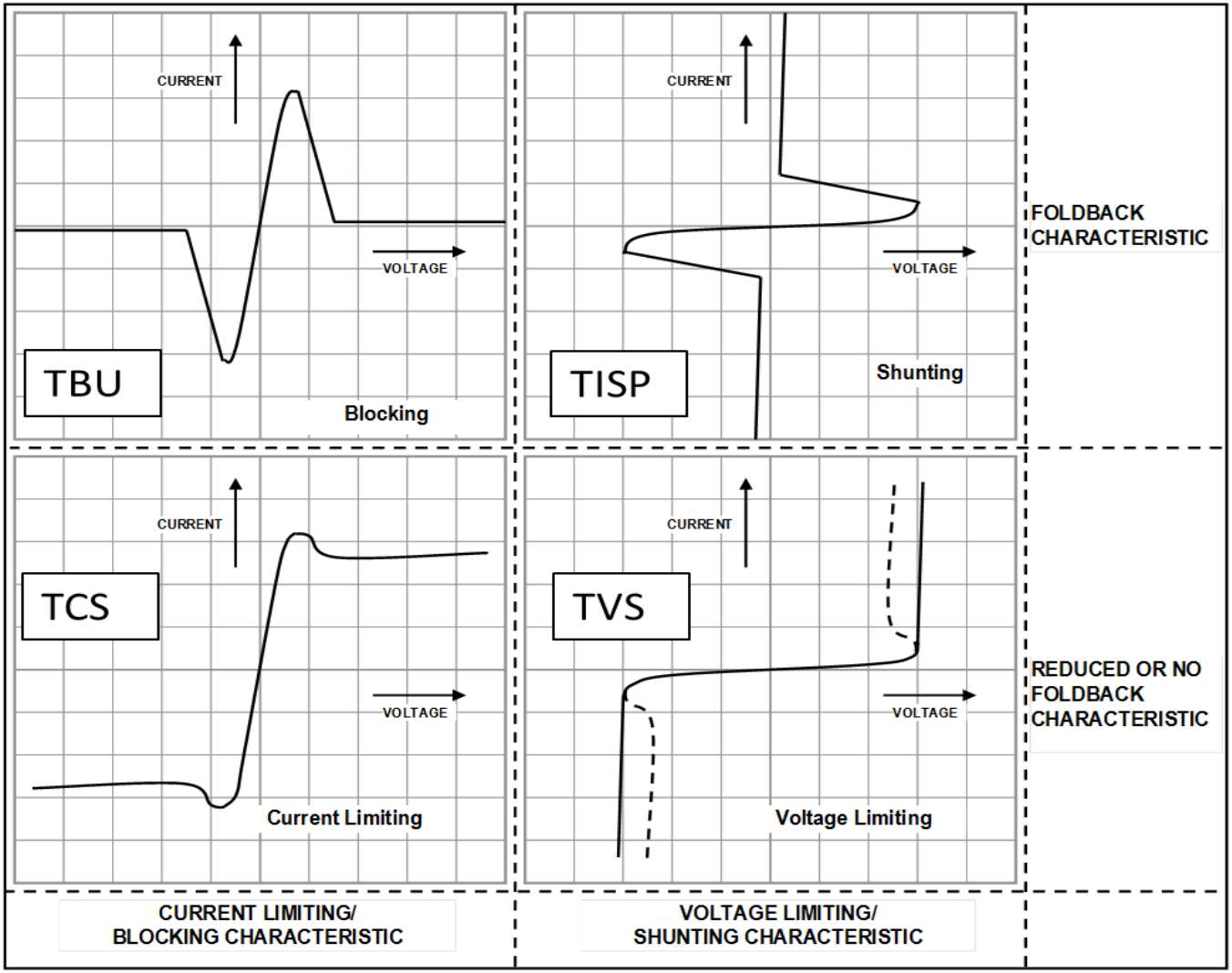
TISP®

TVS



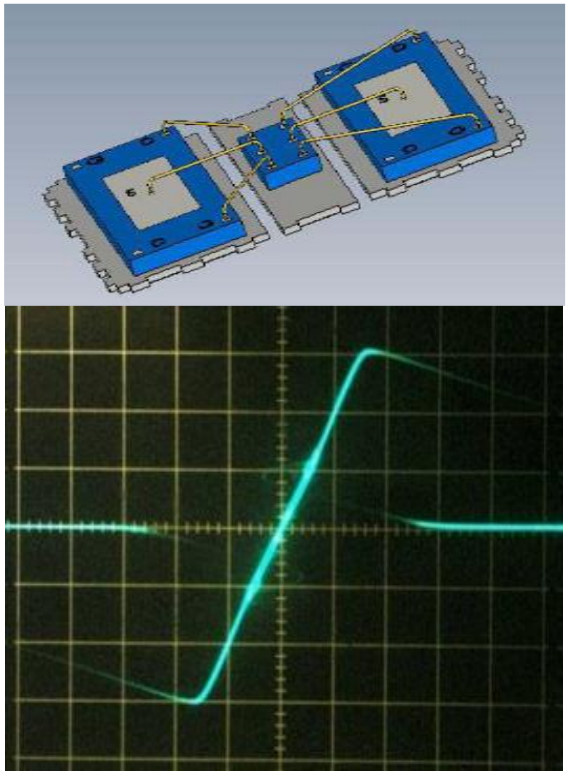
Chip Guard®

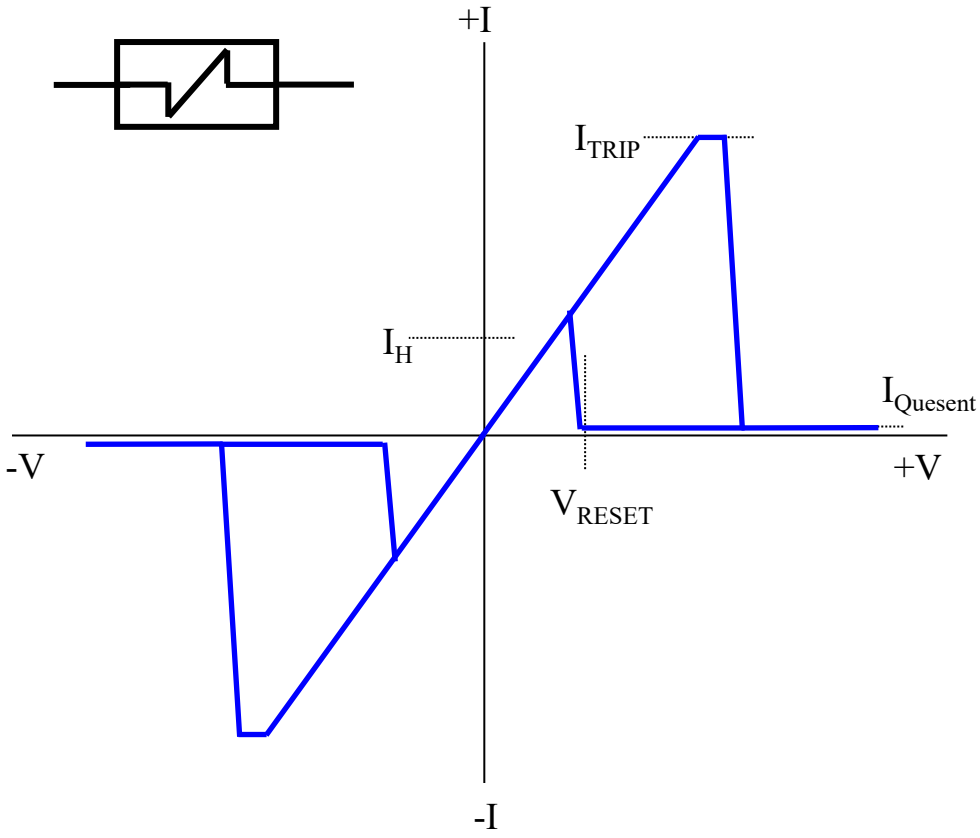
General Characteristics of the Device Types



I-V Characteristic of a TBU™ device

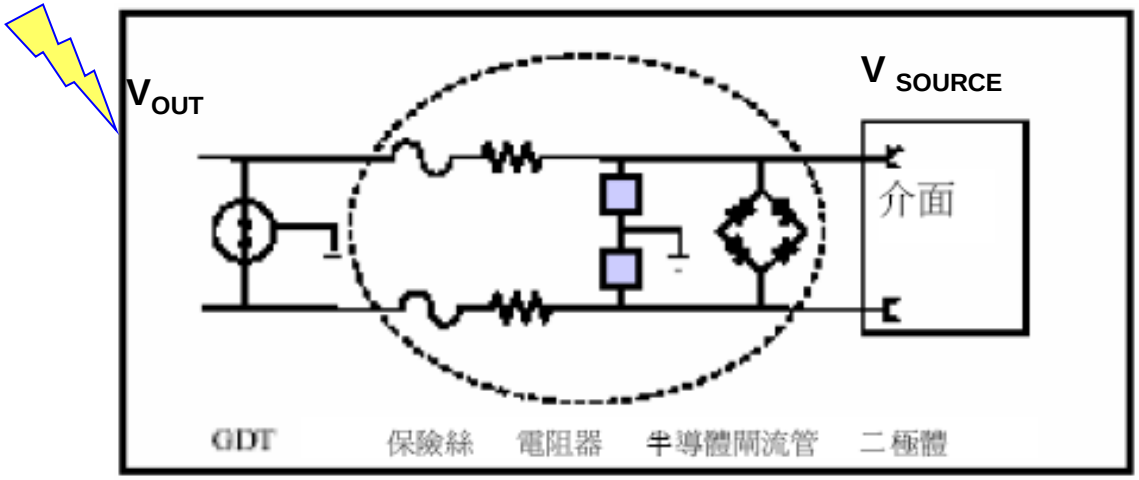
- Below trigger threshold, TBU device acts like a resistor
- Above trigger threshold, TBU acts like a ~1mA current source





Conventional Protection Solution

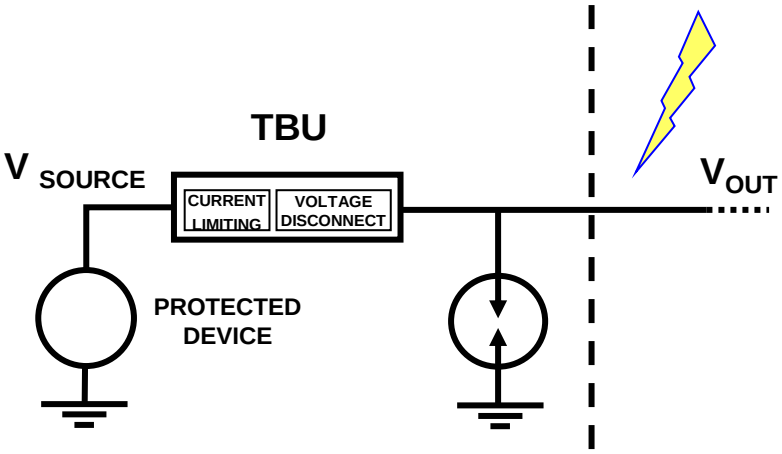
Lightning test circuit

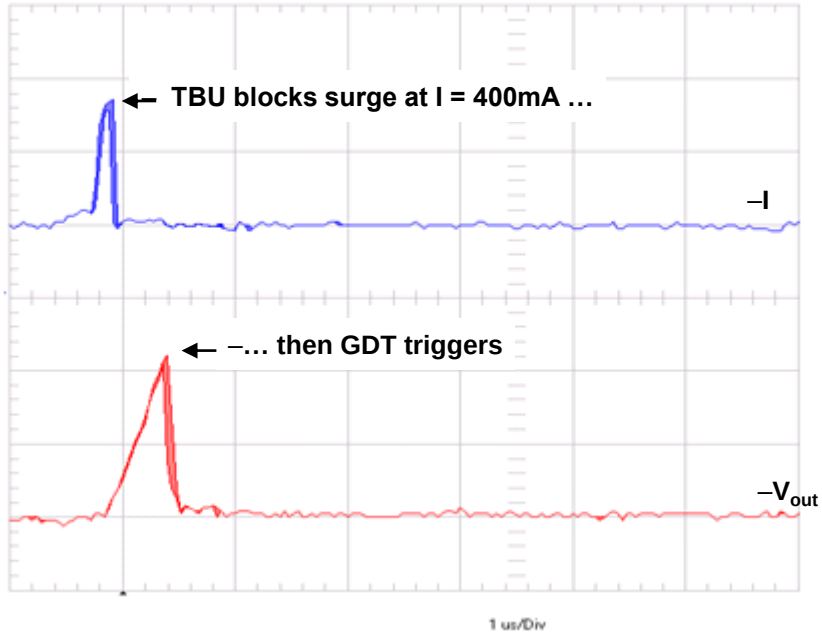


- Circled parts indicating the secondary protection and the Coordinating impedances.

