How to Create a TESLA Cooperative Group

This application note describes the core procedure and settings required to establish a cooperative group of two TESLA 4000 recorders with cybersecurity on a network. Its application can be extended to a cooperative group of up to four recorders. Detailed information about configuration and operation of a Cooperative Group is provided in the TESLA 4000 manual.

This application note purposefully avoids duplication of information found in the manuals. Please refer to manuals for all instructions regarding basic settings, and the retrieval, manipulation and interpretation of record files.

TESLA Recorder Pre-Requisites

1. Each TESLA considered for cooperative group must be the same type. TESLA 3000 and TESLA 4000 recorders may not be combined in the same cooperative group.

2. Cooperative group exclusively uses Port 401 to establish inter-IED communication. Ensure that the recorder is set up properly to communicate over Port 401 before configuring the cooperative group.

3. Cooperative group recorders must be synchronized from a common external IRIG-B time source and must be present. SNTP time source is not recommended.

4. Configure elements and parameters to be displayed on the records.

Standard Configuration Parameters for the TESLA Unit

Configure each cooperative TESLA unit as a stand-alone independent device, including channels and triggers.

Cooperative mode operation requires key settings to be consistent on all recorders in a cooperative group. The following is a list of the critical settings that need to be identical for all cooperative units:

1. Time Control Settings (Main Menu>Time)
   UTC offset to be displayed in logs, screens and records
   Incoming IRIG-B Time Signal Properties
   Recorder Time Zone

2. Records Configuration Settings (Main Menu>Records>Records Config)
   Trigger Mode
   Pre-Trigger Mode
   Normal Record Mode
   Maximum Record Length

3. TESLA Device Configuration (Settings Edit>Identification)
   Sample Rate

It is wise to include the cooperative group or substation name in each defined TESLA name to make tracking and future associations easier. Include additional useful information in the comments field.

For this example, we'll use one TESLA 4000-36 recorder and one TESLA 4000-18 recorder. They were created and defined for use in the Winnipeg Substation. The ID screen definitions for the two units are shown in Figure 1.
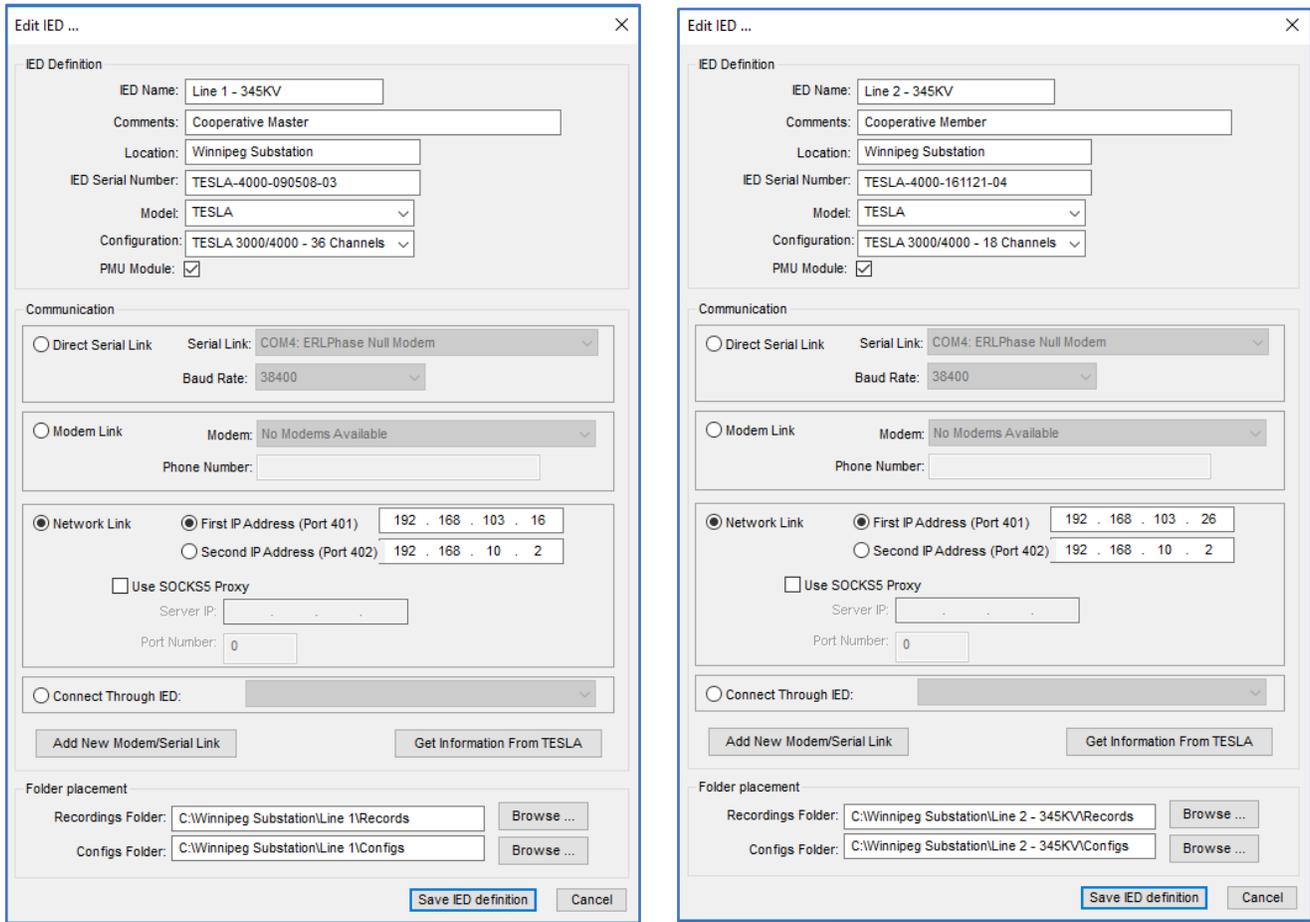
The location of recordings and configuration data is user selectable.

