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Single and Dual Form C Solid State Relays for ATE/Semiconductor Test Applications

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- Driving Factors for Solid State (SSR) Replacement Devices
- Form C SPDT – DPDT SSR Realization
- ATE/Semiconductor Test Application Examples
- Considerations and Benefits in Form C SSR ATE Use-Cases



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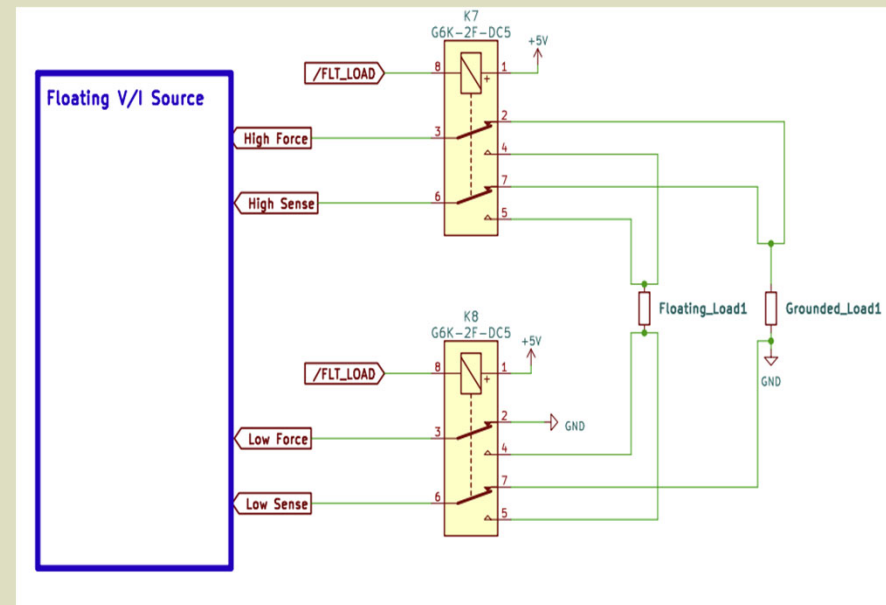
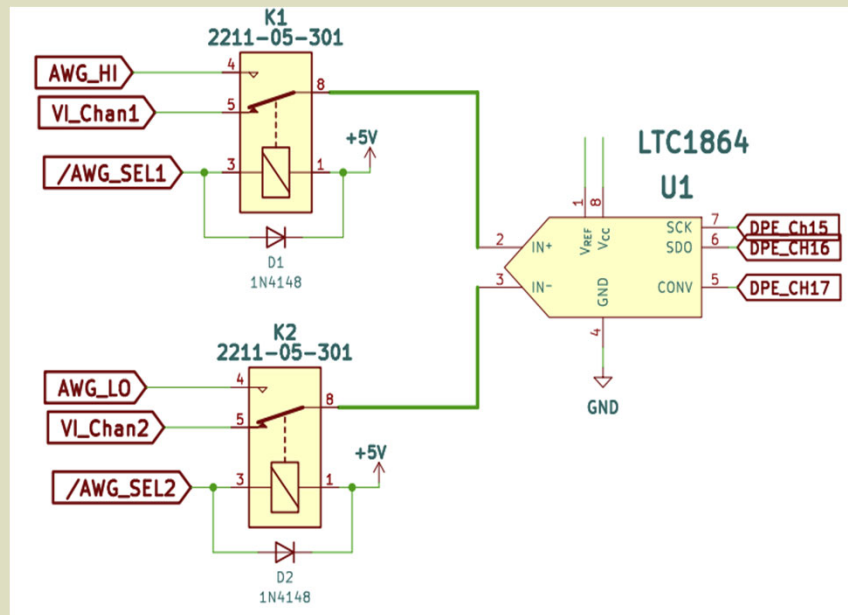
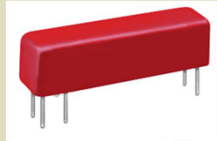


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The Ubiquitous Form C Relay

1 Form C SPDT Low Current /Signal Switch

2 Form C DPDT Kelvin Force-Sense Switch



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The Electro-Mechanical Legacy

- Electro-Mechanical Relays – Sticky Technology!!
 - 80+ year old technology used in modern ATE test applications
 - Weakest link in ATE loadboard hardware
 - Limited Operating Life for high-volume Semiconductor production
 - Insidious source of production yield loss
 - Physical size and spacing constraints
 - Switch contact bounce
 - Contribution to measurement Error Budget-
- Dual Form C – DPDT highest BOM count on Loadboards



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Electro-Mechanical Relay Problems to Solve

