CHAR SYSTEM
OPERATION & TRAINING

Module 6
Reverse Time Domain Reflectometry

REVERSE TDR LEARNING OBJECTIVE

- Basic principles of RTDR testing
  - Shield integrity test to identify location of EMI coupling into shielded cable circuits
- Properly configure test connectors for RTDR testing
- Types of cables an RTDR test can be performed on
- Understanding anomalies that RTDR can identify
- Analyzing RTDR data by comparison to TDR signature
- Be able to perform an RTDR test

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PURPOSE OF RTDR

- Used to identify if cable and/or connector systems may be susceptible to transient electrical noise interference
- Identify the location where transient electrical noise can couple into cable systems
- RTDR testing is often performed on cable systems that carry low level signals (< 100 mV) because of susceptibility to noise interference
- RTDR is primarily used to diagnose shielding degradation in nuclear instrumentation (NI) cables and detector

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DESCRIPTION OF REVERSE TDR

- An electrical pulse is injected on the shield of a coax/triax cable from the cabinet connections
- The center conductor of the cable is simultaneously monitored for a return signal
- Excessive coupling of the injected pulse onto the center conductor indicates noise susceptibility in the system under test
- The distance to degraded shielding locations is calculated from the velocity of propagation

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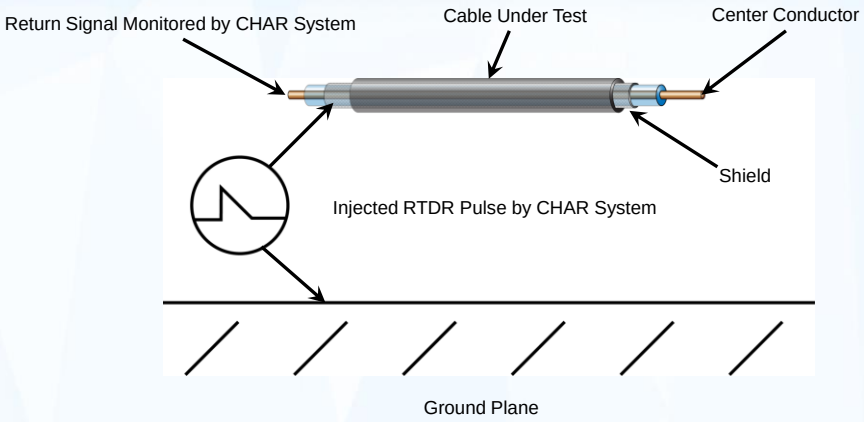
RTDR CONNECTION



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EQUIPMENT NEEDED

- CHARacterization System
- Paired 10 ft yellow RTDR test cables
- Coax or triax test adapter for connecting the RTDR Return test lead to the cable under test
  - Important Note: Adapter must maintain the 360° shield between the coax test lead and the cable under test
- BNC to banana adapter with large cable clamp
  - Used to inject noise pulse onto cable shield

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RTDR TEST PROCEDURE

- Configure the EID for the RTDR test
- RTDR test is applied under the Waveform tab
- Disconnect the cable under test from signal processing electronics i.e. instrumentation drawer
  - The RTDR test should use the 10 ft paired coax test cables provided with the CHAR System

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RTDR TEST PROCEDURE

- The "RTDR Return" Port on the front panel of the CHAR System is connected center conductor to shield of the cable under test
  - Note: The RTDR Return Port is used to measure voltage that may be coupled onto the center conductor during testing
- The "RTDR Return" test lead must be connected to the cable under test using an adapter that maintains 360° shielding

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RTDR TEST PROCEDURE (CONT'D)

- The "Shield Connection" port on the front panel of the CHAR System can be connected shield to ground or inner to outer shield (for triax cables)
  - Note: The "Shield Connection" port is continuously outputting a pulse that is injected on the shield of the cable under test

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RTDR TEST PROCEDURE (CONT'D)