Figure 1 – Winnipeg Substation TESLA Units

TESLA Master Unit Configuration

One unit in a cooperative group needs to be designated as the Master Unit. The Master Unit is the primary interface between the cooperative group's units and TESLA Control Panel. In addition to its normal recording role, the Master Unit:

1. Maintains the list of group recordings
2. Provides the information needed by TESLA Control Panel to combine records
3. Provides IP address information about the other group members
4. Acts as the communication gateway for remote access

The settings for the defined Master Unit differ slightly from the standard group units as follows:

1. The IED comment should indicate that the unit is a Master Unit. See "Winnipeg SS Line1" in Figure 1.
2. The communication selection must agree with the type of communications that will be used for remote access to the Master Unit.

TESLA Pseudo Cooperative Group IED Configuration Parameters

Within TESLA Control Panel, a special Cooperative Group IED is created to work with the cooperative recording group's units. When the Cooperative Group Virtual IED is selected, TESLA Control Panel functions are applied to the group of recorders, rather than to an individual one.

From the TESLA Control Panel Main Menu, select "Add New" in the same manner as for a new TESLA definition. Define the folder location for the Recordings and Configurations. Open the drop-down "Configuration" menu and choose "*TESLA 4000 – Cooperative Mode*". Define names and comments that clearly associate the Virtual IED with the cooperative group and its location. Leave the IP Address field blank.

Select the "Connect Through IED" button and select the TESLA IED from the drop down box (that will be the Master Unit), then select "Save IED definition". See Figure 2.