- Limited Operating Life
 - 500K-5M operations
 - Contact Resistance degradation – Hot Switching accelerates this
- Loadboard Real Estate Consumption
 - Physical size + magnetic interference
- Contact Gap Time and Bounce
- Error Budget Consumption
 - Contact Resistance repeatability
 - Contact Resistance degradation
 - Thermal EMF



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Initial Solid State Form C Stumbling Blocks

- Plenty of Form A SPST Solid State Relays out there, but....
- No prior existing integrated Form C Solid State Relays
- Form A-Form B devices -- mis-matches in Ron, I_{leak}, Ton/Toff
- Composite Form A circuits -- Gap Time overlap = crowbar current
 - Requires additional components for T_{Gap} BK-B4-MK timing = Real Estate
 - -Or- phase shifted logic drivers = Complexity
- Need for a “Drop-In” EMR replacement



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Solid State Form C Solution

- Uses same MOS device elements for Normally Closed and Normally Open switches
 - Enables close matching of Ron, Ileak, Ton/Toff for NC and NO switch paths
- Integrated logic driver for LED current steering between switches
 - Can be driven by legacy ATE CBit Open Drain/Open Collector drivers
 - Compatible with Darlington output stage relay drivers
- Ensure Gap Time for guaranteed Break-B4-Make operation
- “Drop In” replacement for legacy EMR’s to minimize hardware cost impact
 - One caveat here.....the Ground pin

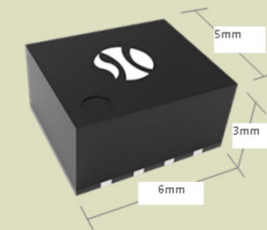
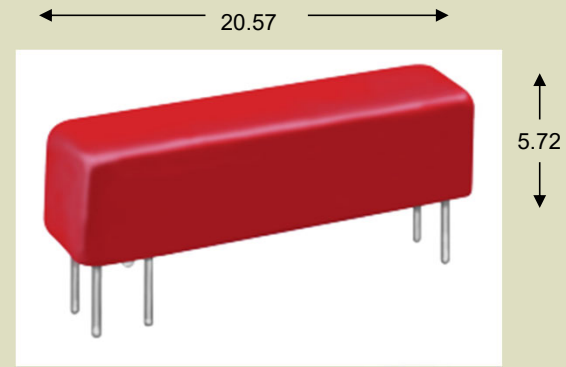
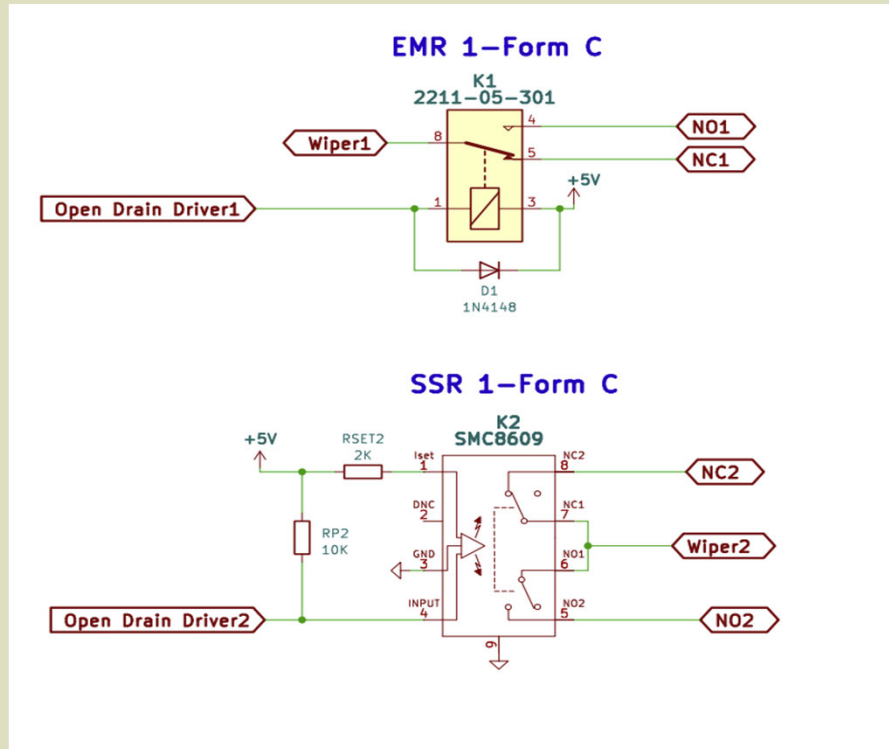