- The "Shield Connection" test lead is connected to the cable under test using a BNC to alligator adapter
  - The BLACK alligator clip is connected to cabinet ground, or to outer shield (of triax cable)
  - The RED alligator clip is connected to the shield of the cable under test

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RTDR TEST CONNECTIONS TO THE CHAR SYSTEM

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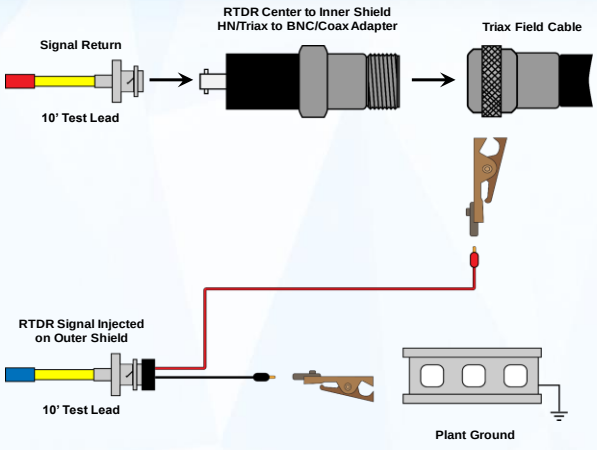
Slide 11 of 23

OUTER SHIELD TO STATION GROUND TRIAX RTDR CONNECTION



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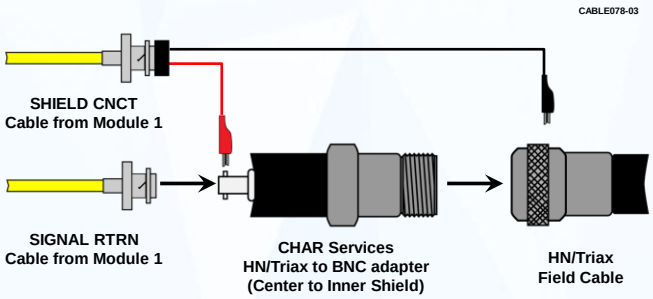
Slide 12 of 23

OUTER SHIELD TO INNER SHIELD TRIAX RTDR CONNECTION



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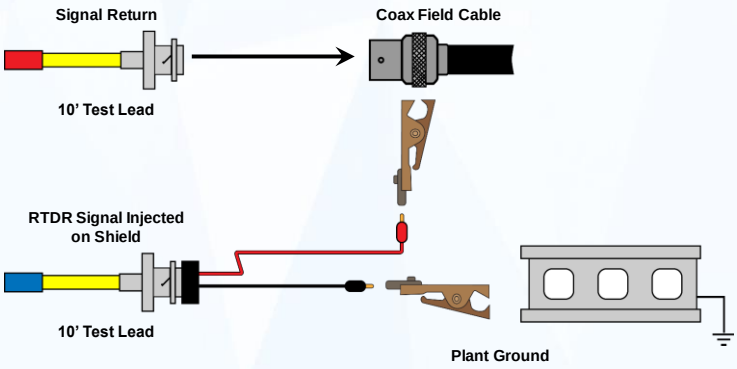
SHIELD TO STATION GROUND COAX RTDR CONNECTION



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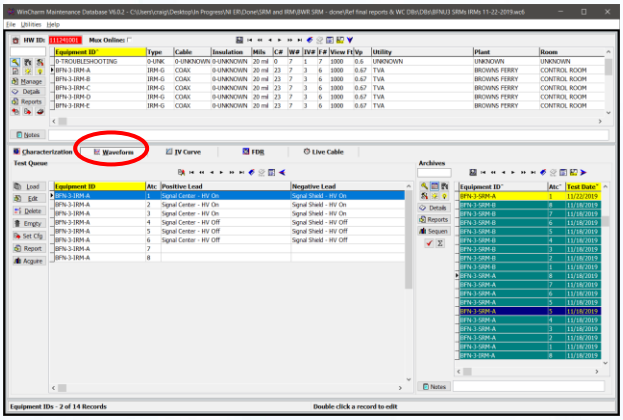
PERFORMING AN RTDR TEST WITH THE CHAR SYSTEM