Example: OVP Coordination using a TBU™ device

Lightning test circuit



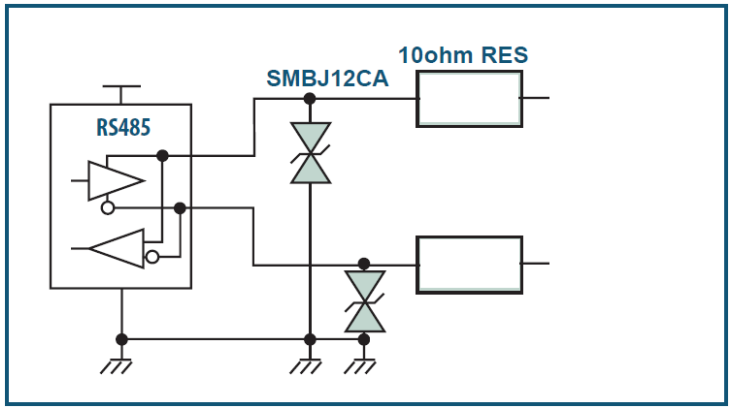


Surge 5000V, 1/50 μsec

TBU Advantages & Benefits

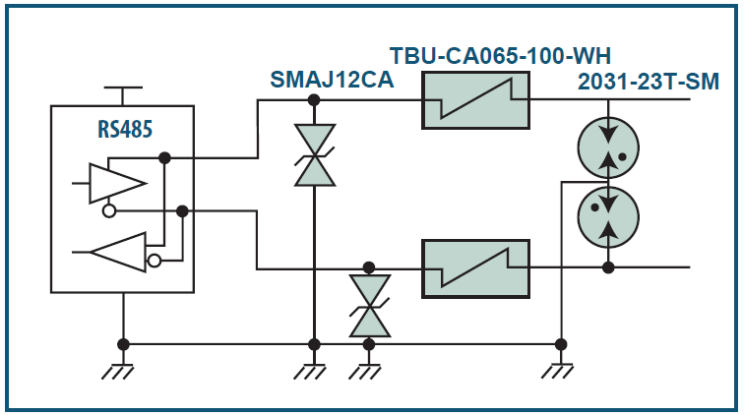
Example: RS485 Port Protection

TVS/Resistor Solution



- Limited Surge Protection
- No AC Power Cross protection
- Non-Resettable
- Fulfills lower tier of protection envelope

TBU solution



- High energy surge protection
- Power cross protection
- Resettable solution
- Works irrespective of surge duration or rate-of-repetition
- No let-thru energy to sensitive chipsets
- Wide operational bandwidth

RS-485 Port Protection Evaluation Board For TBU Solution

Figure 1: RS-485 Evaluation Board Schematic

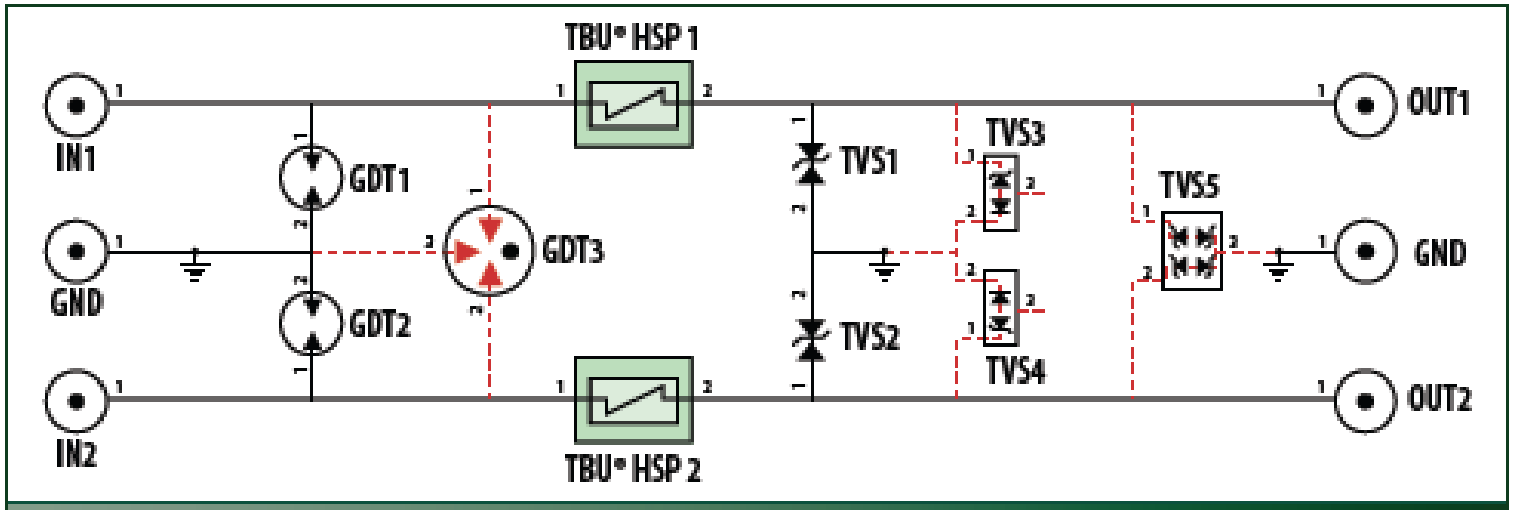


Figure 2: RS-485 Evaluation Board 1

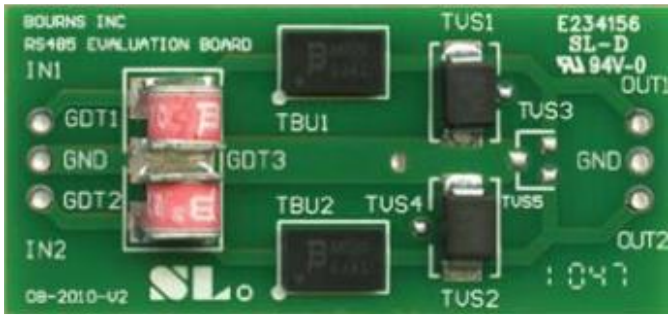
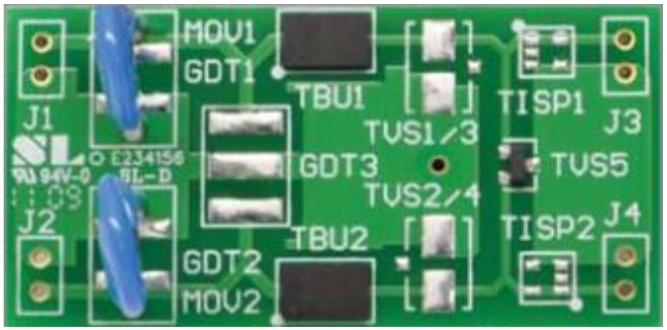


Figure 3: RS-485 Evaluation Board 2



ADI RS-485 Evaluation Board

Features:

- Cost-efficient, three panel board
- Tests circuits at the beginning of the design cycle
- Use of schematics and layout as a starting point in your design
- Certified to protect ADI's ADM3485E, 3.3 V RS-485 transceiver for:
  - 6 kV, 4 kV and 1 kV Surge (IEC 61000-4-5)
  - 15 kV Air Discharge ESD (IEC 61000-4-2)
  - 2 kV EFT and 8 kV Contact (IEC 61000-4-4)
- The ezLINX™ iCoupler® Isolated Interface Development Environment

For more information:

- Visit http://www.bourns.com/adi_board
- Register to watch the webcast, Safeguarding RS485 Communication Networks from Harmful EMC Events, on March 27, 2013

The evaluation boards are now available through select authorized distributors of Bourns and ADI.

Should you have any questions or need additional information, please contact Bourns Customer Service/Inside Sales or ADI Technical Support.

LVDS Protection

- TBU devices have been evaluated and recommended by National Semiconductor for LVDS applications
  - Tested to 3 Gbps up to 100 meters

National Semiconductor
The Sight & Sound of Information

www.national.com

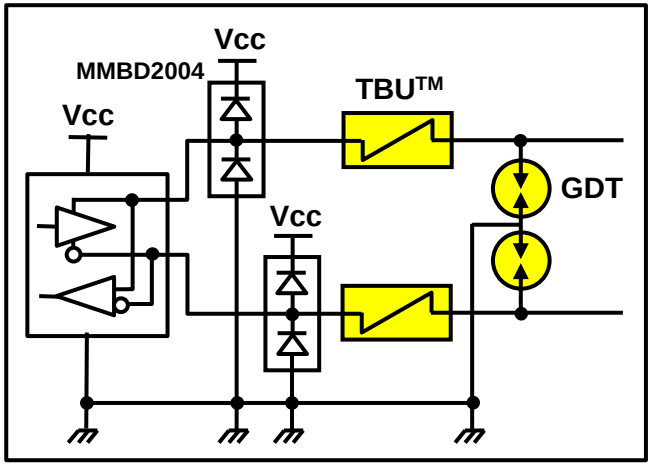
Signal Integrity Evaluation of Bourns Lightning Protection Solutions

Bourns lightning protection solutions suitable for National Semiconductor's high speed interface devices consist of gas discharge tubes (GDT) and transient blocking unit (TBU™) protectors. Table 1 summarizes common lightning protection standards in the industry and Bourns devices suitable for each of the standards.