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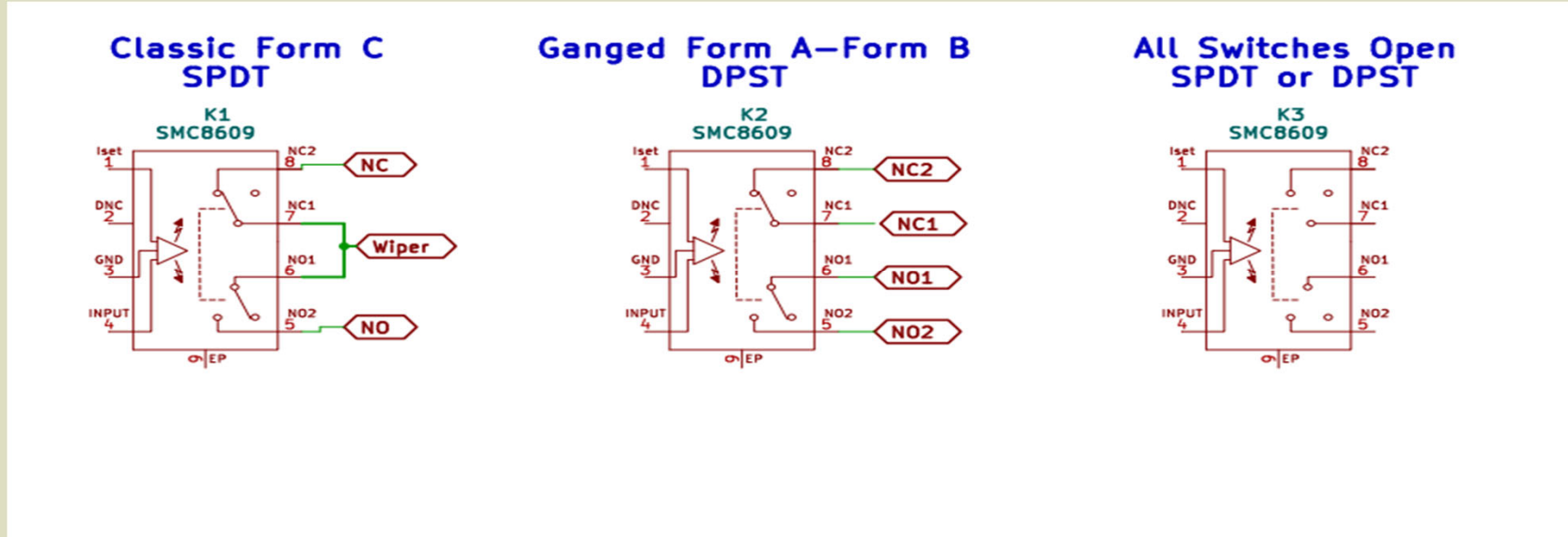
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Comparing 1-Form C EMR vs SSR