The RTDR test is configured and applied under the WAVEFORM tab in the WinCharm software



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BASIC STEPS OF CONFIGURING THE WINCHARM SOFTWARE TO PERFORM AN RTDR TEST

- Load Test Queue
- Edit Attachment to change the following:
  1. Acquisition Type to RTDR
  2. Select 100mV Volts/Division as the initial setting (should be adjusted as needed)
- Select Acquire then Select "OK" to start the test

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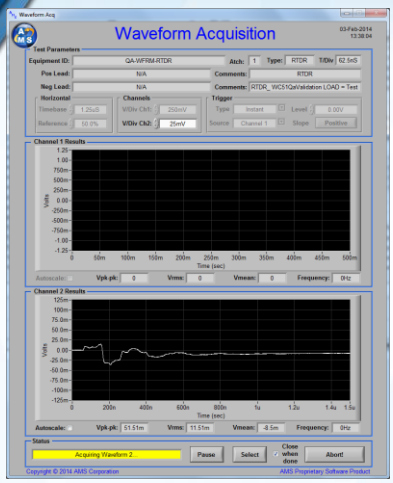
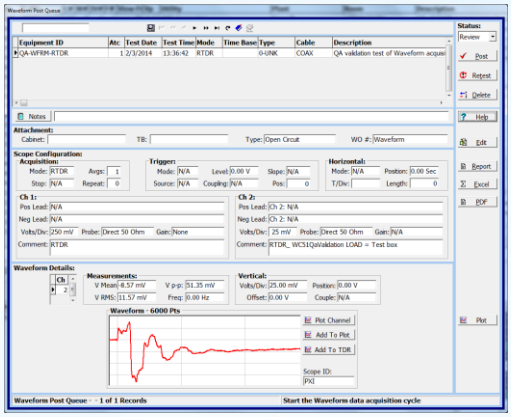
COLLECTING RTDR DATA AND POSTING TO ARCHIVE





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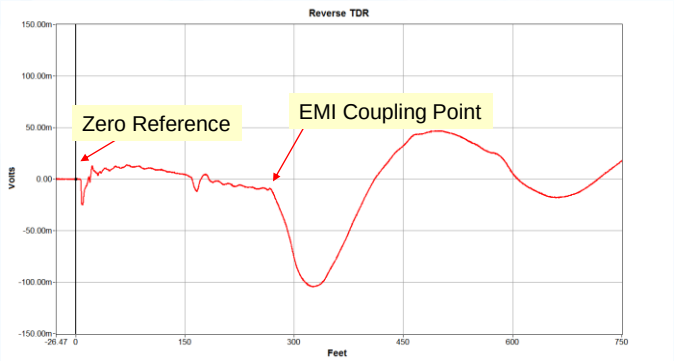
REVIEW OF RTDR DATA

- Thick vertical line represents test lead connection to cable under test
- Increase in RTDR coupling amplitude at 267 feet



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RTDR DETAILS

- Dark vertical line represents the signal injection point, Time = 0 sec, Distance = 0 feet.
- Bi-polar, sinusoidal waveform represents coupling at a shield/connection discontinuity.
- Reference “RTDR Quick Reference Guide” for a refresher on how to configure and apply RTDR

