

Improving overall RF system performance using coaxial devices with integral isolators.

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Iso-Splitter/coupler and combiners

■ Outline

- RF paths route signals throughout a telecommunication satellites. The requirements can be met by using building blocks of coaxial cables, splitters, combiners, couplers etc.
- Each connection within the RF system introduces a degree of poor matching and signal degradation, RF connections may be designed and manufactured to recognised standards, but there are tolerances around these parameters and each variation from the ideal impacts the system performance.

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- **Current situation**
 - **In order to negate the effects of poor RF match and improve overall system performance coaxial Isolators are included into the RF path.**
 - **Isolators act to improve the RF match of each path, providing an optimum match and reducing reflected signals.**
 - **Adding Isolators into a RF path will increase the insertion loss and this needs to be balanced against the over all system performance improvement.**

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■ Problem

- However each additional RF connection can bring with it additional RF match reductions.
- Common RF connectors such as SMA have relatively good return loss performance, up to -30dB to 18ghz for RF interface.
- RF connectors degrade with applications, where the limiting factor becomes the interaction between the connector and cable, or substrate or housing.

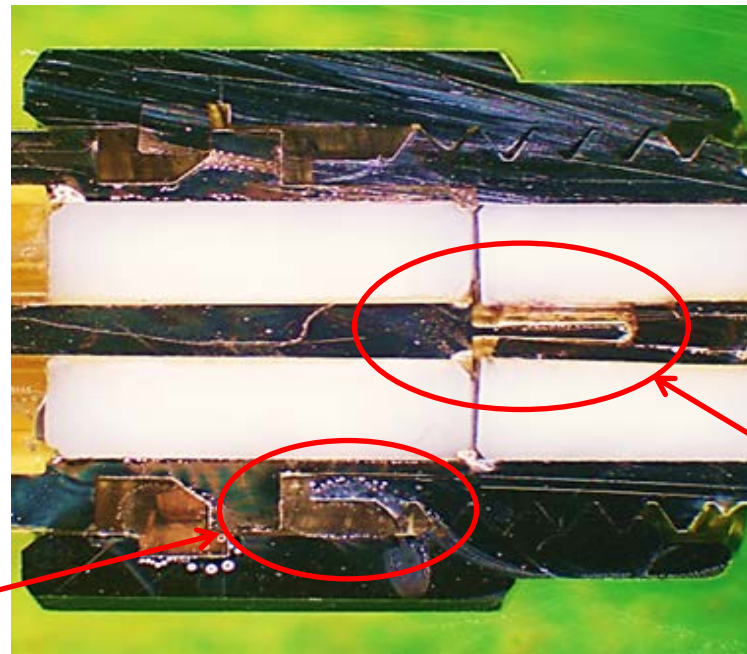
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■ Solution

- **One solution would be to reduce the number of RF connections or replace generic connectors with optimised RF connections.**
- **By incorporating Isolators into Coaxial Dividers, splitter, couplers and hybrids ADS have removed generic RF connectors with integrated RF joints.**
- **Instead of reliance on pin to socket interfaces we have moved to use substrate to substrate connection with bond tapes or soldered wires.**