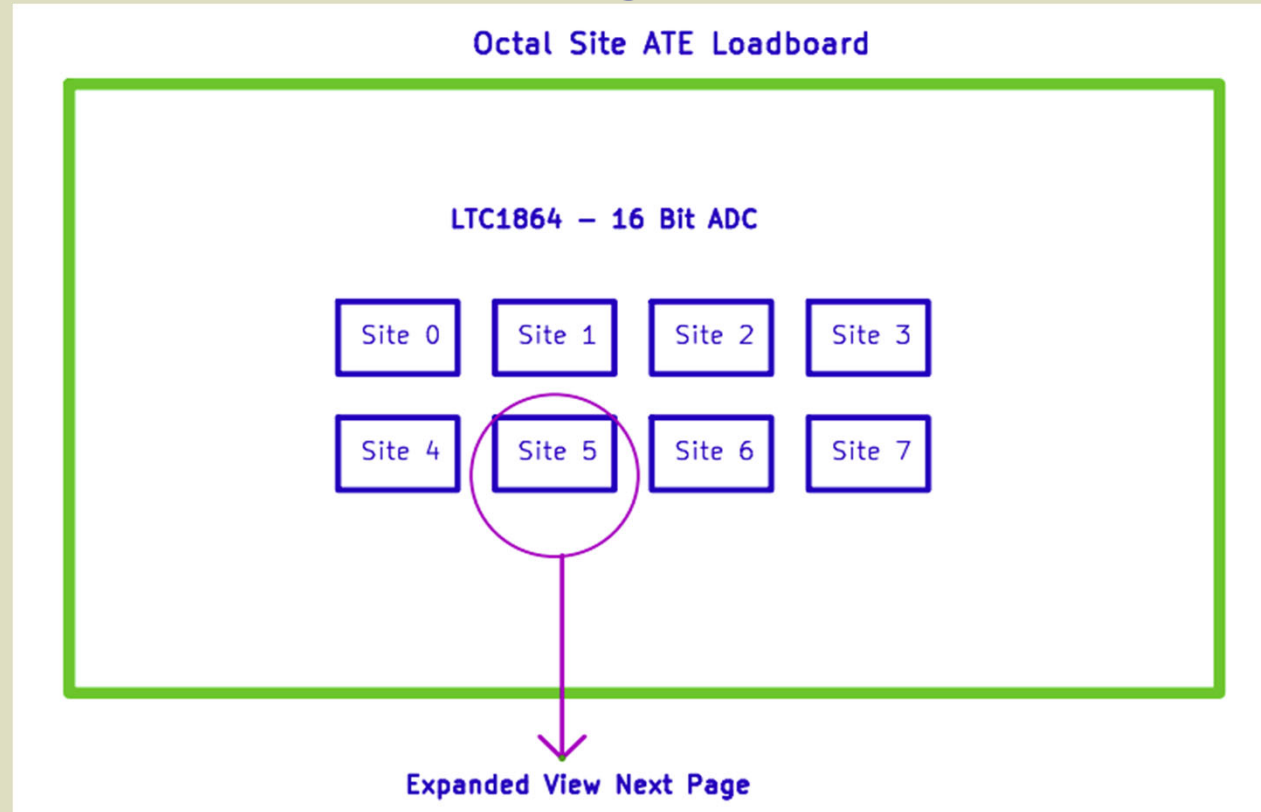


Single Form C SSR Three Functions In One Device Type



SSR 1-Form C ATE Application Examples

ATE Resource Switching on Octal Site Loadboard



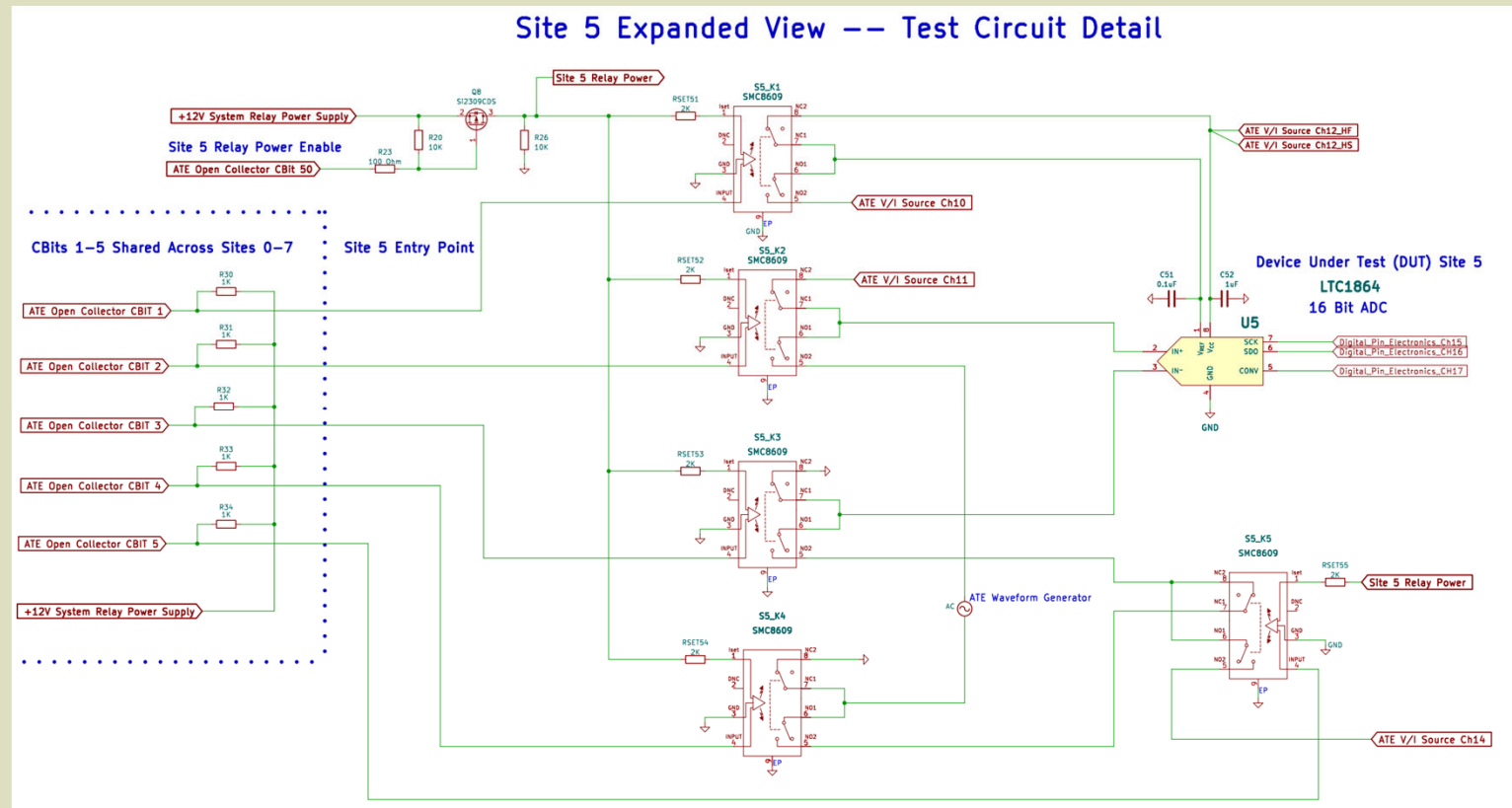
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SSR 1-Form C ATE Application Examples SPDT + DPST + All Open Feature Set