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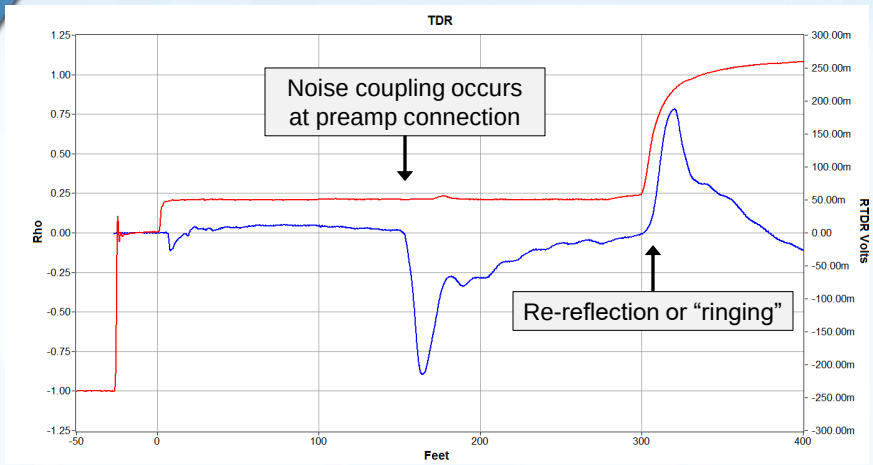
OVERLAY RTDR AND TDR PLOTS



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REVERSE TDR SUMMARY

- Degraded shield connections allow EMI to couple onto the signal cable output
  - EMI is then amplified by the preamplifier and may be recorded as neutron counts by the discriminator
- RTDR is a shield integrity test for coax or triax cables
- Velocity of propagation is used to determine the distance to the degraded shield location
- Overlay RTDR onto TDR signature to help determine the location of degraded shield connections
- TDR alone cannot identify noise susceptibility of cable shield

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LAB EXERCISE

Perform the RTDR demo as a group

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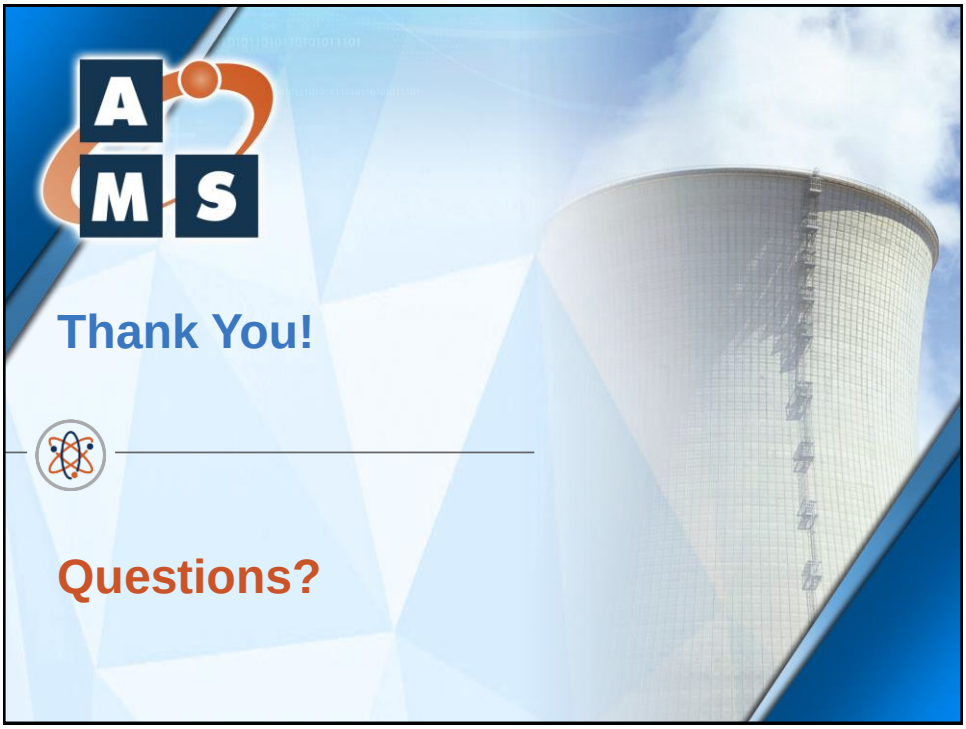
Thank You!
Questions?