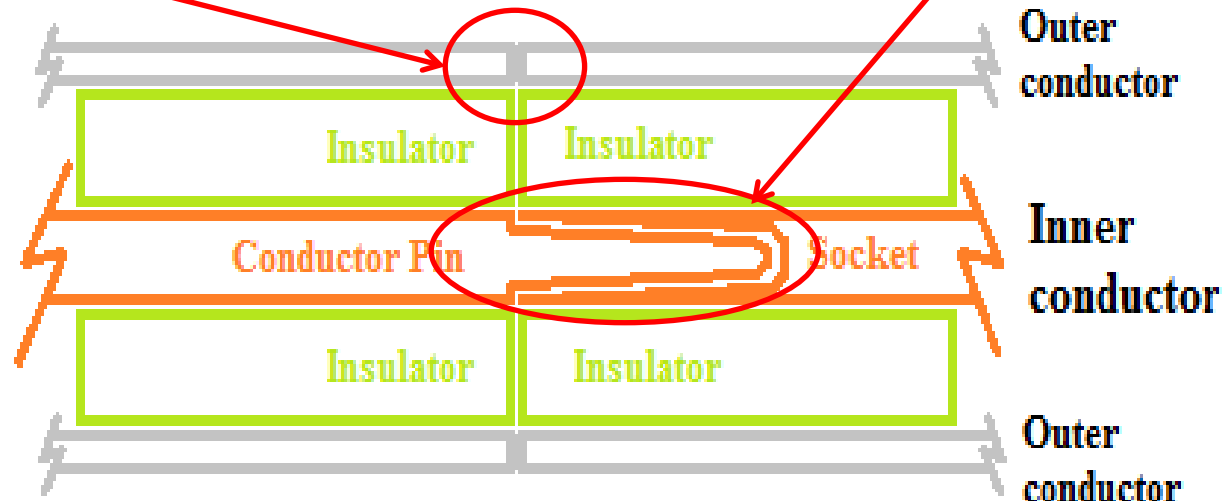
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- Illustration
- **Current solution**



Outer RF connection, mechanically abutted and held with torqued coupling nut, no movement expected

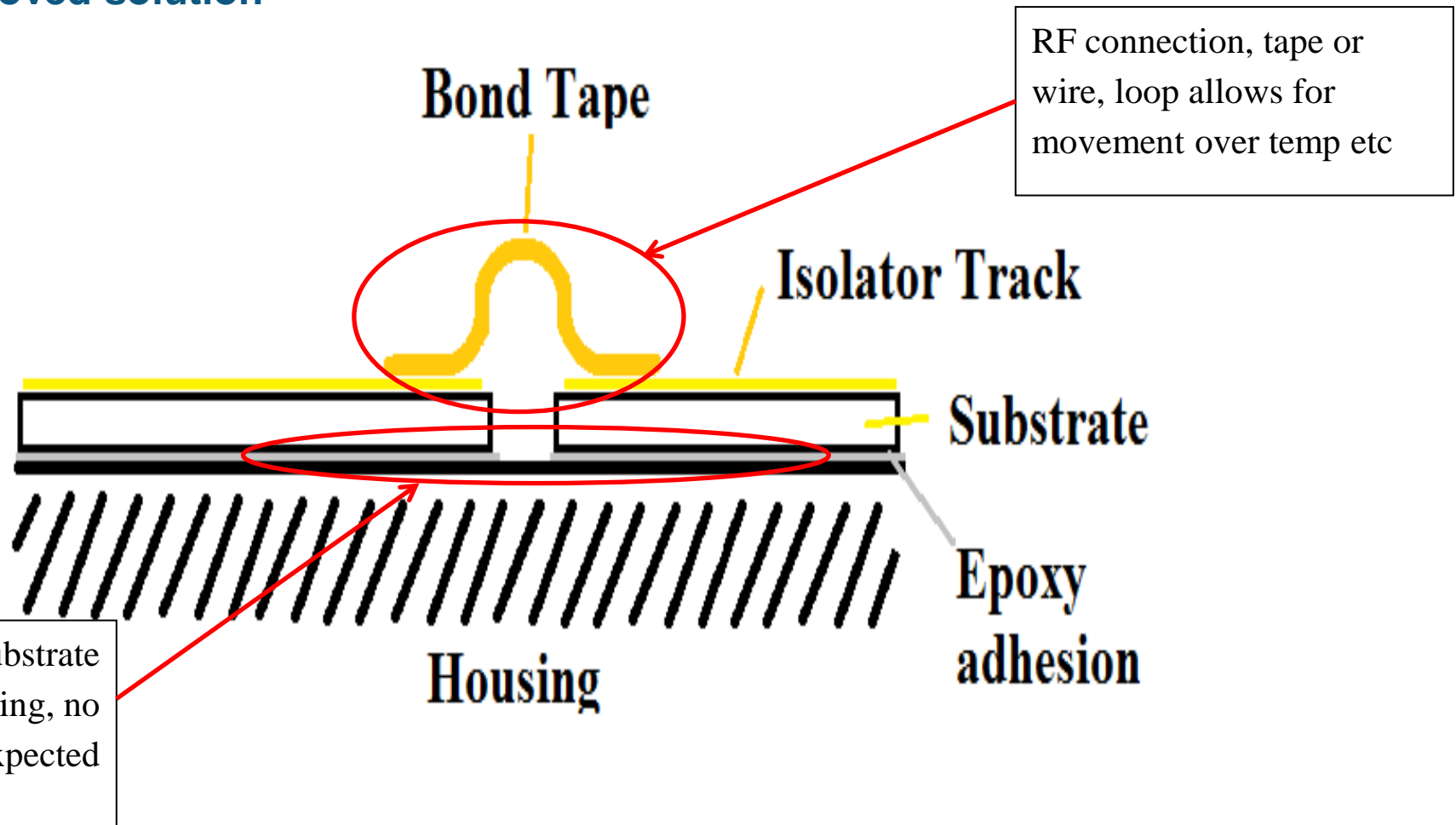
Inner RF connection, pin into socket, sliding joint allows for movement over temp etc