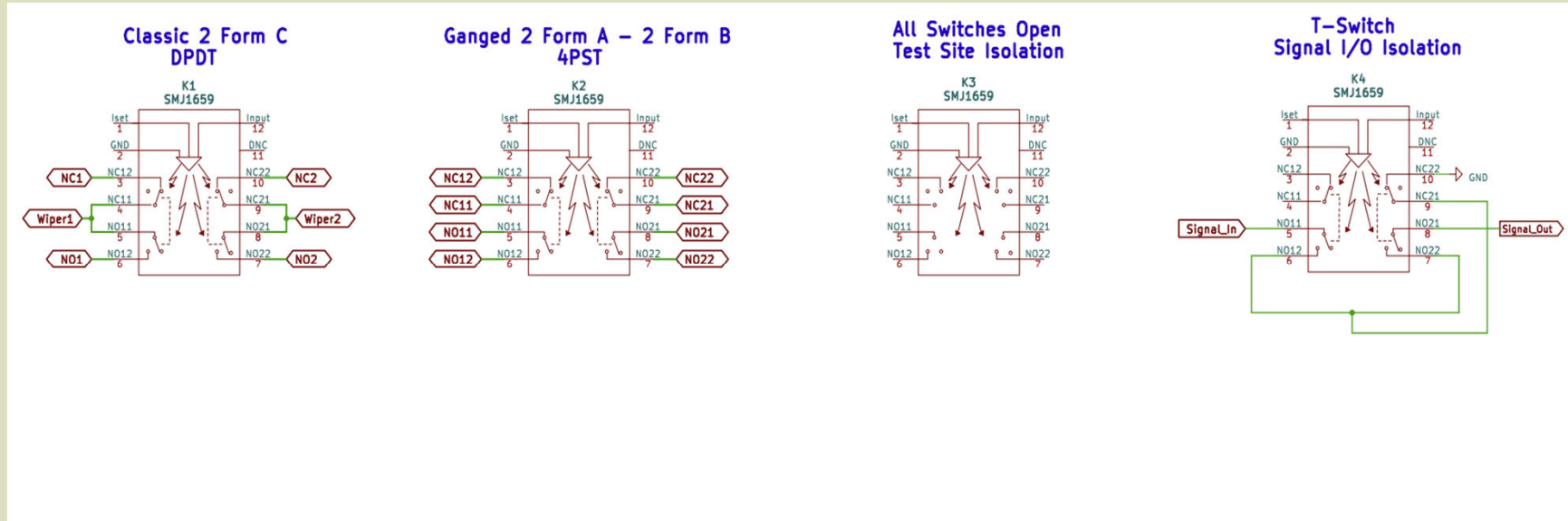
Site 5 Expanded View -- Test Circuit Detail



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Dual Form C SSR Four Functions for the Price of One!



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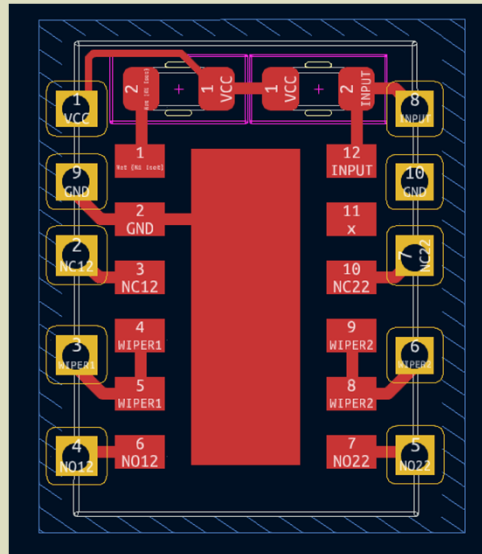
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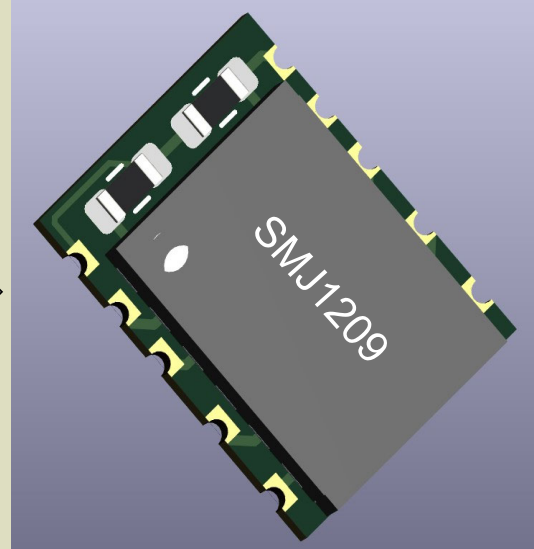
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Dual Form C SSR to EMR Footprint Adaptor