Figure 2 – Cooperative Group IED

Once the Cooperative Group IED is created, all of the cooperative group units need to be added to the defined cooperative group. This is done on the Cooperative Mode Setup screen, and requires that all group units be powered on and connected to the network. To access the Cooperative Mode Setup screen while in TESLA Control Panel, select the Cooperative Group IED from the IED list on the Main Menu tab and click on *Connect*. See Figure 3.
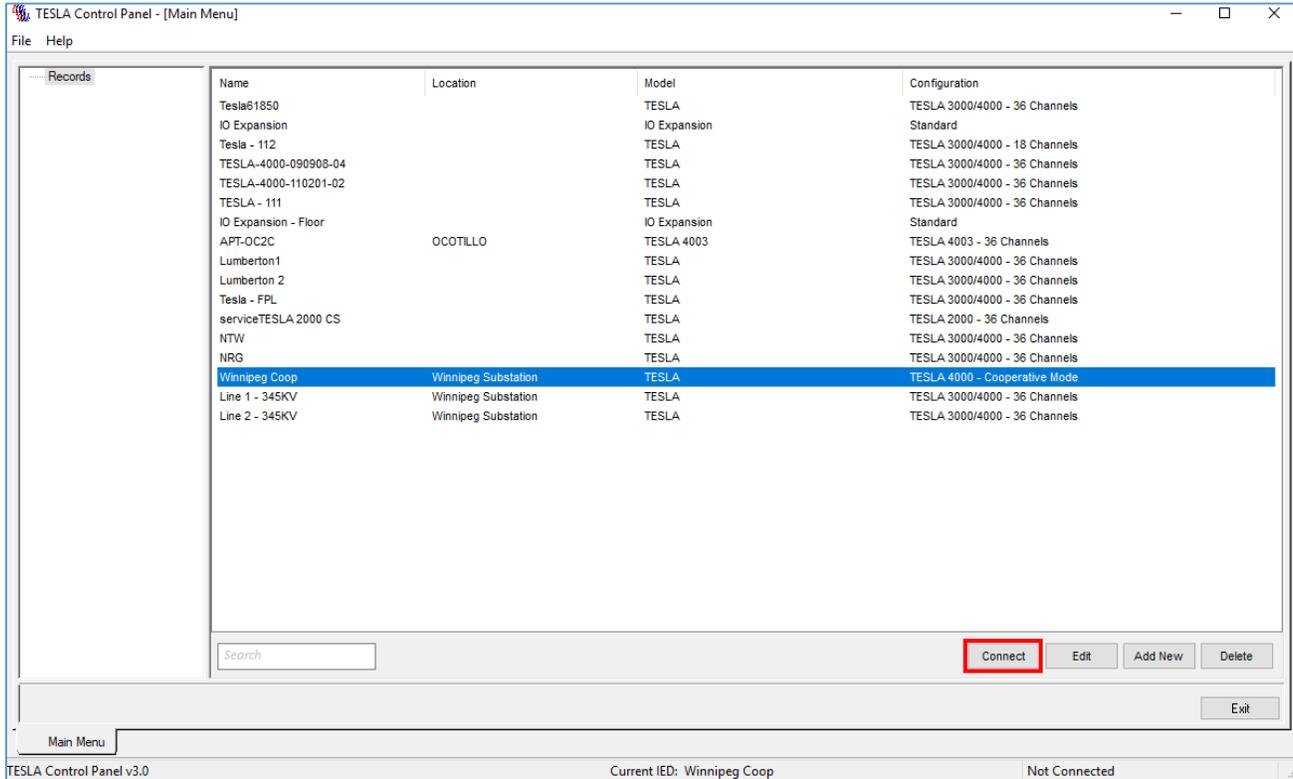

Figure 3 – TESLA IED List

You will be prompted for the login information. User must have either "Engineer" or "Update" roles in order to configure and save the Cooperative Mode setup. You may login with the username:

