

Enhancing Electrical Safety at Final Sub Circuit

The 3 Phase TN-C-S MEN Electrical Distribution System used in Australia is failing to deliver what it was designed to do: enable a high level of safety for users.

The time has come to take decisive action, now more than ever, to ensure electrical safety is truly at the levels we must demand.

For many years the integrity of the **TN-C-S MEN** earthing system has been eroded away, often leaving electrical safety compromised. The dangers associated with these changes, (structural, environmental & technological) are very high, placing peoples' safety, even their very lives, at risk.

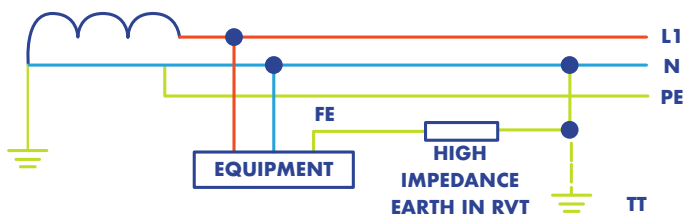
A technical solution has been developed which combines 3 aspects of protection to enable the ultimate level of electrical safety.

The combination of **RCD (residual current) with RVT (residual voltage) Technology** (fully tested and approved) when applied in a **TN-C-S MEN + High Resistive Earth (HRE)** environment, enables superior electrical safety outcomes for domestic and commercial final sub-circuit applications.



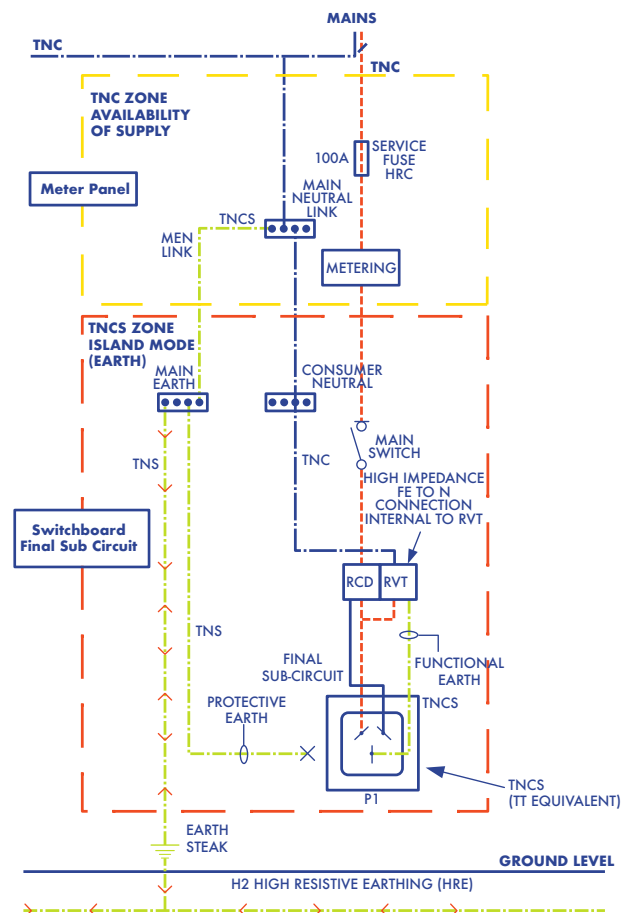
COMBINED RCD & RVT PROTECTION

TN-C-S (MEN) HRE EARTHING SYSTEM



The arrangement of the final sub-circuit (shown on right) utilises a **HRE** to complete the separate earthing of the **TN-C Neutral** at the socket outlet. This combination provides a solution to many of the well documented and most dangerous faults including:

- **Loss of supply neutral**
- **Loss of supply earth**
- **Short-circuit**
- **Corroded or damaged earth stakes**
- **Loss of MEN bond**
- **Reverse polarity**
- **Island Mode (earth)**
- **Voltage rise**



Ensuring good **Earth integrity** is the most obvious yet often overlooked way of ensuring that the protective earthing system is always in the best possible condition. However, many issues impinge on even this most basic of fundamentals. Soil types play an important role and impact significantly on the resistance levels present which can range from 15 to 1050 Ωm dependent on material make-up, moisture and other factors, all of which are outside of our control, which can change daily.