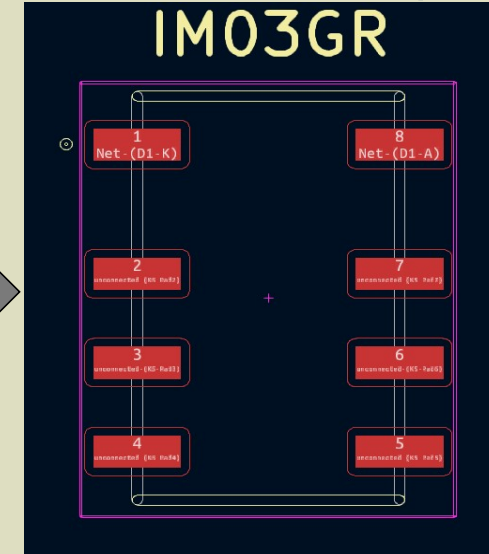
SMJxx to IMxx
Adaptor Board



SMJ1209 Mounted
To Adaptor Board



Adaptor Board Mount
To IM03 PCB Footprint

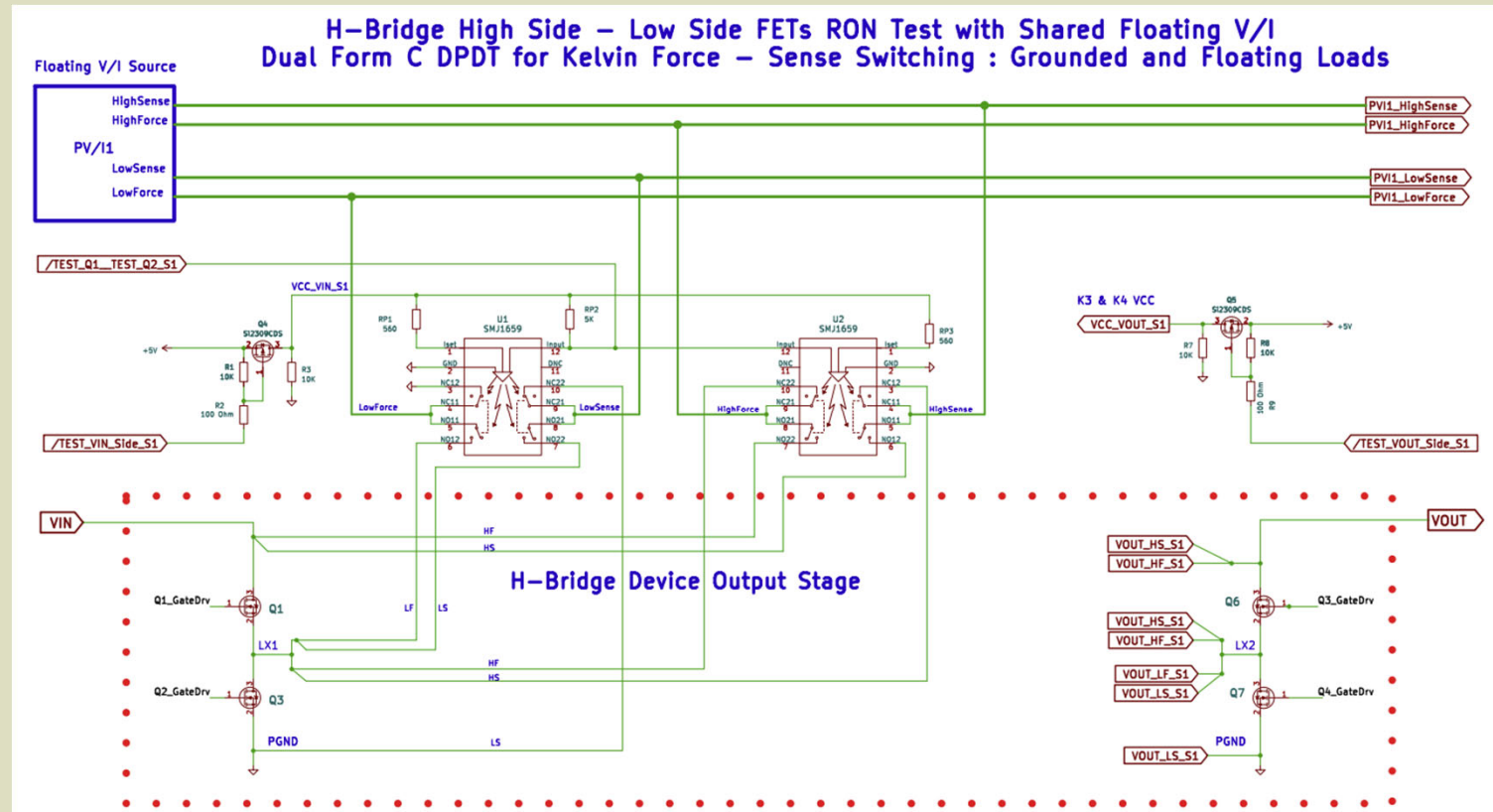