	GR-1089 Intra-B	GR-1089 Intra-B Enhanced	IEC61000-4-5 Class 0-3	IEC61000-4-5 Class 4-5	ITU-T K.21
Lightning	800V/100A Diff 1500V/100A Com	5000V/500A	2000V/48A	4000V/95A	6000V/150A
Power Cross	120V	230V	-	-	230V
TBU	C650	C850	C650	C850	C850
GDT	G5500AS	G5200AS	G5500AS	G5200AS	G5200AS
Resistance	10Ω	14Ω	10Ω	14Ω	14Ω
Capacitance	1 pF	1 pF	1 pF	1 pF	1 pF

Table 1. Common Lightning Protection Standards and Recommended Bourns Solutions

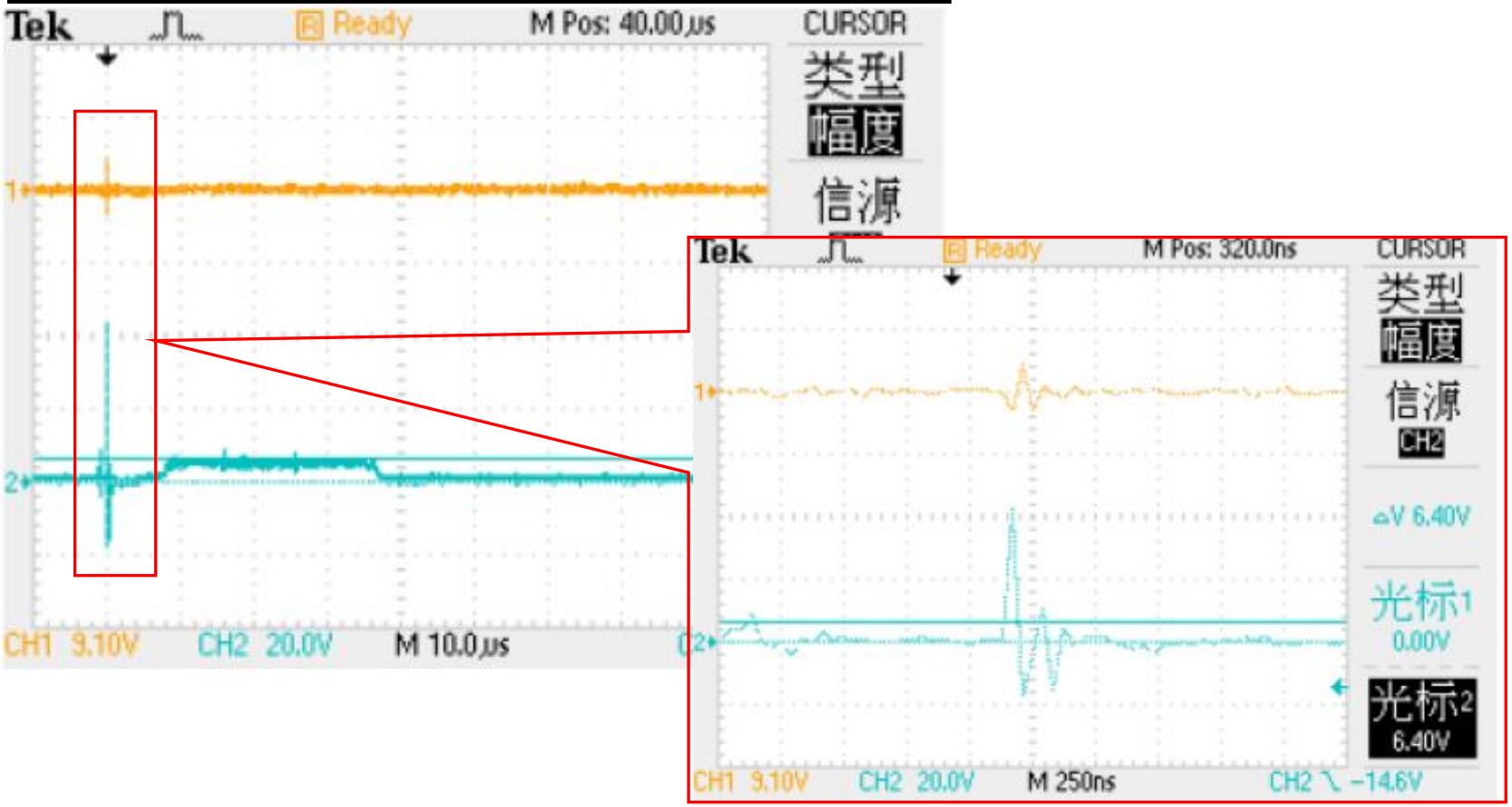
Excerpt from National Semiconductor white paper



- **TBU and GDT device selection are per the required protection level**

TBU-CA Solution for RS485

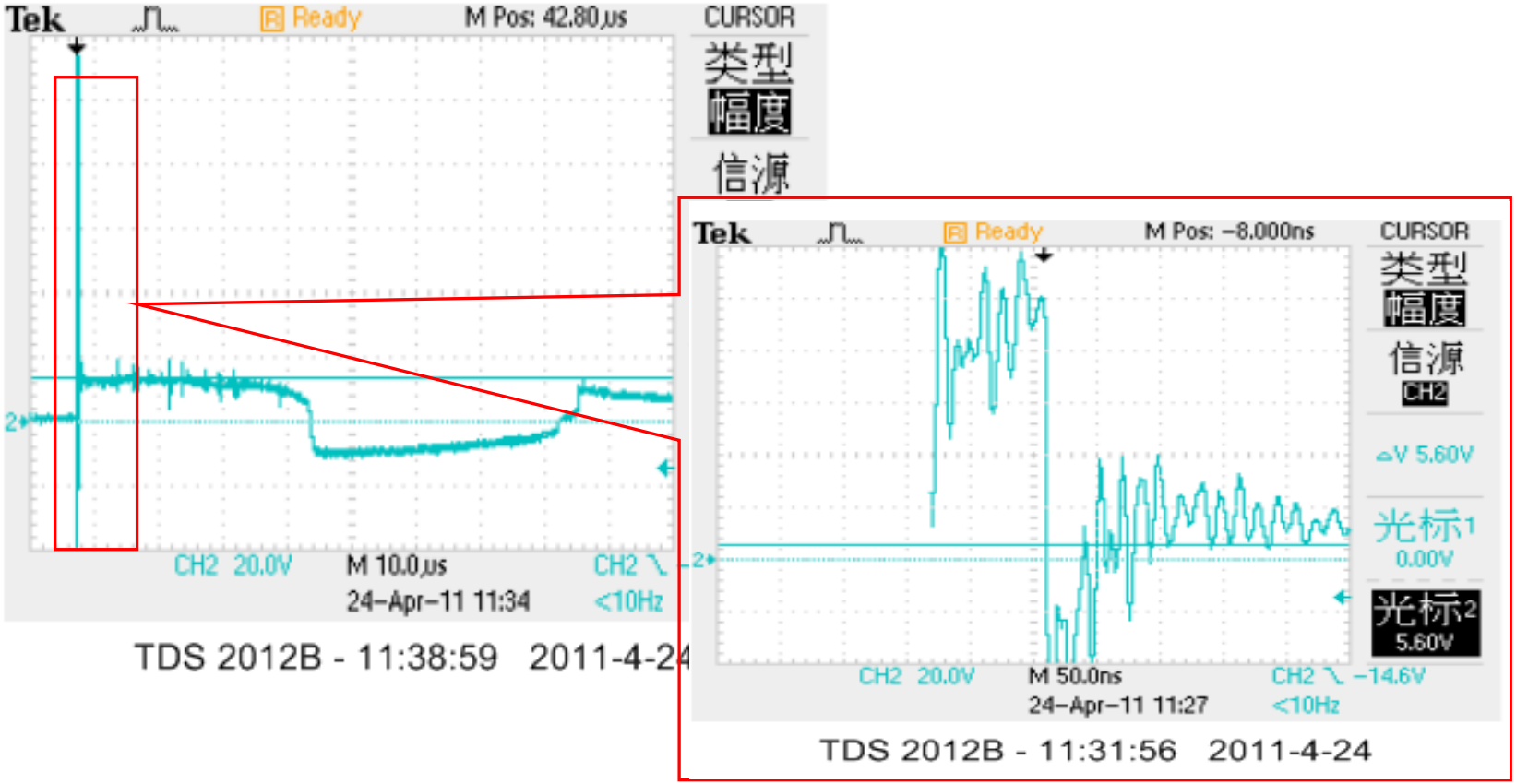
Lightning: 8/20μs,20kV, 10kA



Conventional Vedio Protection Solution

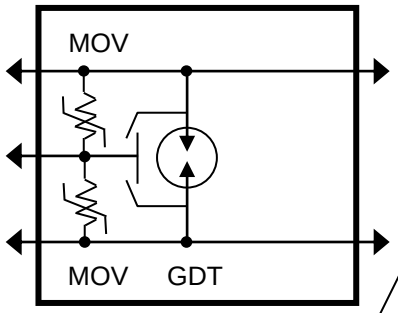
——(GDT+PR+TVS)

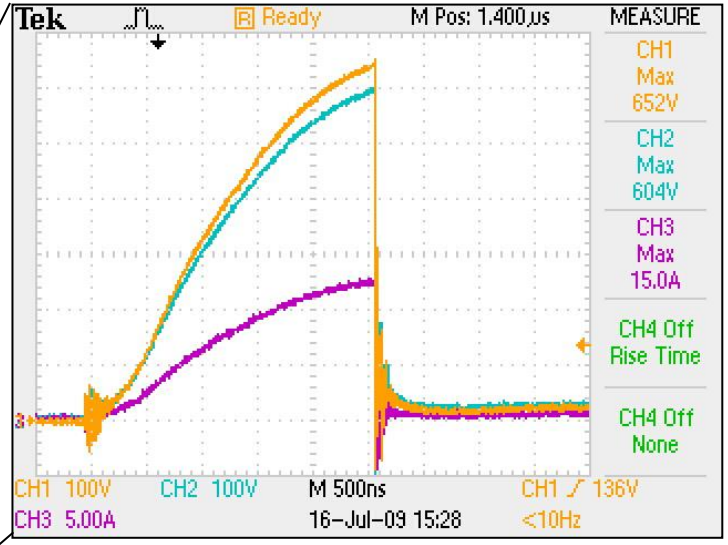
Lightning: 8/20μs,20kV, 10kA



Leading Technology-Integrated MDF Modules

2410





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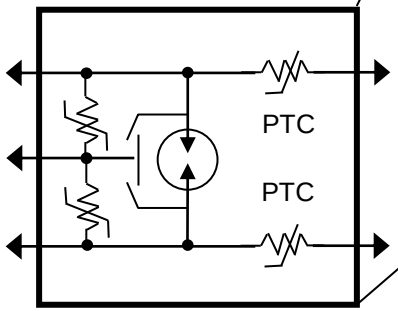