Earth Stake after 5 years in Acidic Soil



Ageing Infrastructure along with National Construction Codes (NCC) & Plumbing Standards changes, have impacted upon the number of multiple earth points present in dwellings/buildings. Ageing infrastructure in terms of earth stakes & connections, are subject to erosion/degradation but are seldom verified. The widespread use of **PVC piping** for water and gas has meant that the multiple earth paths necessary for correct functioning of the **MEN system** are no longer present and the only earth present is the earth-stake itself, culminating in a phenomenon called **Island Mode**.

The removal of multiple earthing points, specifically in wet areas such as bathrooms, laundries and kitchens, all high risk, means that these areas are now isolated from **True earth (Island mode)** & thus **the basic principle of the TN-C-S MEN Earthing System is compromised**. The Loss of Multiple Earth points has resulted in the change from a **Low Impedance Protective Earth** environment to a **High Resistive Earth system** where the level of protection offered by the RCD, is subsequently restricted. **Island Mode** is a very real problem which is well documented in International Standards such as **IEC 60364** and **BS:7671**.



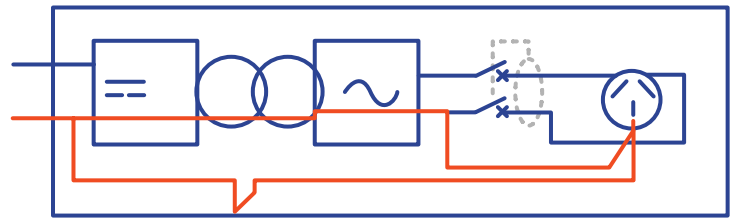
The uptake of **Renewables Micro Grid Systems** has resulted in a 'tipping point' for the MEN system, where the use of both **AC and DC voltages and the Earthing (to earth or unearth)** method used is still debated within the Electrical Industry. The uptake of **Roof Top Solar Systems** fuelled by Government incentives was greater than expected, with Utilities unprepared for these major changes. The random roll-out of single-phase roof top **Micro-Grids** into a 3-phase distribution system, has created **Load Balancing and Synchronisation issues**. This has created other problems such as the increase of **Voltage Rise (DC)** now present throughout the AC earthing system where some systems put 120V onto the neutral/earth conductor. This represents a potentially very dangerous situation where, under a fault condition, a person will not be protected as such a fault is upstream of the RCD which will not detect it.