Username: service

Password: Service@2015

Once connected, the online window and Main Menu will appear. Note: unlike a standard connection with a TESLA unit, "Records" and "Coop" are the only options that appear. See Figure 4.
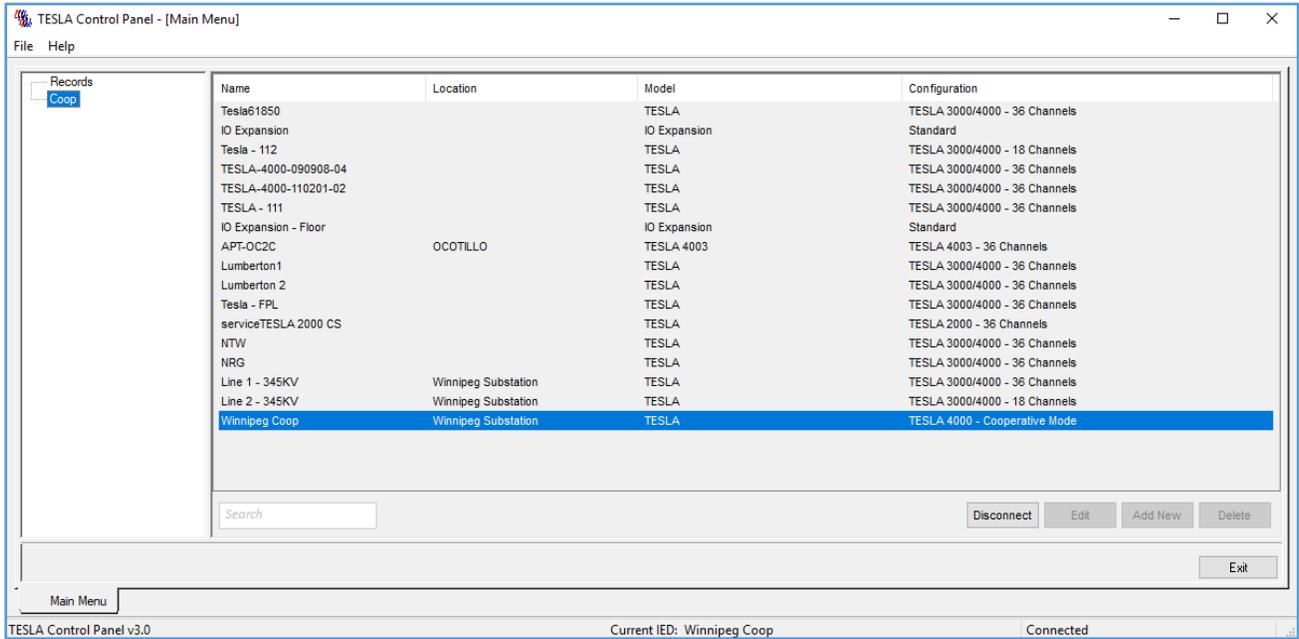
Select "Coop".

Figure 4 – Coop IED Main Menu

The "Cooperative Mode Setup" screen will appear and try to connect to the Master and the other members in the cooperative group. See Figure 5.
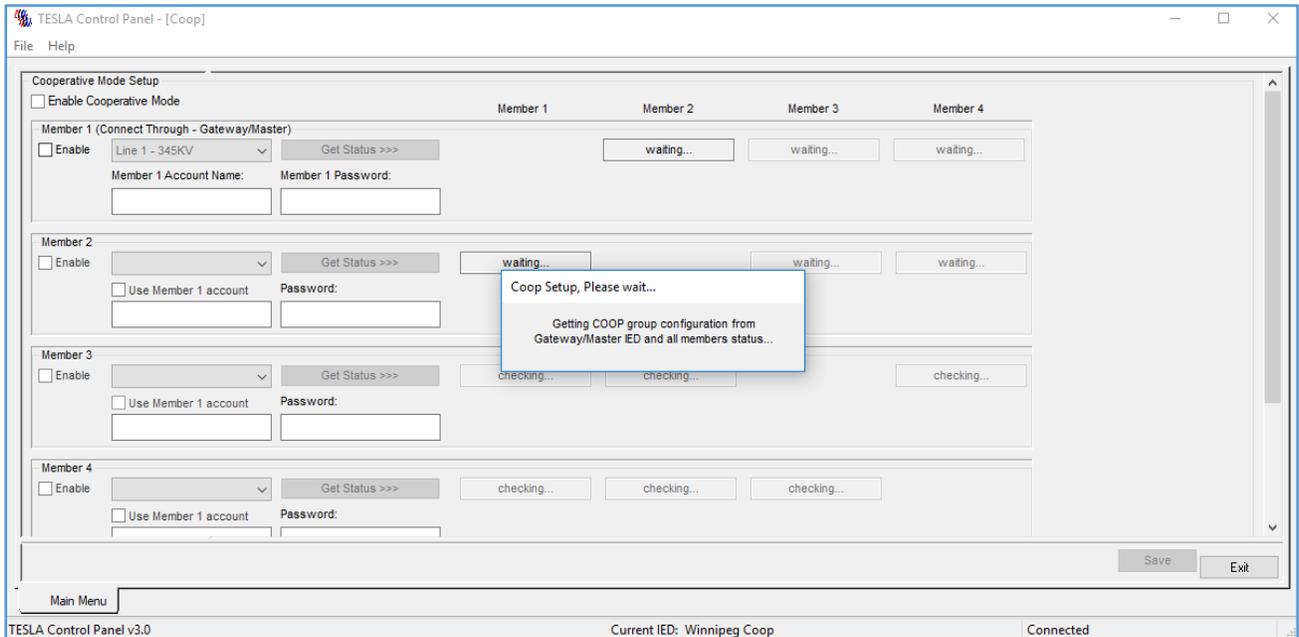