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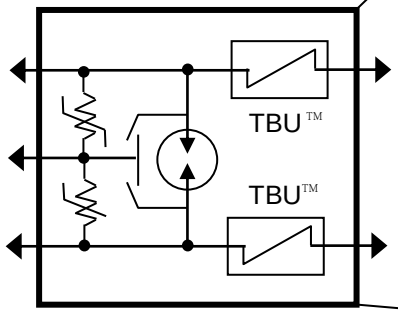
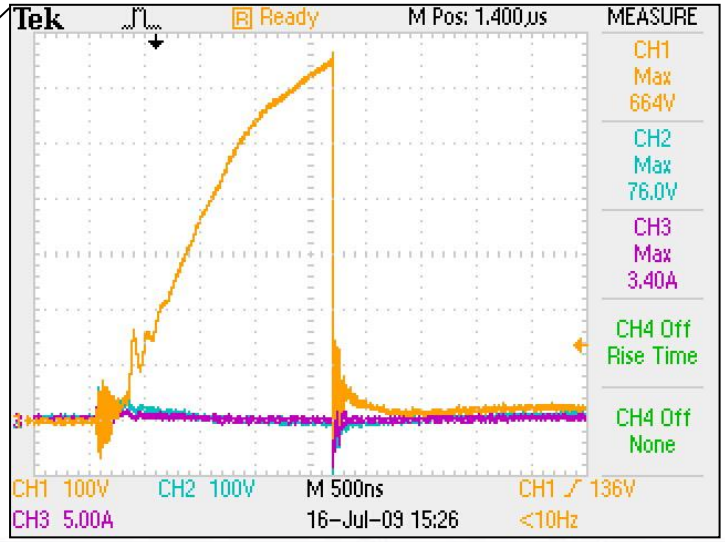
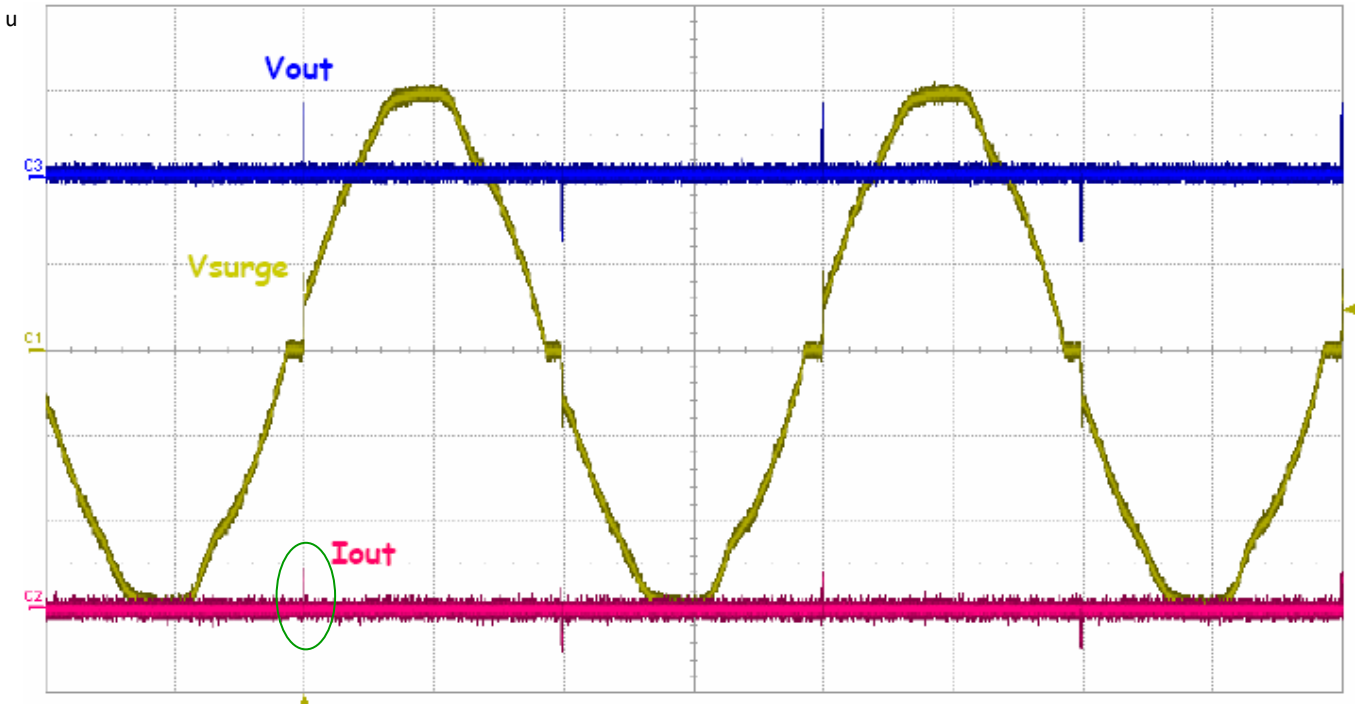




AC Power Cross using a TBU™ device

- **During power cross, the TBU device turns on and off every cycle:**



V_{SURGE}	: 100V/div	5ms/div
I_{OUT}	: 1A/div	5ms/div
V_{OUT}	: 5V/div	5ms/div

Vout determined by the load resistance and TBU trip current:

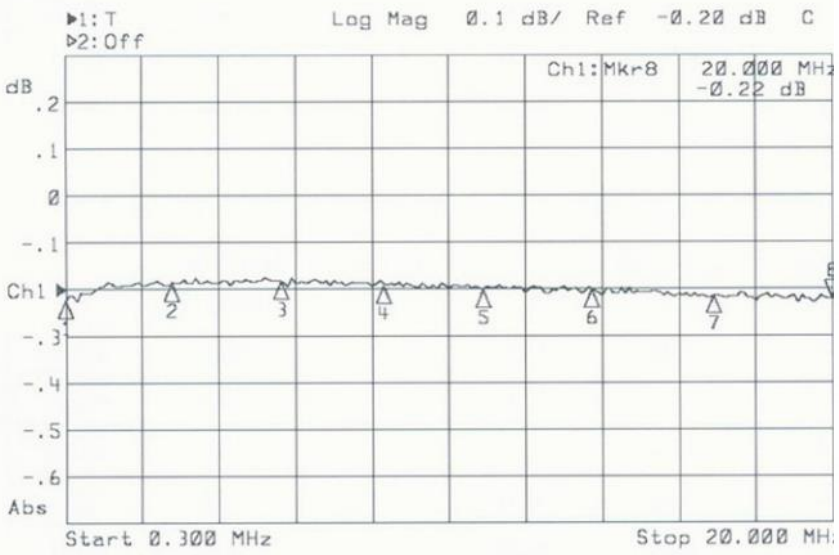
Vout = Iout * Rload

Bandwidth using a TBU™ device

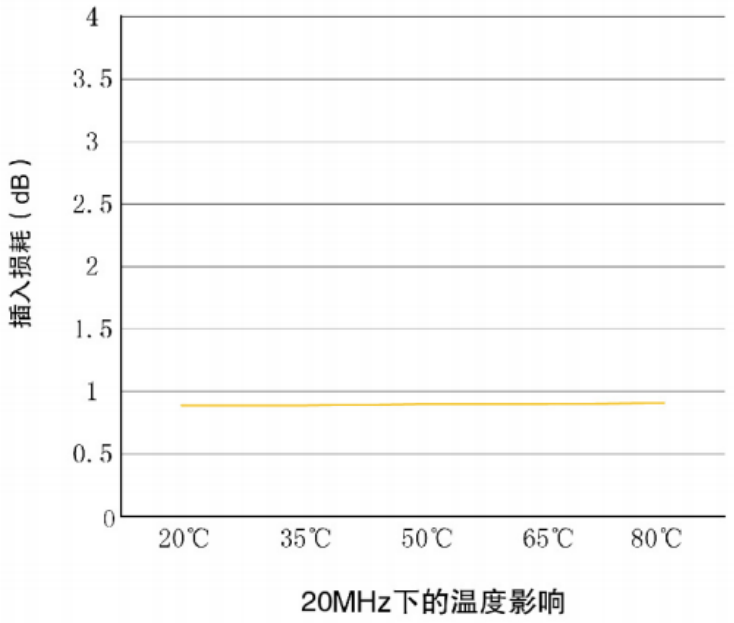
- **Insertion Loss of two C850-260-WH TBU devices in a 50ohm LVDS test circuit**

TBU-CA Solution for RS485

传输特性图（T=25℃，0.3-20MHz）



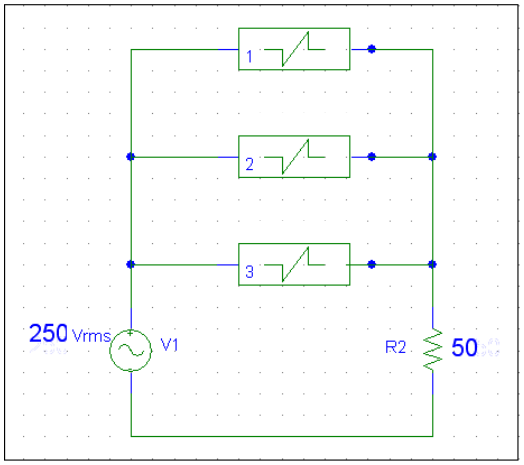
温度特性图（20℃-80℃，20MHz）

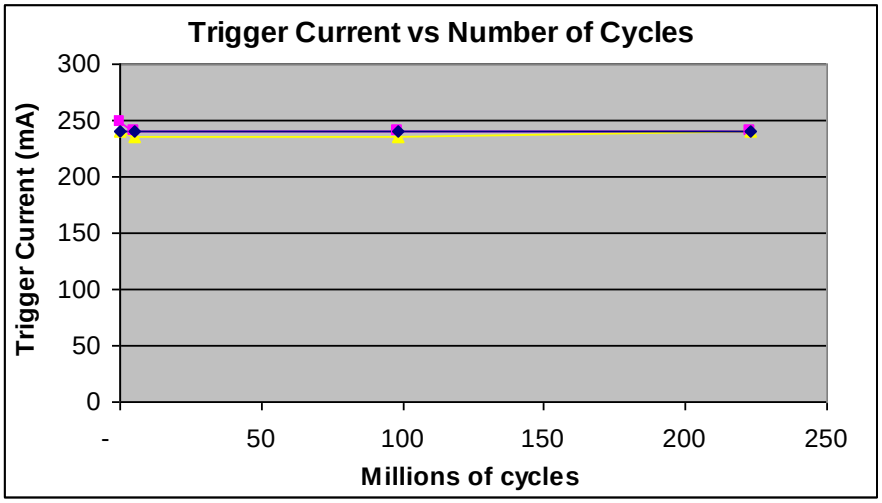


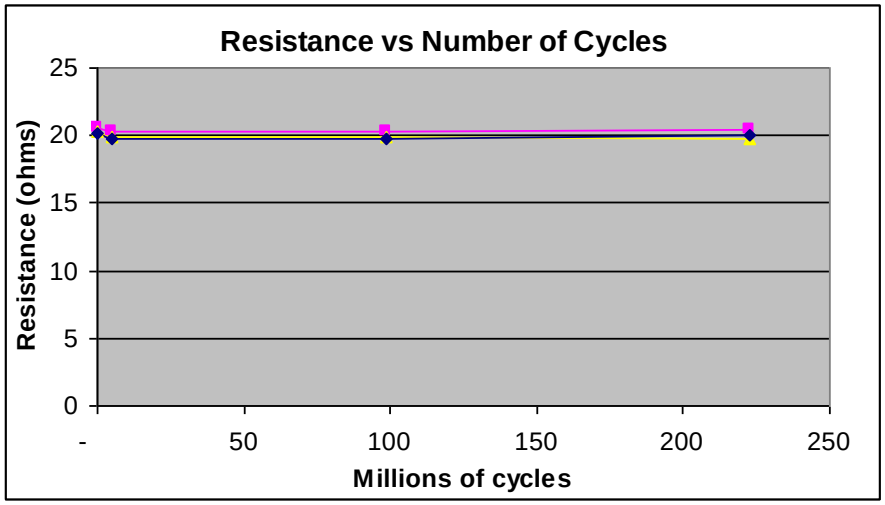
TBU Has Exceptional Stability

Fault cycle test results (UL1434)