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- Illustration
 - Improved solution



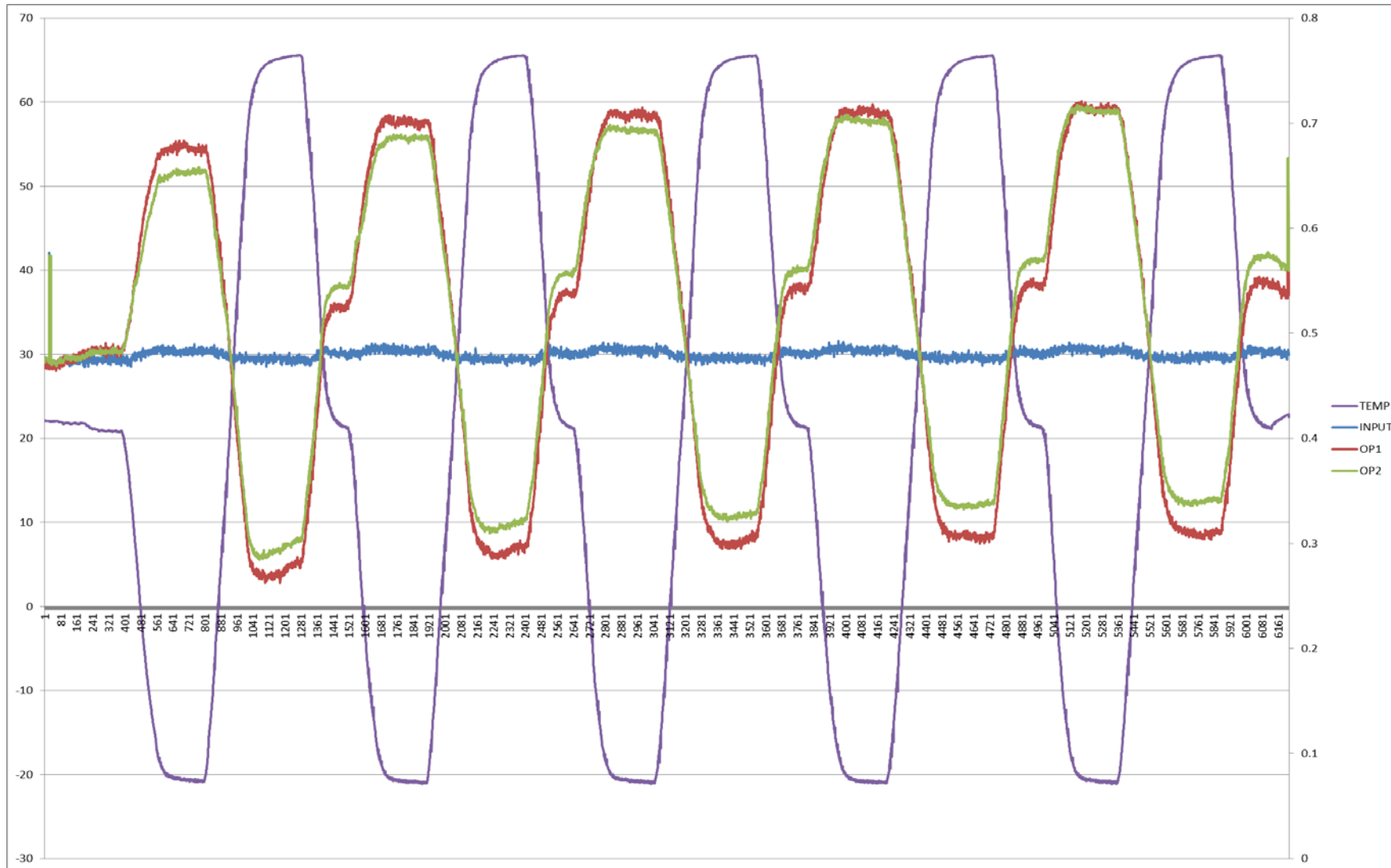
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■ Glitch