Figure 5 – Initial Cooperative Mode Setup

Once the communication check is completed, assign the other members that will be part of the cooperative group from the pulldown list. See Figure 6.
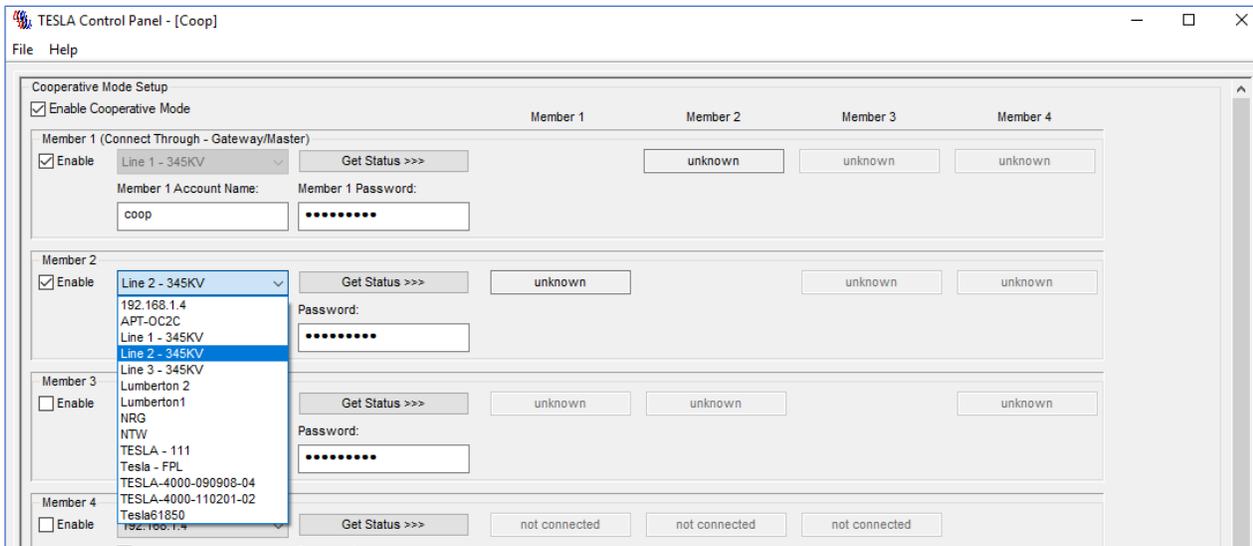