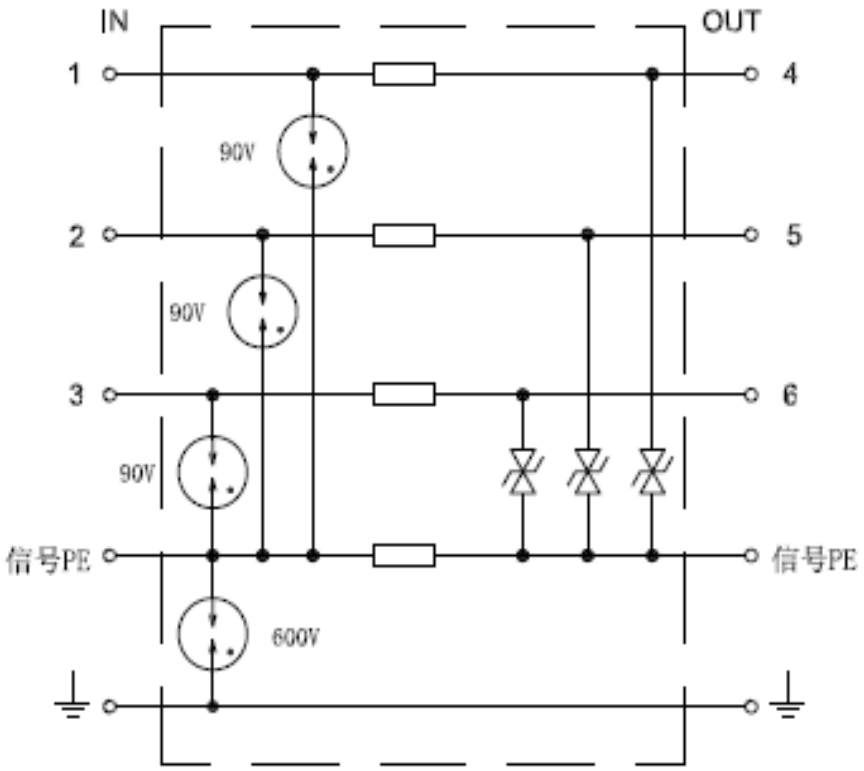
- **250V_{ac}, ~4A fault current, 85° C;**
- **TBU remains <u>unchanged</u> after 200M cycles**

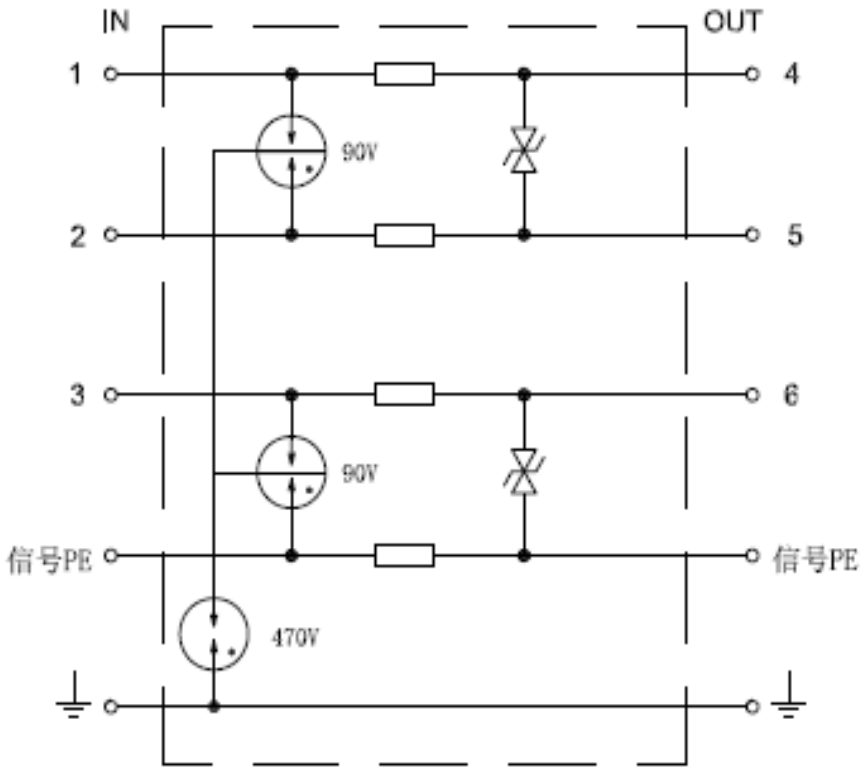




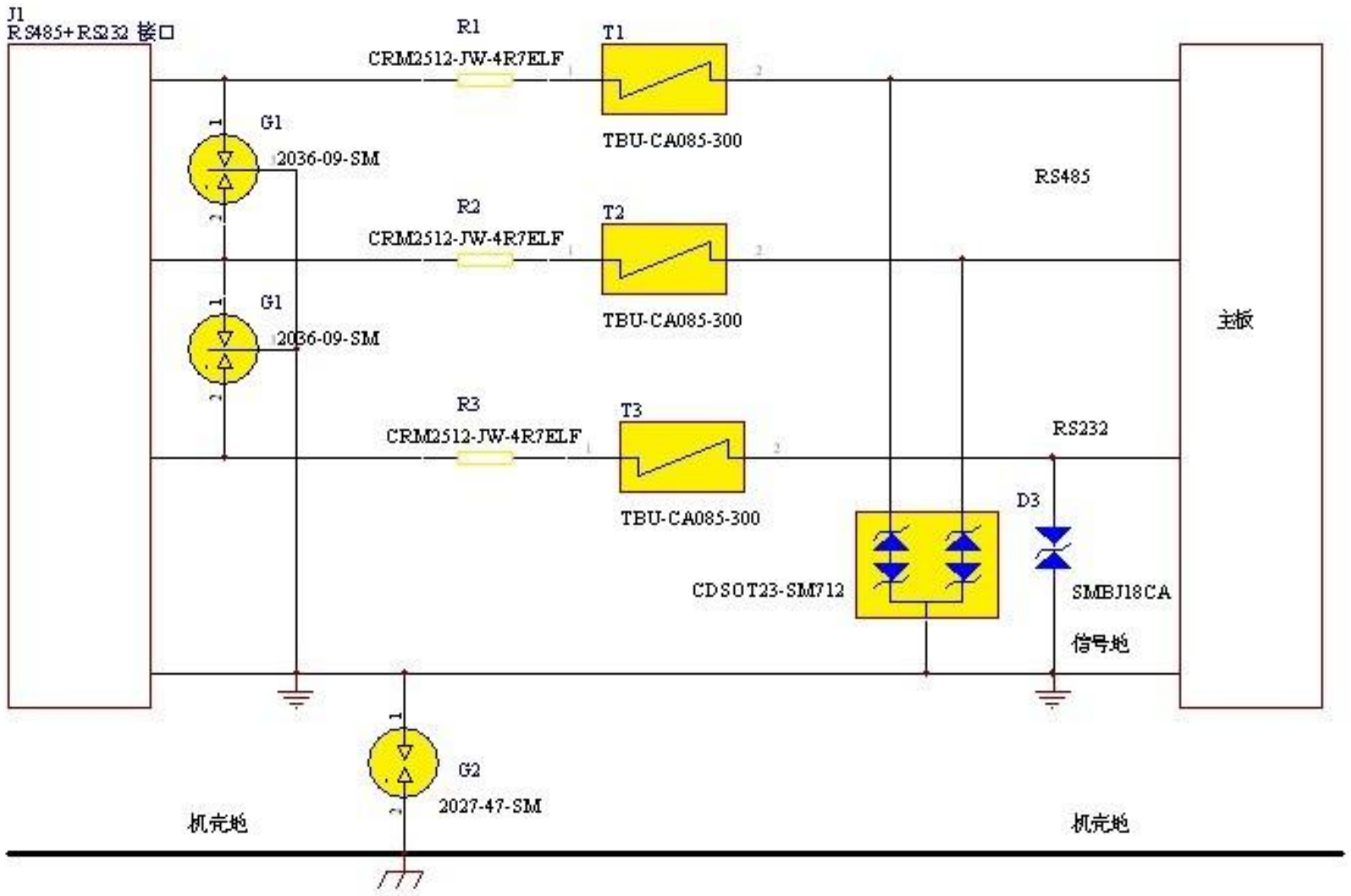


常规500V隔离应用电路图





RS485+RS232复合端口加强浪涌保护方案 (500V隔离)