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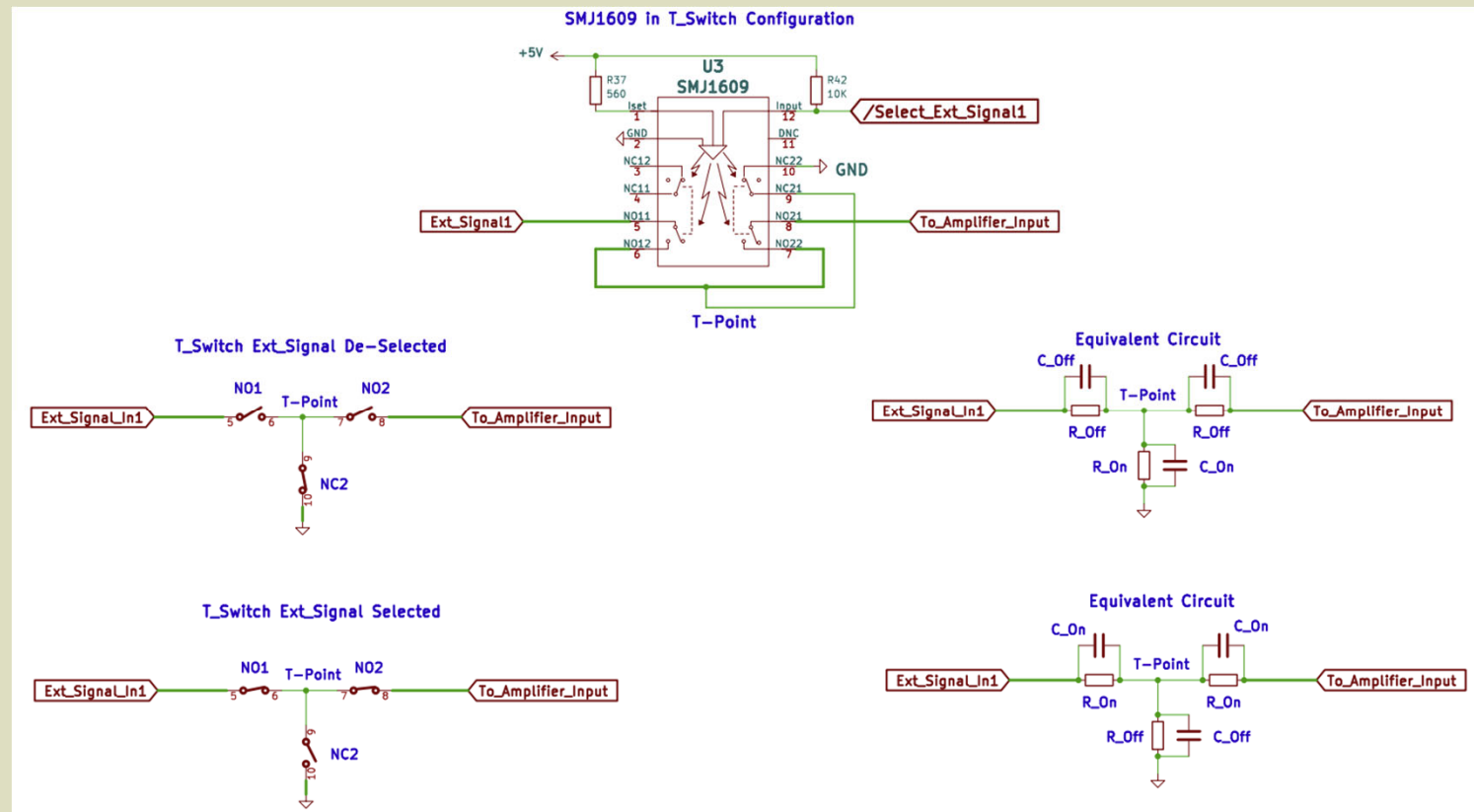
SSR 2-Form C ATE Application Examples Utilizing "All Open" Feature to Share Floating PV/I



