

TESLA 4000 Redundancy

This app note will cover selected topics on network redundancy and how they are implemented in the TESLA 4000 Recorder.

What is network redundancy?

The principle of network redundancy is to create two or more data paths within a network so that a single point of failure will not disrupt network communication.

The TESLA 4000 is capable of redundancy with the following protocols. Please be aware that in order to use one of the following protocols¹, the unit will have to be configured at the factory.

- RSTP (Rapid Spanning Tree Protocol; IEEE 802.1w) is for networks with multiple paths from source to target (like a mesh). RSTP uses hardware with algorithms to prevent network packets from being passed within the redundant paths and to use the quickest path from source to target. All hardware must be RSTP capable. *Basically, one data packet has many routes to get to the target.*
- PRP (Parallel Redundancy Protocol; IEC 62439-3 Claus 3). PRP is a type of redundancy where two completely separate paths are used simultaneously with the same data. The first data to arrive will be used and the second data (copy) will be discarded. Hardware at each end of the paths must be PRP capable. *Basically there are 2 identical data packets, each travelling on its own independent network to the target.*
- HSR (High availability Seamless Redundancy; IEC 62439-3 Clause 5) shares the same principle with PRP where there are two paths with the same data. If one fails the other will switch over almost immediately. Unlike PRP, typically a HSR connection incorporates a double attached node that connects the two interfaces to form a ring. Hardware on the ring must be HSR capable. *Basically, there are 2 identical data packets, each travelling on its own direction around the ring to the target.*

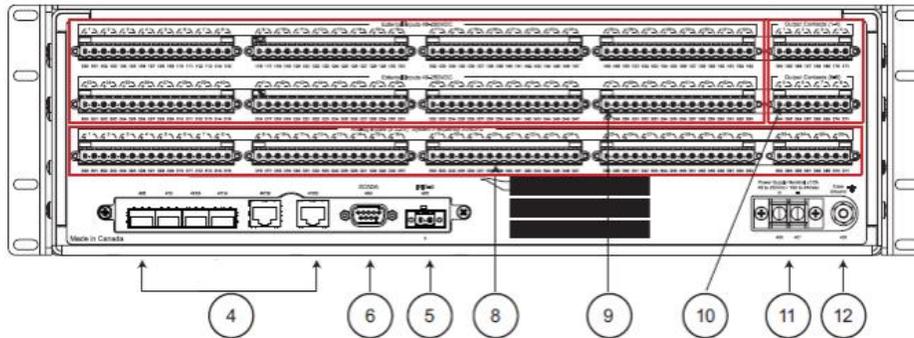
Redundant TESLA 4000 connections and configuration

The redundant TESLA 4000 will have a different configuration than the regular TESLA 4000 model with two network cards that have different MAC addresses.

¹ Protocols information source:

<https://www.excitingip.com/1688/understanding-spanning-tree-protocols-stp-rstp-mstp/>

https://www.eiseverywhere.com/file_uploads/21893ab38e0b7ba63a8c74d922f6d07f_hun_pap.pdf



- 4. Ports 401A/401B, 402, 410, 411A/411B: Network Ports
- 5. Port 403: IRIG B External Clock, modulated or unmodulated
- 6. Port 404: EIA 232 SCADA Communication (DNP 3 and Modbus)
- 8. Ports 300 – 347 (18), Ports 300 – 363 (3 6): Analog Input Channels. Non-isolated.
- 9. Ports 100 – 163 (18) and 200 – 263 (36): External (digital) Input Channels
- 10. Ports 164 – 171 and 264 – 271 (8): Output Contacts
- 11. Port 406 – 407: Power Supply (40-300 Vdc). Handles 48,125 or 250 Vdc or 120 Vac nominal
- 12. Port 408: Chassis Ground

Figure 1.4: Rear LAN Port Configuration: Option 4 Advanced

Figure 1 - TESLA 4000 back view diagram with redundant ports

Note: Since the network redundancy is an option in the TESLA 4000, when the product is ordered with the correct part number, the type of ports that will be provided for the redundancy are already predefined from factory. This can be seen under Figure 2-3 under network configuration of the ports that will provide the network redundancy.