8/20 us 10KV/5KA浪涌冲击& 500V绝缘耐压测试

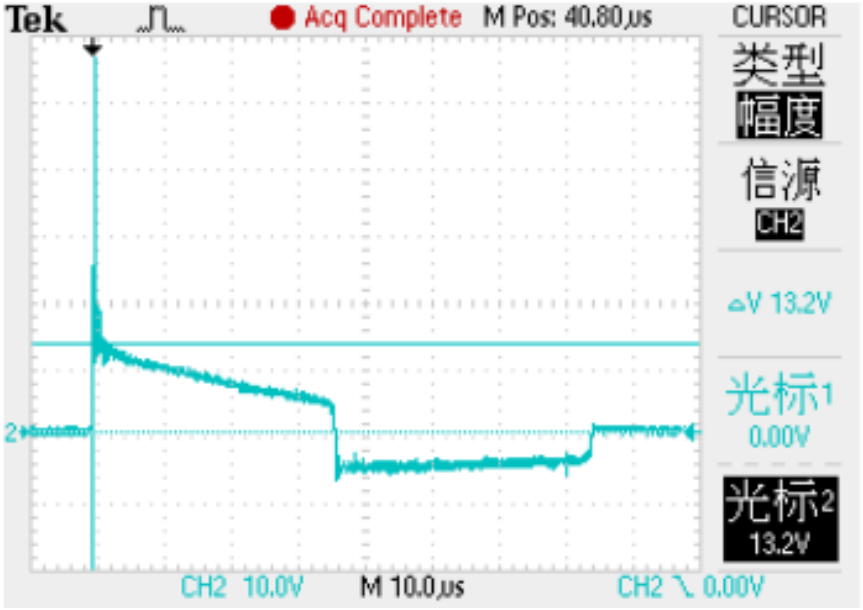


图1：L-L信号到信号地实测残压图

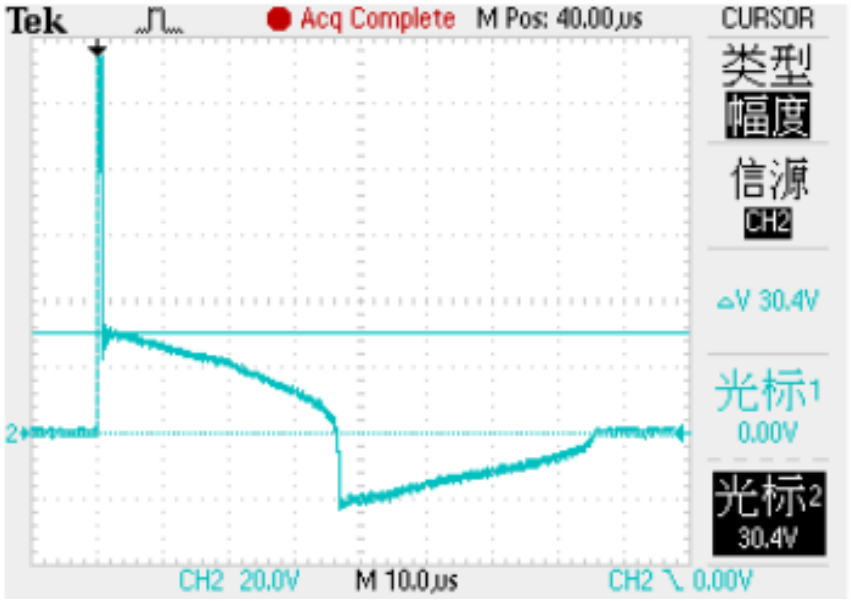
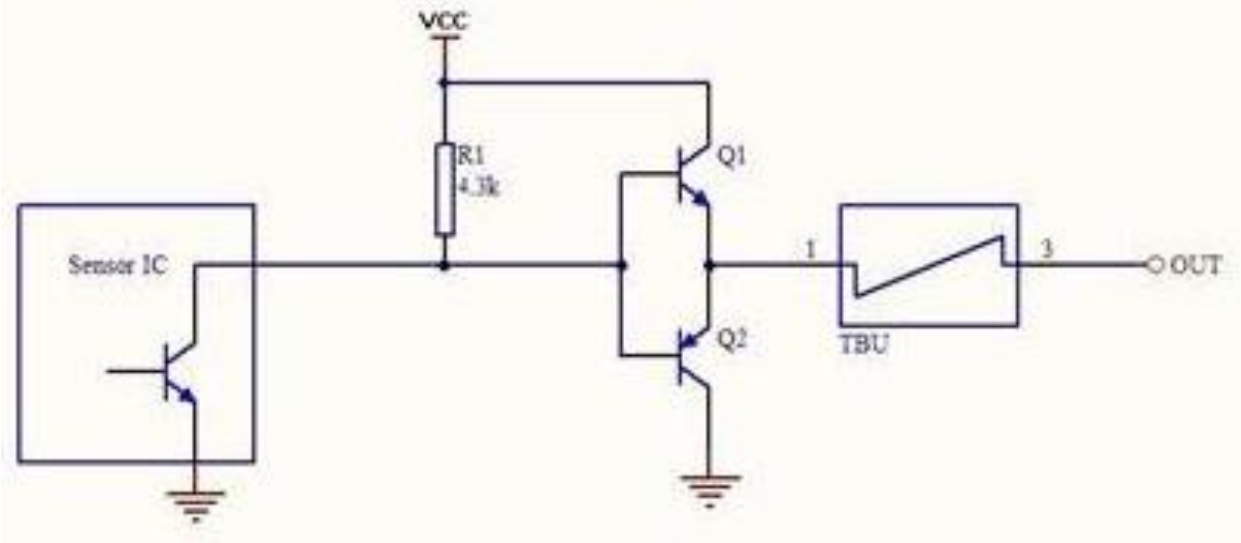


图2：L-PE信号到机壳地实测的残压图

PS: CDSOT23-SM712的正向击穿启动电压为13.3V,反向击穿启动电压为7.5V*2=15V.
因为后端有18V的TVS做钳位，所以信号地上的残压不会很高.

Serial Port Protection Solution

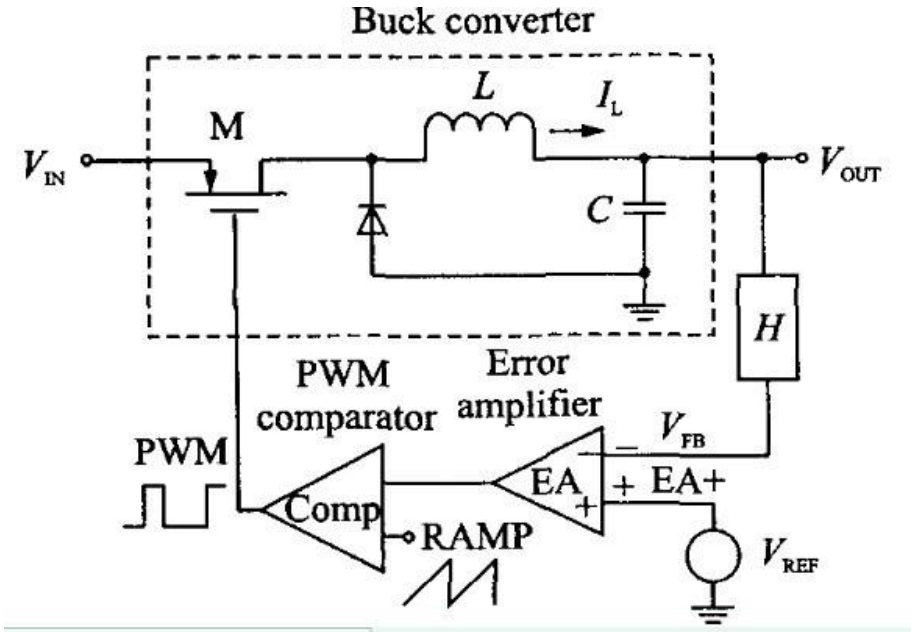
Current Solution: 2*TVS+2*PPTC
Next Solution: P40-G240-WH

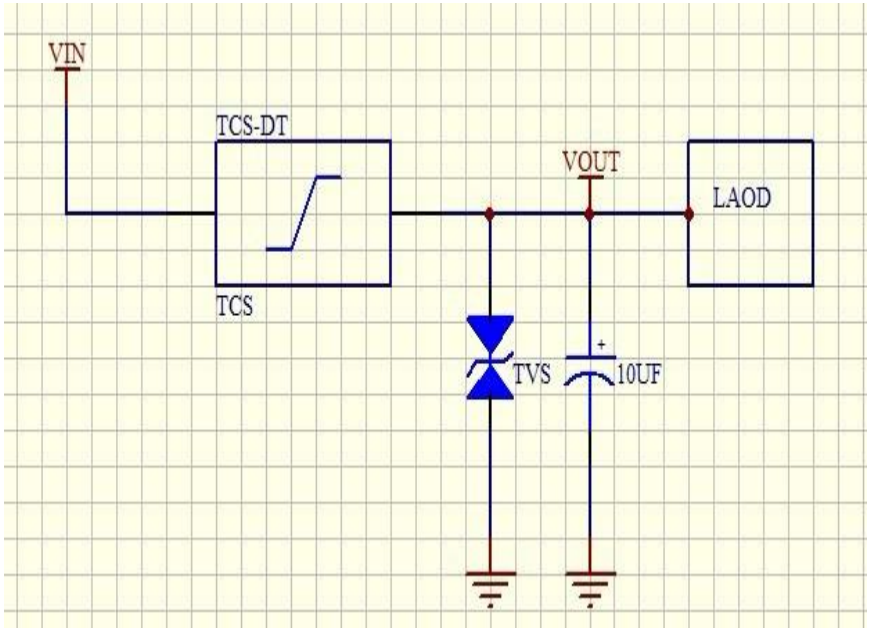


Application: IC's operation voltage is 5V and need pass 12V DC power cross testing

TBU Advantages: High reliability, it can work in a wide range of temperature; Fast response time, the output residual depression and small package size

4~20mA软启动应用电路图

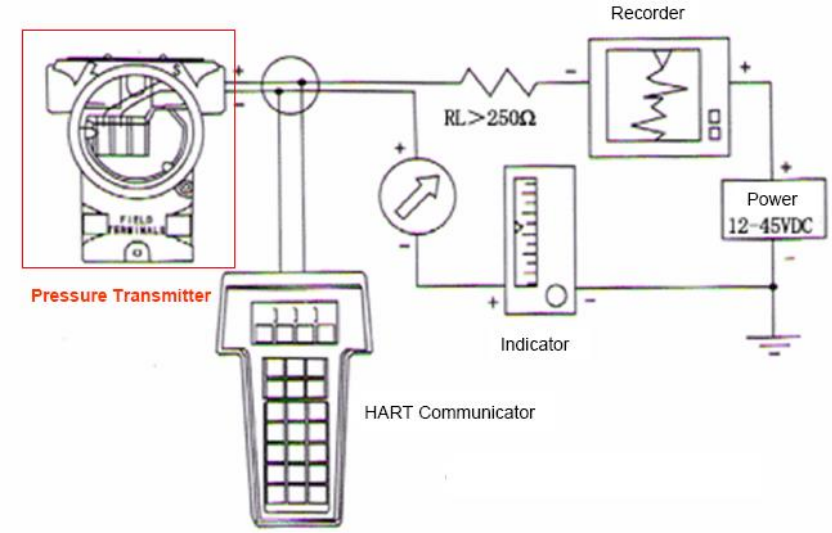


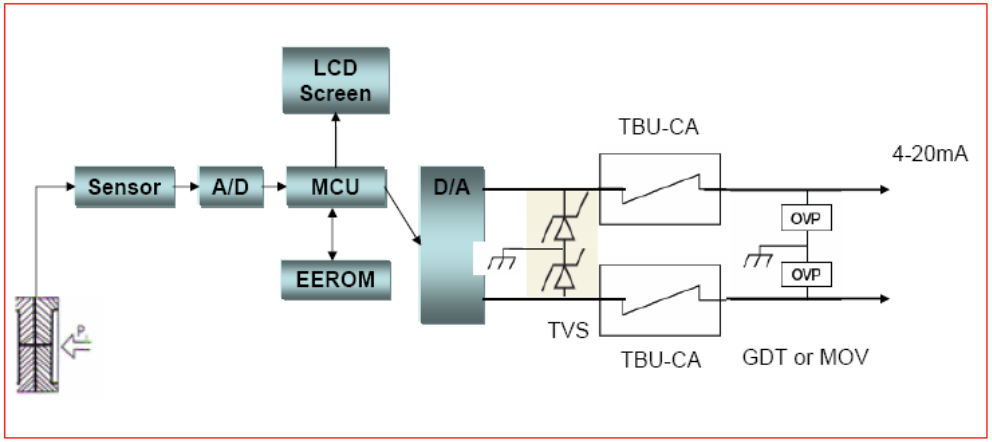


- 传统软启动电路
- 推荐TCS软启动电路

Reference Design for Industrial Applications-3

Pressure Transmitter – HART application





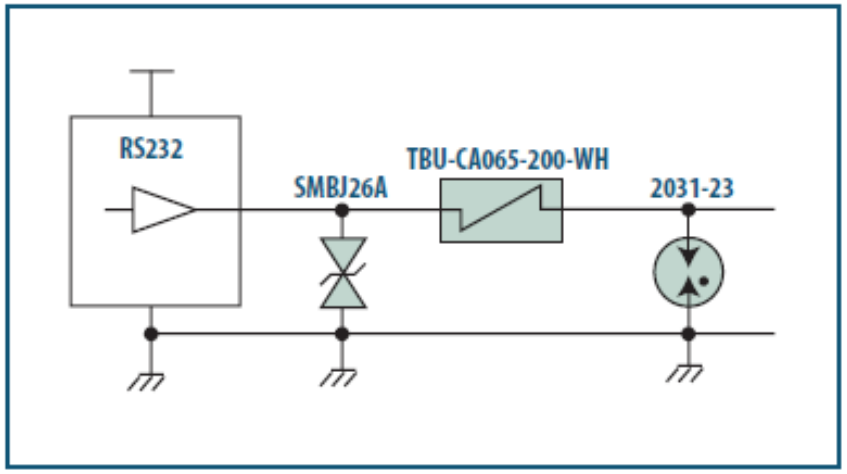
Pressure Transmitter with Transient Protection

- **Port Protection**
  - **GDT: 2027-09-SM or 2026-07**
  - **TBU™: C650-180-WH**
  - **TVS: SMBJ51CA**