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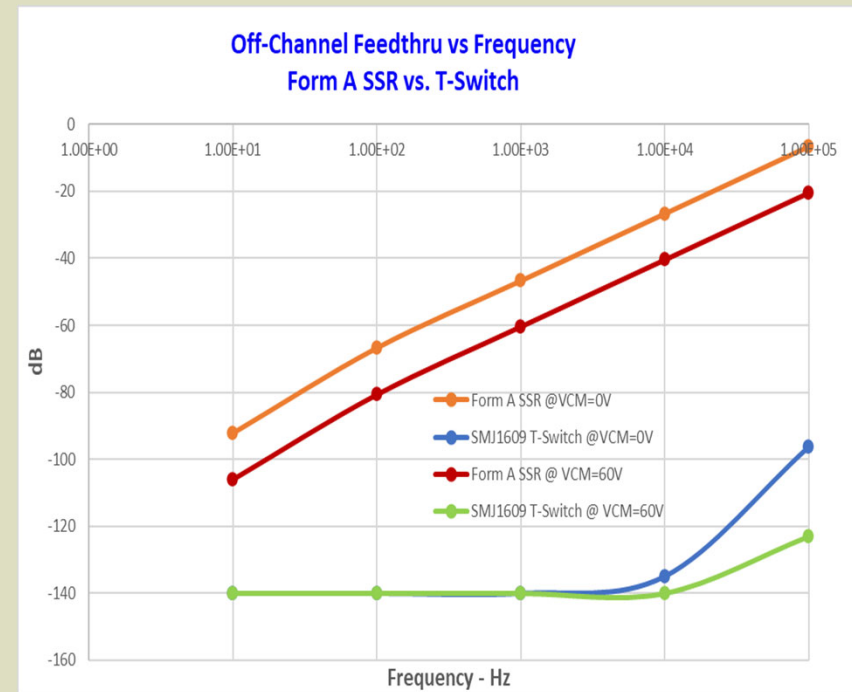
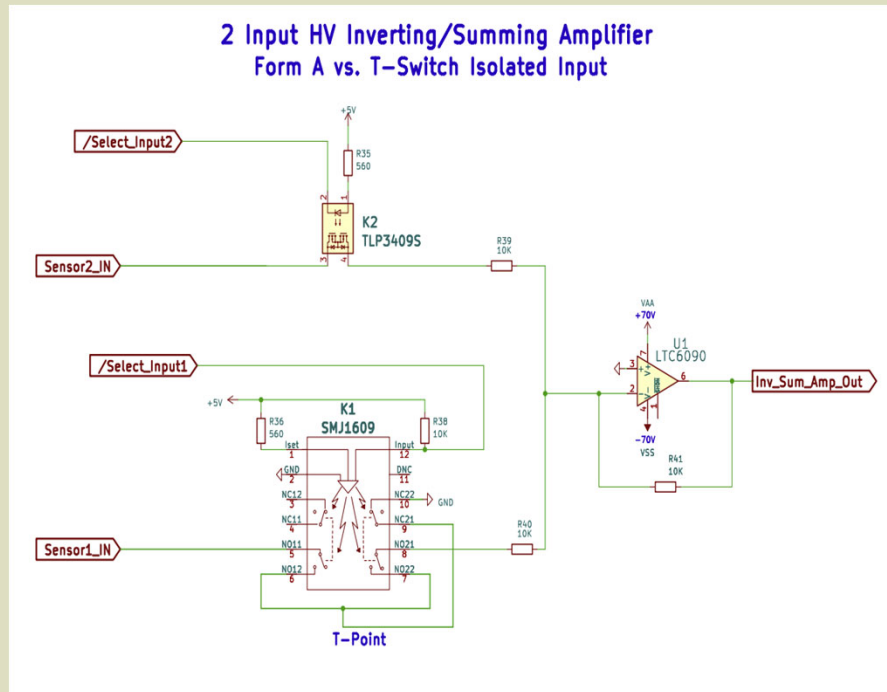
T-Switch Configurations and Equivalent Circuits



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SMJ1609 T-Switch Isolation vs. Form A SSR



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EMR to Form C SSR Application Switchover

Considerations

- Contact Resistance – RON
- Blocking Voltage – VB
- Open Switch Leakage – I_{leak}
- Open Switch Capacitance – C_{off}

Benefits

- Stable RON vs. Time
- Hot Switching Tolerant
- Low Thermal EMF
- I_{leak} & C_{off} minimized with T-Switch
- No Magnetic Interference
- 1 Billion+ Operating Life



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Acknowledgements

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 - Walid Baroudi, Juan Kadah, Bob Jesson –SSO device technology
 - Mike Blankenship – PCB Design and Layout



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