Figure 6 – Member Selection

Enable the member(s) that will be used in the cooperative group. Verify "Enable Cooperative Mode" is active.
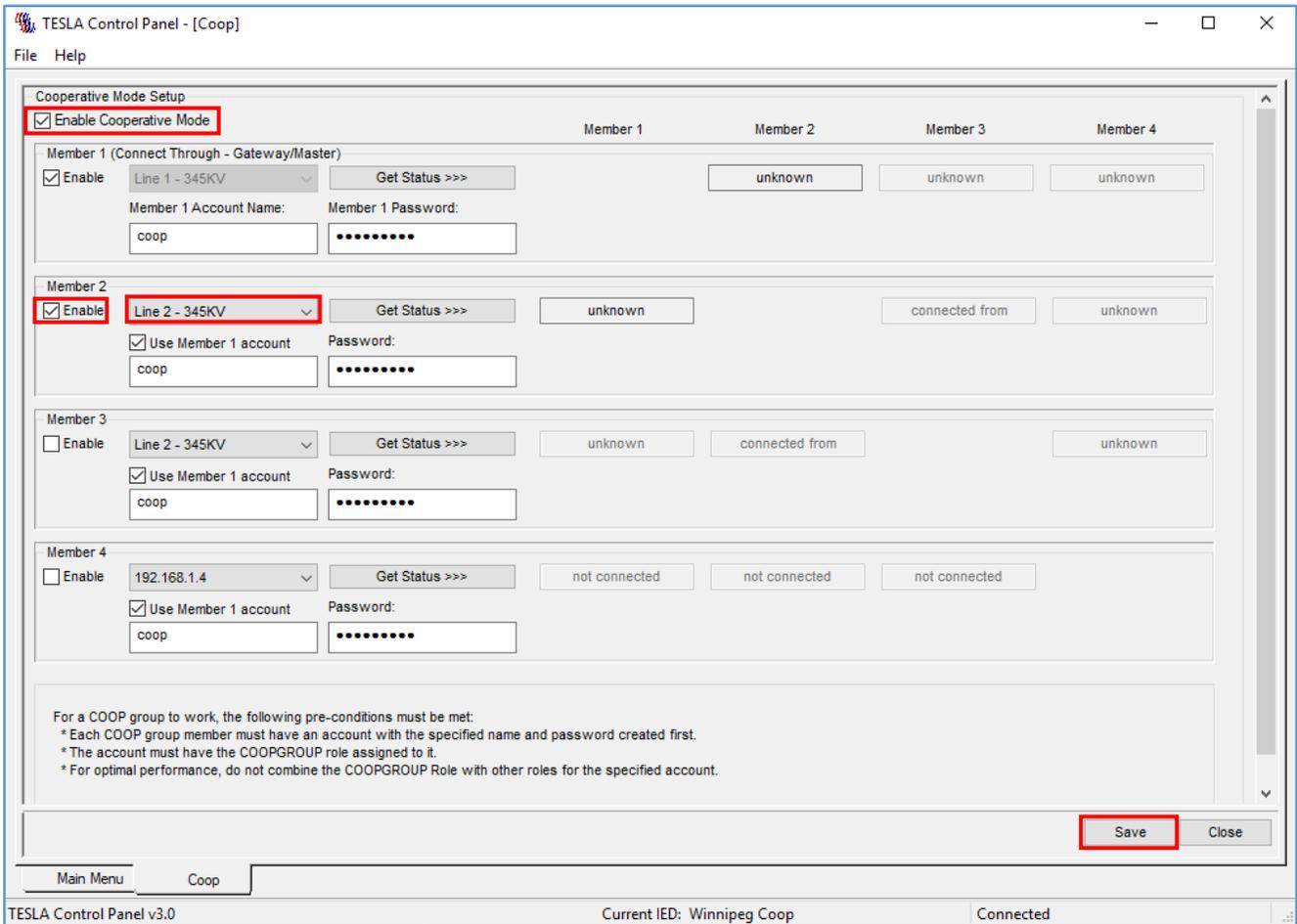
See Figure 7.

Figure 7 – Cooperative Mode Setup

There is a 75 second delay for all members to save their changes and activate or deactivate. See Figure 8.
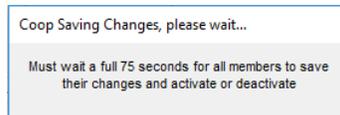

Figure 8 – Coop Saving Changes

To remove or modify a member within the cooperative group, unselect the member (break the cooperative group) and select "Save". Now select the new member and select "Save" to create the new cooperative group.

Note: This member list determines the order in which the records are combined. The member number shown will be appended onto each digital and analog channel in the combined record, to identify which unit it came from.

TESLA Control Panel will attempt to connect to each unit to provide member IP addresses and to enable cross-triggering. Progress status information will be displayed as each member unit is connected and updated. When the status of each member is displayed as "connected", the communication between the Master and Member(s) has successfully been established. See Figure 9.