- **With all RF connections there is the possibility of undesirable performance change over temperature, also known as glitches.**
- **RF connections with mechanical interfaces take into account of environmental effects by allowing some movement, when this movement is smooth and measured performance can be predicted.**
- **Sometimes the mechanical movement is not linear and predictable, joints may suffer from poor tolerances or surface impurities or reduced contact retention.**
- **Replacing moving mechanical connections with bond tapes etc can help reduce RF glitches through more controlled change over temperature.**

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- Typical glitch free performance over temp. 2 way Iso splitter.



Key
 Blue – Input RF
 Purple – Temp
 Red – Ouput 1
 Green– Output 2

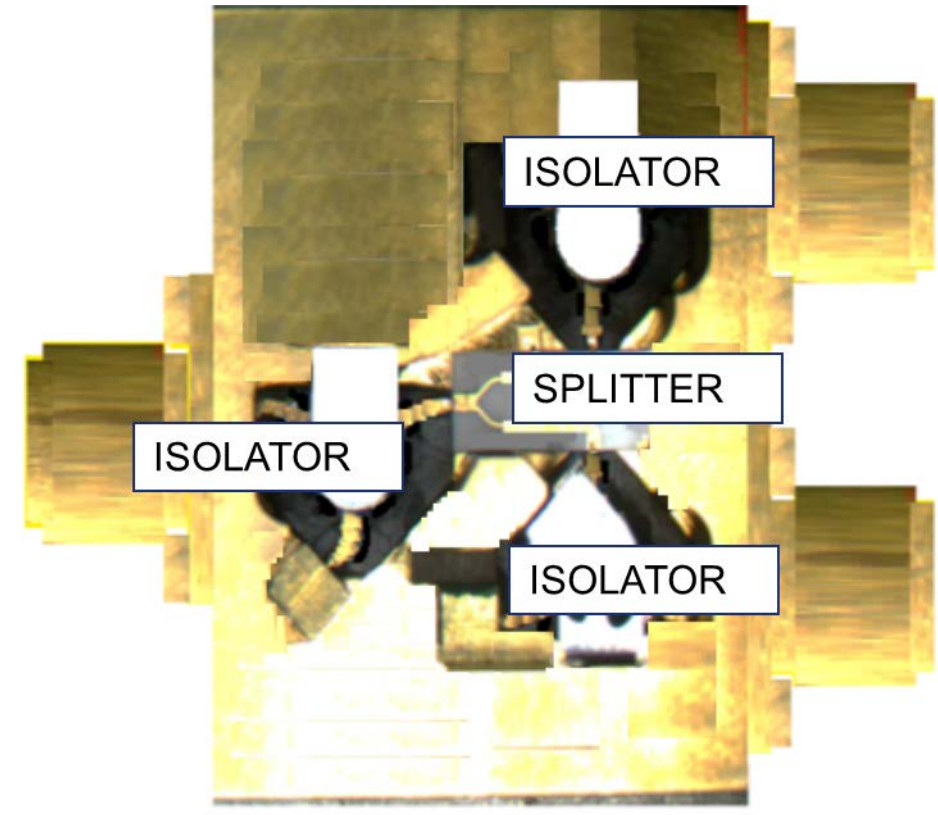
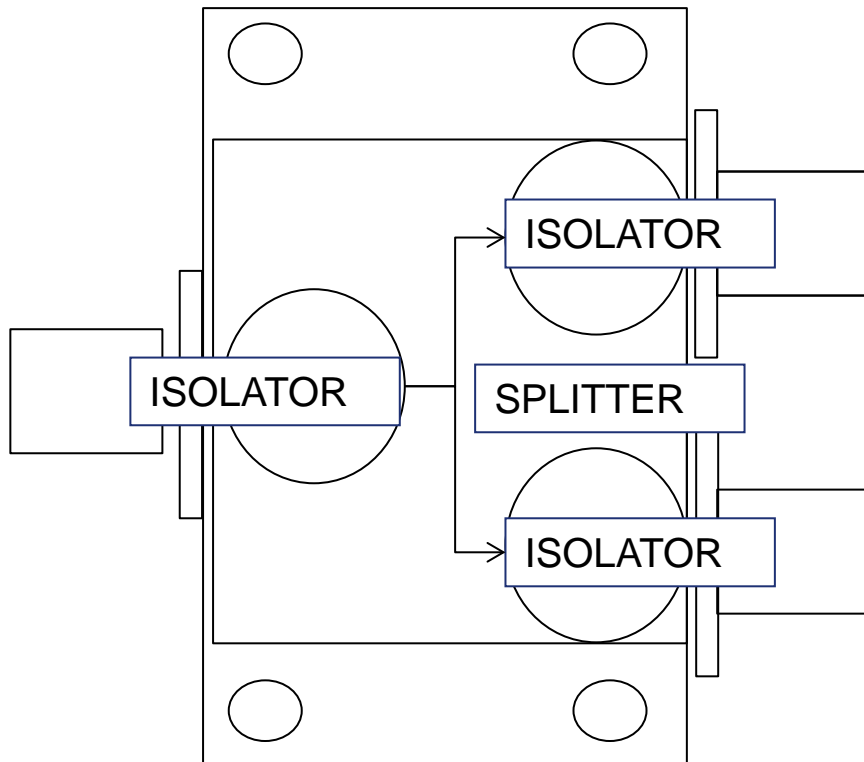
Iso-Splitter/coupler and combiners

■ Process

- Integrating components into a housing is not simply a task of making the box bigger.
- Isolators can be surface mount, drop in or integrated onto the splitter/coupler/combine substrate.
- An interesting point is to consider if all the internal RF connection need to be 50ohm, other values may provide advantages as long as the external match is 50ohm.
- Understanding the component parts, function, construction and their interaction is important.
- Equally as important are the external RF connections, these can still dictate the overall device performance, and can in fact deteriorate the improved performance provided by the isolators.

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■ 2 WAY SPLITTER ILLUSTRATION



Iso-Splitter/coupler and combiners

- **Space Flight units**
 - **Airbus Defence and Space are currently integrating coaxial Splitters, combiner and couplers with integrated Isolators.**
 - **The devices have successfully completed qualification testing as assemblies.**
 - **The qualification covers the three main phases for spaceflight.**
 - **Integration, AIT installation onto Payload**
 - **Inspection, baseline RF performance**
 - **Launch, Mechanical testing**
 - **Vibration, sine, random and shock**
 - **Lifetime, simulate 15 years GEO**
 - **Thermal cycling.**
 - **To ensure compliance each assembly completes the whole qual.**

Thank you for your attention.

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