Final Sub-Circuit Risk Matrix Comparison

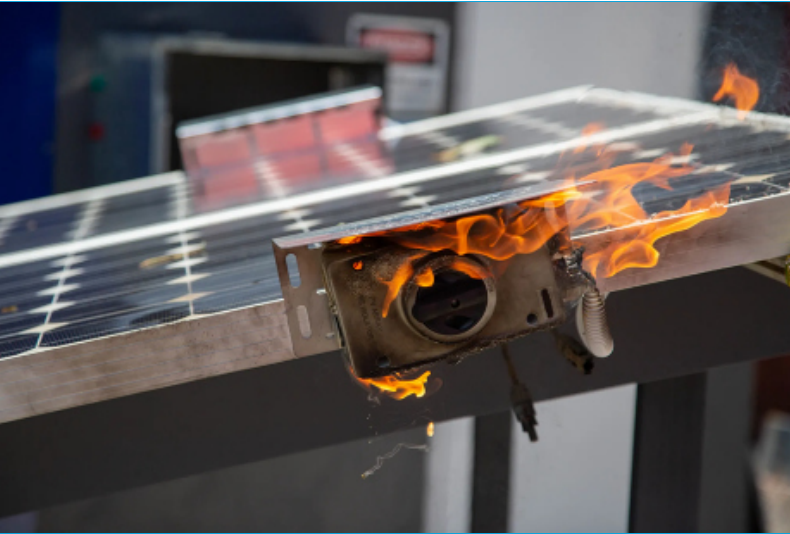
Fault Type	Earthing Zone	Earthing Arrangement	Associated Risks	Risk Level RCD + Low Impedance	Risk Level RCD + RVT + HRE
Reverse Polarity	TN-C	TN-C Consumer Mains	Electrocution and Fire	Extreme	Eliminated
Loss of Supply Neutral	TN-C	TN-C Consumer Mains	Electrocution and Fire	Extreme	Eliminated
Loss of Main/Supply Earth	TN-C	TN-C Consumer Mains	Electrocution and Fire	Extreme	Eliminated
Short-Circuit/ Arc Flash	TN-C-S	TN-C-S MEN Main Sw./Bd.	Electrocution and Fire	Extreme	Eliminated
Corroded/ Damaged Earth Electrode	TN-C-S	TN-C-S MEN Main Sw./Bd.	Electric Shock and Fire	High	Eliminated
Loss of MEN Bond	TN-C-S	TN-C-S MEN/TNC Main Sw./Bd.	Electric Shock and Fire	High	Eliminated
Voltage Rise	TN-C-S	TN-C-S MEN/TNC Main Sw./Bd.	Electric Shock and Fire	High	Eliminated
Island Mode	TN-C-S	TN-C-S MEN Main Sw./Bd.	Electric Shock and Fire	Medium	Eliminated

WWEST Risk Matrix	Consequence				
	Likelihood	Major (Death/Disability)	Serious (Serious/Hospitalisation)	Minor (First Aid)	Insignificant (No Injury)
Almost Certain	Extreme	High	High	Medium	Medium
Likely	High	High	Medium	Medium	Low
Unlikely	High	Medium	Medium	Low	Low
Remote	Medium	Medium	Low	Low	Low

The many reported **solar or battery storage system fires** represent a failure of protective earthing fundamentals. This demonstrates that there is an Earthing system compatibility issue between the **ELV and LV side** of the installation with **Segregation** being a clear issue.

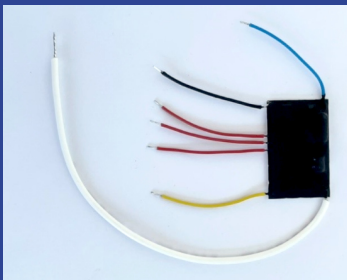


RCDP Inverter



Conflicting Standards have failed to provide clarity & have served to create confusion in terms of fundamental earthing compatibility issues. The **TN-C-S MEN** as designed, and as stated in **AS/NZ3000 Clause 5.1.2**, must "provide an effective & reliable low impedance fault path". A fully operational infrastructure, regular maintenance, and a 'good earth' are 'foundation pillars' of the **TN-C-S MEN earthing system**, put in place to mitigate the electrical safety risk. However, when any of these foundations are absent or compromised, which is becoming more commonplace, the underlying principles of safety are undermined.

The use of RCD's is mandatory in all earthing systems used within Australia and Globally under **AS/NZ:3000 and IEC 60364-4-41**. However, RCD's will not always work well or at all and can only operate effectively in a **TN-C-S low impedance earth environment**. Hence the application of RCD's in all other **Earthing Systems is inappropriate**, as they are impotent in terms of providing protection and only operate based on probability and the earth loop impedance path.



RVT-VMD

The **WWEST Residual Voltage Technology (RVT-VMD)** has evolved over a number of years, and is now the size of a postage stamp. This enables the technology to be integrated in all electrical products. Using micro electronics, on a super thin IC substrate and ceramic encapsulation ensures the RVT-VMD will operate in many product applications.

RVT-VMD;

- Independently tested by a NATA approved agency and is the only product of its type on the market.
- NSW Fair Trading issued a certificate of suitability CS10890 N
- Approved to Australian/New Zealand Standard 3100:2017 + A1 & Australian/New Zealand standard 3190:2016.

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