On completion, select "Close". Cooperative record group configuration is now complete and cross-triggering, record collection and combining of member records are now enabled.
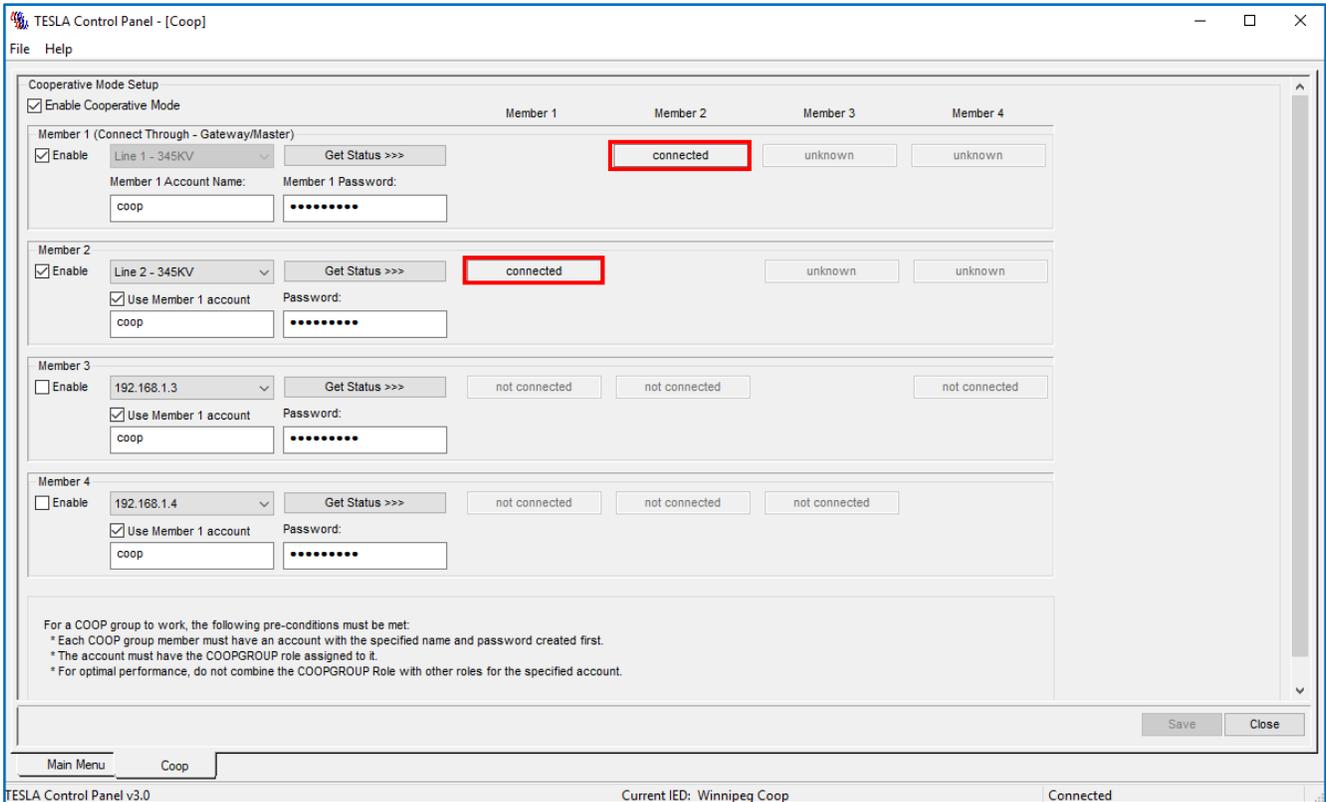

Figure 9 – Cooperative Group Established

If this process fails, check the unit's IED definition for errors, and check for a proper network connection to all units. You can also try to modify the Cooperative Mode Setup by enabling or disabling members and select "Save".

Note: A quick communication integrity test can be performed prior to attempting the cooperative mode setup by simply connecting to each unit from Control Panel.

The integrity of the cooperative group is constantly verified by the Cooperative Mode Master. If a member of the cooperative group is removed from service and is not replaced, make sure that unit is also removed from the cooperative group configuration.