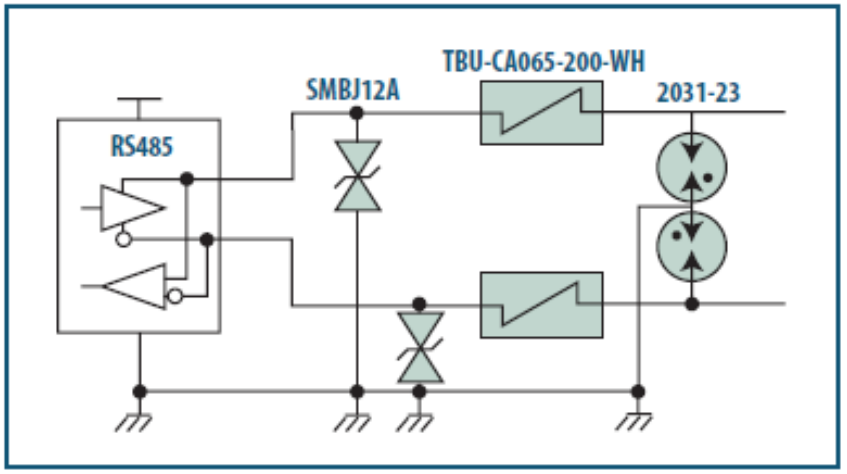
Testing standard: GB/T 17626.5 surge standard with 150 V insulation live testing

Solutions - Industrial

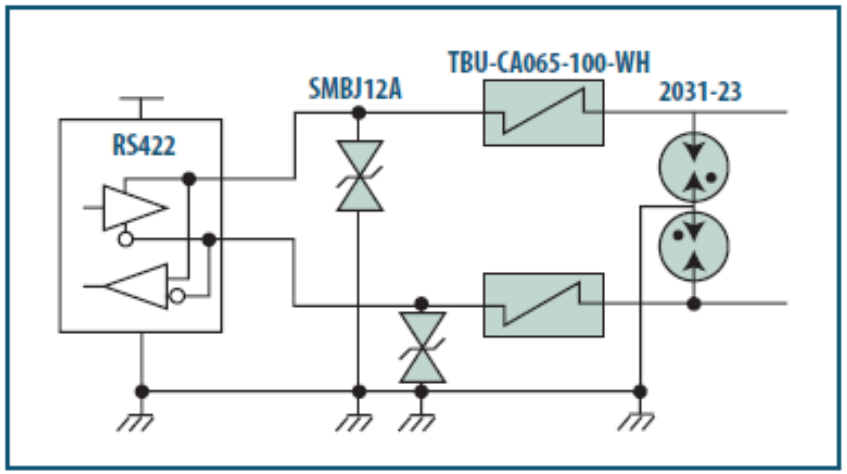
RS232 Interface



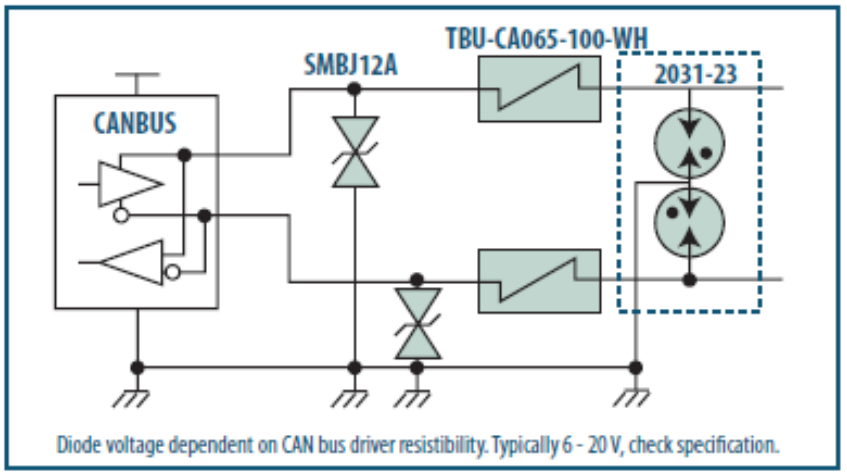
RS485 Interface



RS422 Interface



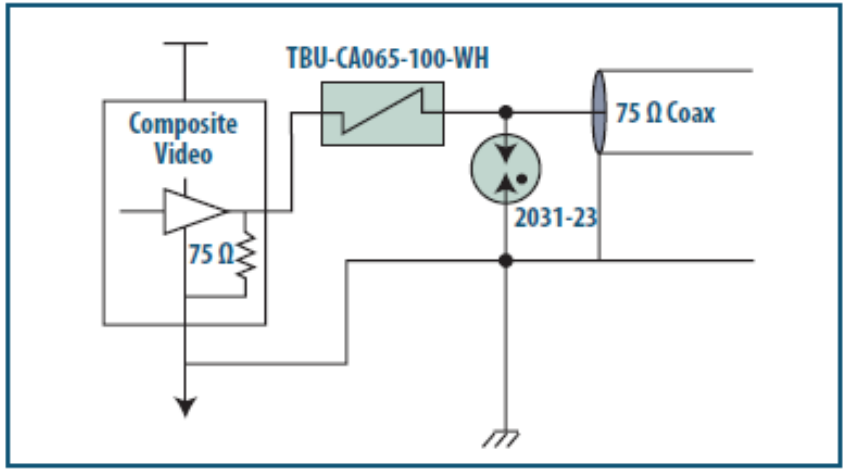
CANBUS



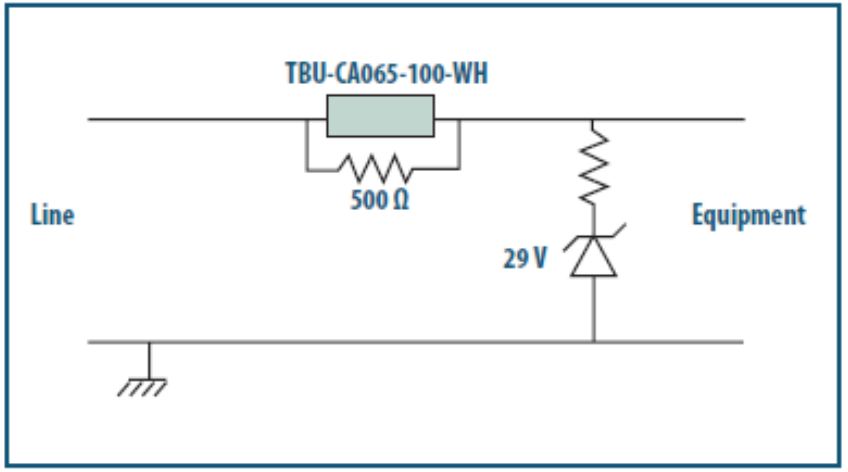
BOURNS®

Solutions – Industrial

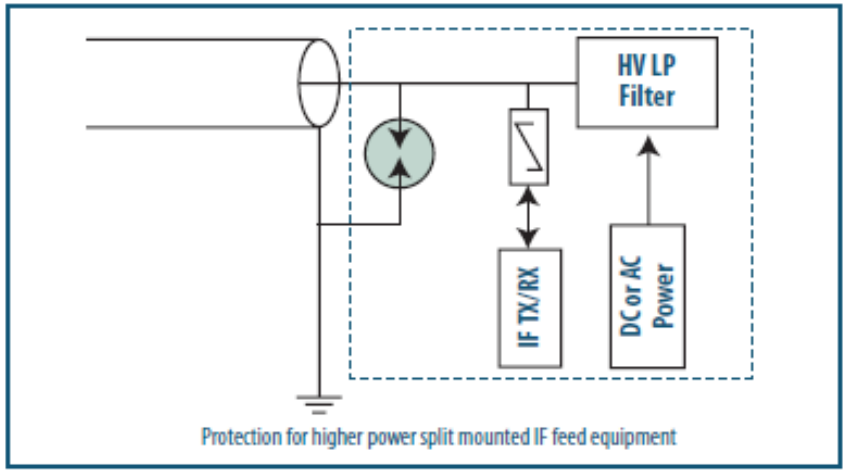
Intelligent Transport System



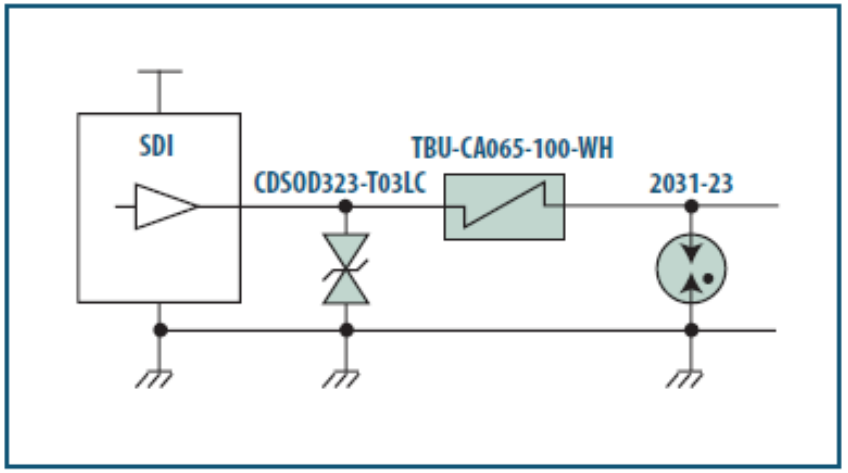
Intrinsically Safe Sensor



Microwave Link



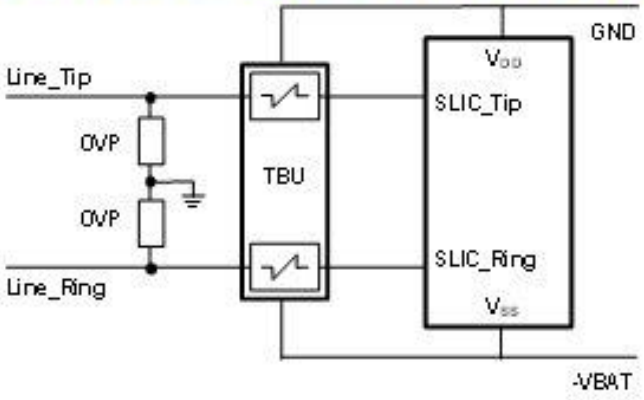
Video Surveillance



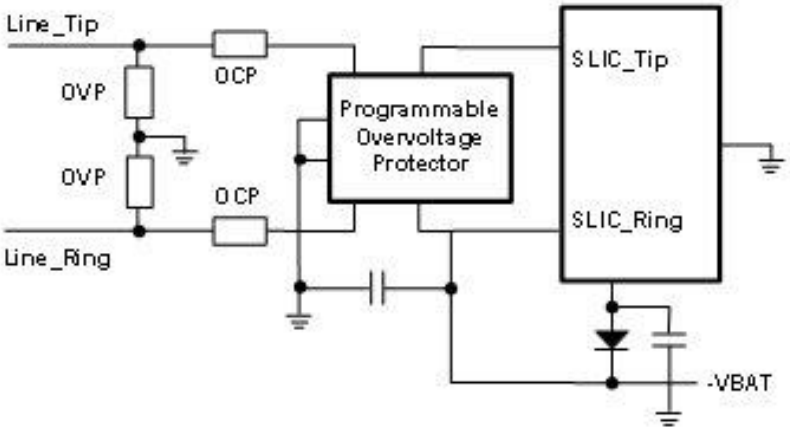
BOURNS®

TBU Solution Has Lowest Component Count

Voice Port Protection



- TBU block surge surge and power fault
- Simple, 3 Components
- Meets 4kV and 6kV surge
- Lowest residual voltage
- Tightest line balance
- OVP-GDT, Thyristor, MOV