Figure 2 – Rear view of a TESLA 4000 with redundant network ports

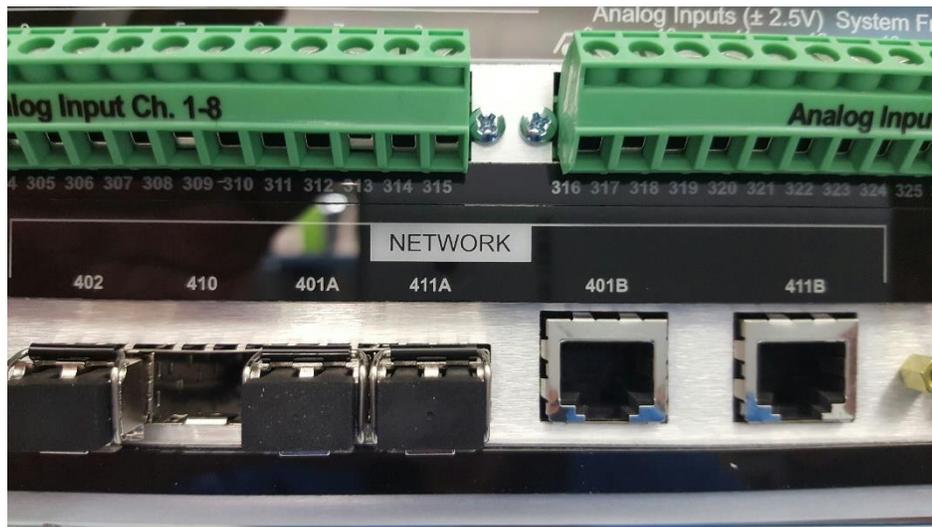


Figure 3 - Close up view of a TESLA 4000 with redundant network ports

Figure 2 & 3 show the network configuration for the redundant ports on the TESLA 4000.

- The redundant ports are 401 (A or B) and 411 (A or B) on the same subnet as front port 401
- 401A and 411A support LC type optical receptacle SFP, 100BASE-FX Ethernet interfaces
- 401B and 411B support RJ-45 receptacles (permanent factory installed), 100BASE-T Ethernet interfaces
- 402 is a non-redundant port with LC type optical receptacle SFP, 100BASE-FX Ethernet interface
- Port 410 is not used and on the same subnet as port 402

As shown in Figure 2 & 3, ports 401A/411A are the optical redundant ports and ports 401B/411B are the copper redundant ports.

Port configuration is read at unit power up – changing port configuration while powered up is not supported.

Since the TESLA 4000 will offer a combination of optical and copper ports, the following rules must be taken into account to select the desired combination of ports:

- If the unit powers up WITH an optical module in the 401A position, port 401A is enabled and port 401B is disabled/ignored
- If the unit powers up WITHOUT an optical module installed in the 401A position, then 401B is enabled/active
- If the unit powers up WITH an optical module in the 411A position, port 411A is enabled and port 411B is disabled/ignored
- If the unit powers up WITHOUT an optical module installed in the 411A position, then 411B is enabled/active
- Port 401 and 411 copper/optical selection is independent
- Connecting cables to any port will not guaranty redundancy. The following are the port combinations to ensure proper operation of the redundancy functionality of the TESLA 4000. Connect cables to ports 401* and 411* as follows:
 - 401A and 411A
 - 401A and 411B
 - 401B and 411A
 - 401B and 411B

If the user desires to use an optical and copper ports for redundancy, the following procedure must be followed:

- Use ports 401A and 411B for redundancy:
 - Power up the TESLA 4000 WITH an optical module in port 401A and WITHOUT an optical module in port 411A. This will enable ports 401A and 401B and will disable port 411A and 411B
 - Connect cables to Ports 401A and 411B
- Use ports 401B and 411A for redundancy:
 - Power up the TESLA 4000 WITH an optical module in port 411A and WITHOUT an optical module in port 401A. This will enable ports 411A and 401B and will disable port 401A and 411B
 - Connect cables to ports 401B and 411A

If the user desires to use only optical ports for redundancy, the following procedure must be followed:

- Use ports 401A and 411A for redundancy:
 - Power up the TESLA 4000 WITH an optical module in ports 401A and 411A. This will enable ports 401A and 411A and will disable port 401B and 411B
 - Connect cables to Ports 401A and 411A

If the user desires to use only copper ports for redundancy, the following procedure must be followed:

- Use ports 401B and 411B for redundancy:
 - Power up the TESLA 4000 *WITHOUT* an optical module in ports 401A and 411A. This will enable ports 401B and 4011B and will disable port 401A and 411A
 - Connect cables to Ports 401B and 411B

Any other port combination will cause an incorrect operation and redundancy will not be achieved as expected.

IP Addresses

There will be 3 IPs associated with a TESLA having a redundancy board:

- 1 IP address for redundant ports 401A/411A and 401B/411B
- 1 IP address for port 402
- 1 IP for the board that implements the redundancy. Using Maintenance login functions 8, then 9, and to have access to the IP address for the board inside the TESLA 4000 that will be managing the redundancy. This IP address is not usually changed.

Note: with the redundancy option installed there are a couple of other changes to the rear connections.

- The rear RS232 communication port is not available / not installed. This is normally port 405 on a standard TESLA 4000 unit.
- The IRIG connector is not BNC. It is a 2 wire connector. See picture below.



Figure 4 - IRIG-B and SCADA RS-232 ports