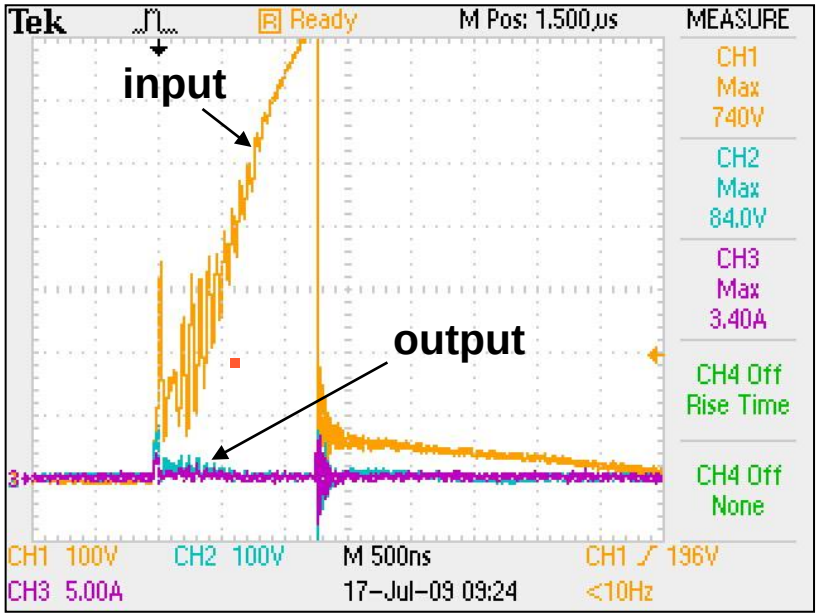


- Conventional design
- 8 Components
- 4kV require primary protection OVP
- OCP- Fuse, PTC

TBU Solution Has 100X Less Let-Thru Energy

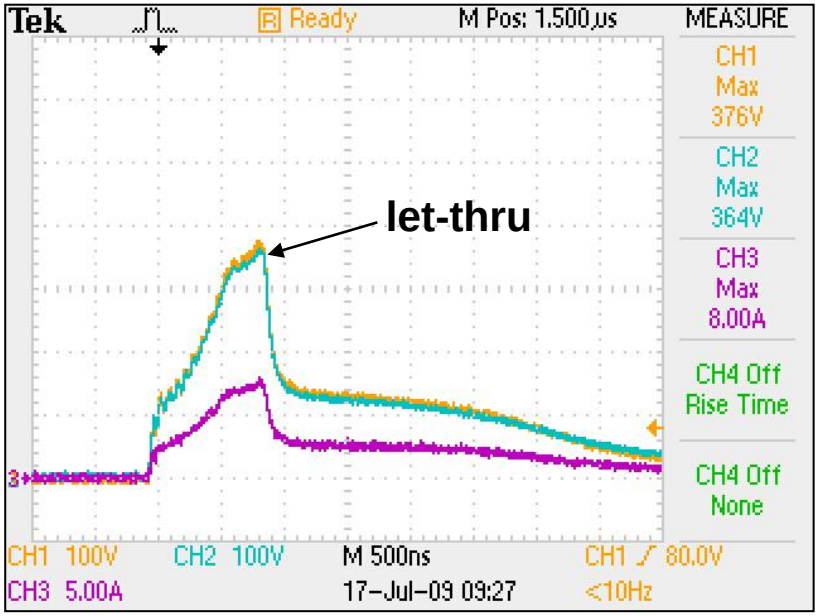
Surge Test: 10/700µs, 5000V, 400A

TBU/GDT Protection



Ch1 – input V (yellow)
Ch2 – output V (blue)
Ch3 – current (purple)

PTC/Thyristor Protection



Ch1 – input V (yellow)
Ch2 – output V (blue)
Ch3 – current (purple)

TBU-PL Solution for Voice Port

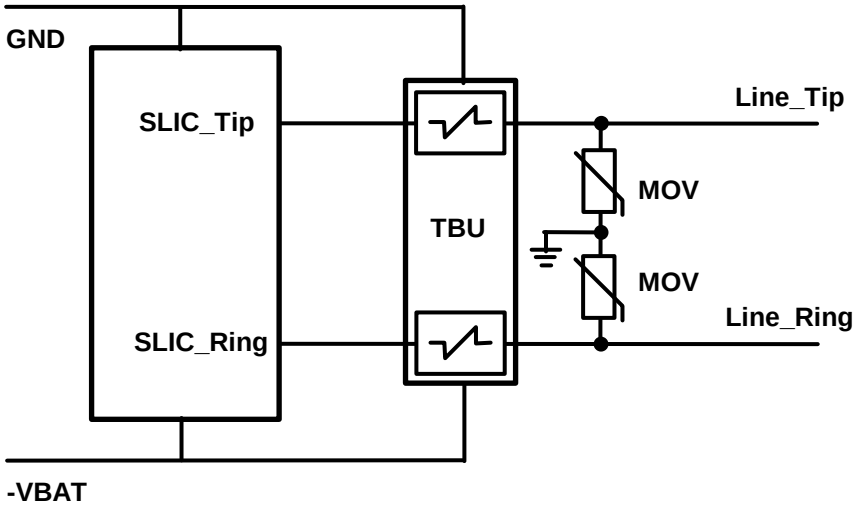
- Triggers on current or any voltage exceeding the Vbat (-20V to -180V) SLIC :

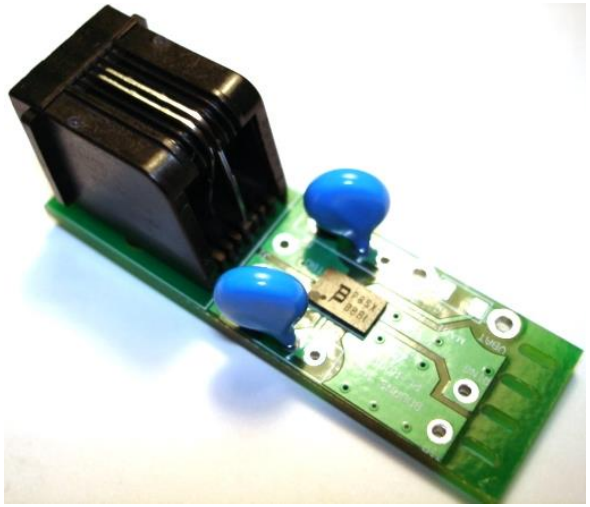
  (i) Enhanced GR-1089 IntraBuilding + 2/10 5kV/500A, ITU K.2x 2kV

  PL075-200-WH + 10D201K or 10D391K

  (ii) ITU K20/21/45 (10/700 2kV-4kV, 600Vac 600ohms 0.2s induction)

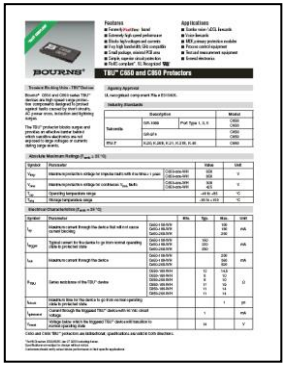
  PL085-100-WH+ 2*10D391K

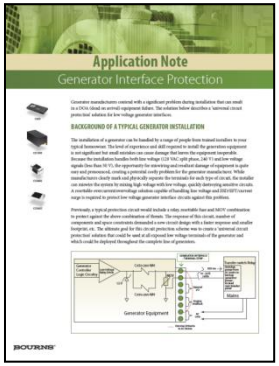


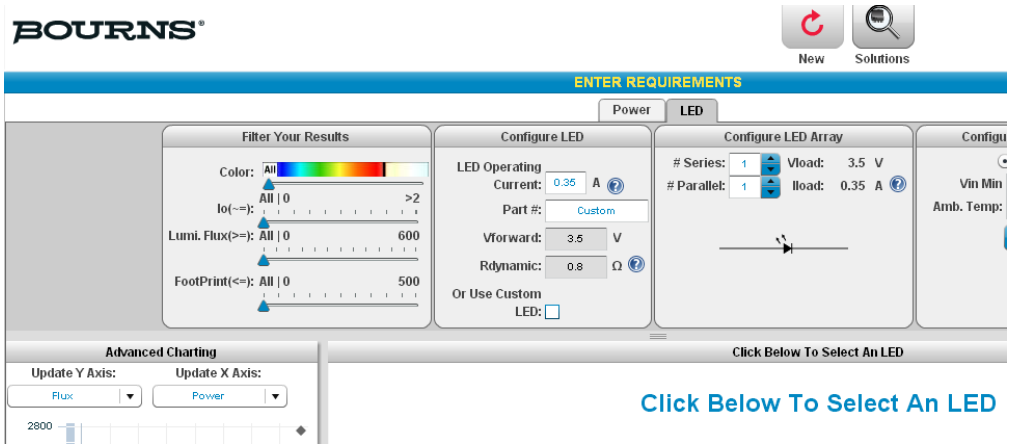


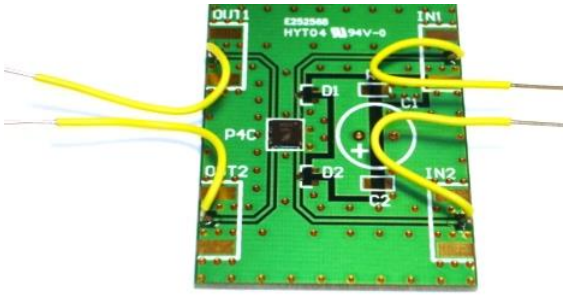
Engineering Tools

- Application notes
- Evaluation boards
- Data sheets
- Lab kits
- FAE support
- Online LED design tool









Success Stories using TBU Products

Telecom		
Cisco	**SLIC Protection**	**P850-G200-WH**
Adtran	**Ethernet Protection**	**P40-G240-WH**
Selta Telematica	**VDSL Protection**	**TBU-CA050-500-WH**
Industrial		
Generac	**Generator Controller Protection**	**C650-260-WH**
Catu	**Detector Sensor**	**C850-180-WH**
Geotest-Marvin	**Temp Sensor Protection**	**C650-100-WH**
Instrumentation		
Advantest	**ATE Test Point Protection**	**TBU-CA025-050-WH**
Schut Gemometrische	**Measure Point Protection**	**P40-G240-WH**
Chuanyi Automation	**RS-485 Port Protection**	**C650-180-WH**
Aerospace		
Nord-Micro AG	**Boeing 787 Air Pressure Control**	**C650-100-WH**
Rockwell Collins	**Aircraft Power Circuit Protection**	**C650-100-WH**
TQ Systems	**Airbus Cabin Light Protection**	**C650-260-WH**

Outside World

Primary Protection

Overcurrent Protection

Secondary Protection

Tertiary Protection

Integrated Circuit

Primary (GDT/OSP)

5

PTC Multifuse®

4

SinglFuse™ Telefuse®

TBU™

Line Feed Resistor

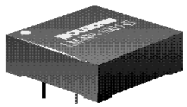
TISP®

3

Fast GDT

Transformers

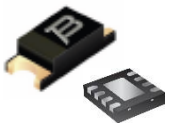
3



Inductors

TVS Diodes

1



Chipguard™

EMI Filters

STANDARDS