The successful operation of the cooperative group depends on stable communication between the members and on a reliable IRIG-B signal. If either communication or IRIG-B is interrupted, the performance of the cooperative group will be affected.

TESLA Cooperative Group Records Viewing

To verify the operation of the cooperative group, manually trigger a record. Access the records by logging into the Cooperative Mode IED and selecting "Records". See Figure 10.
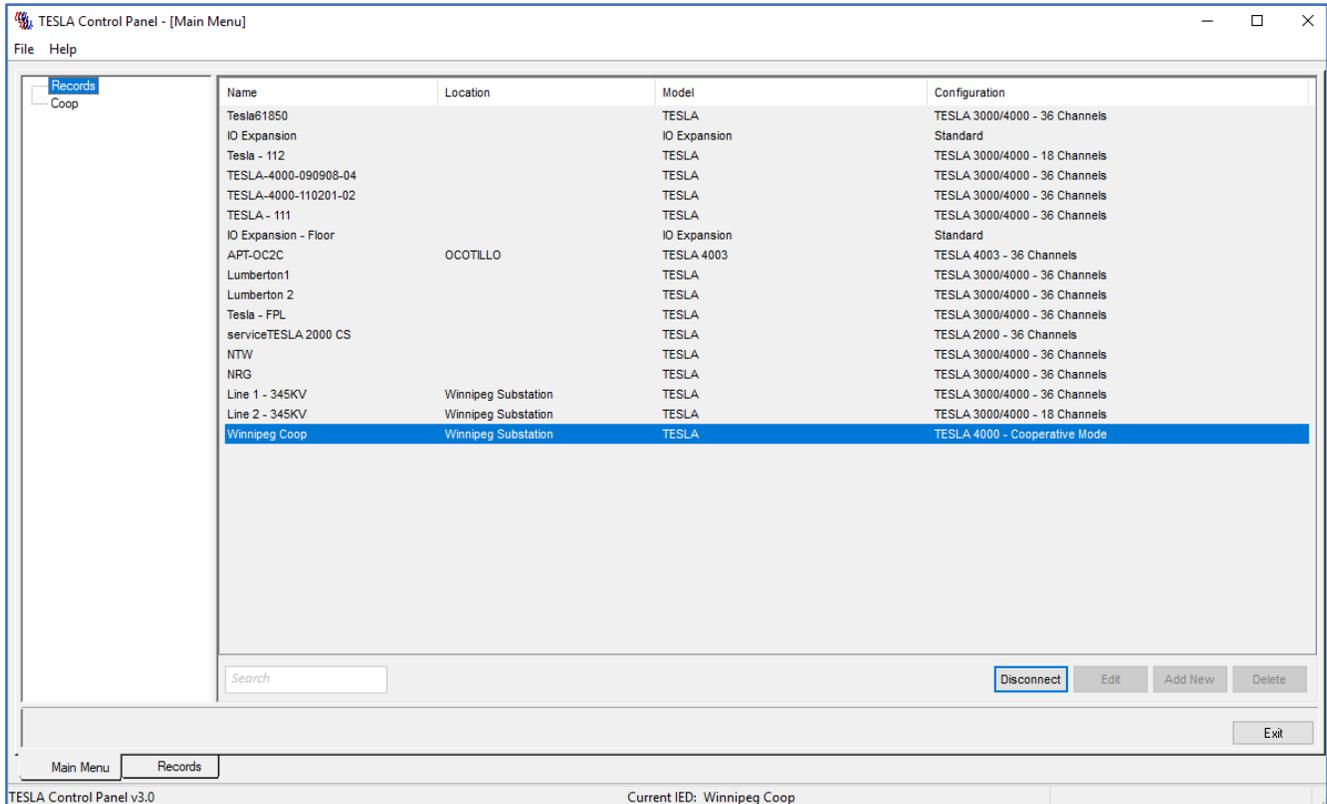

Figure 10 – Main Menu Records

In the Records menu, select "Trigger Fault" to create a manual trigger. By performing this action, it will trigger all the TESLAs in the Cooperative Mode. See Figure 11.
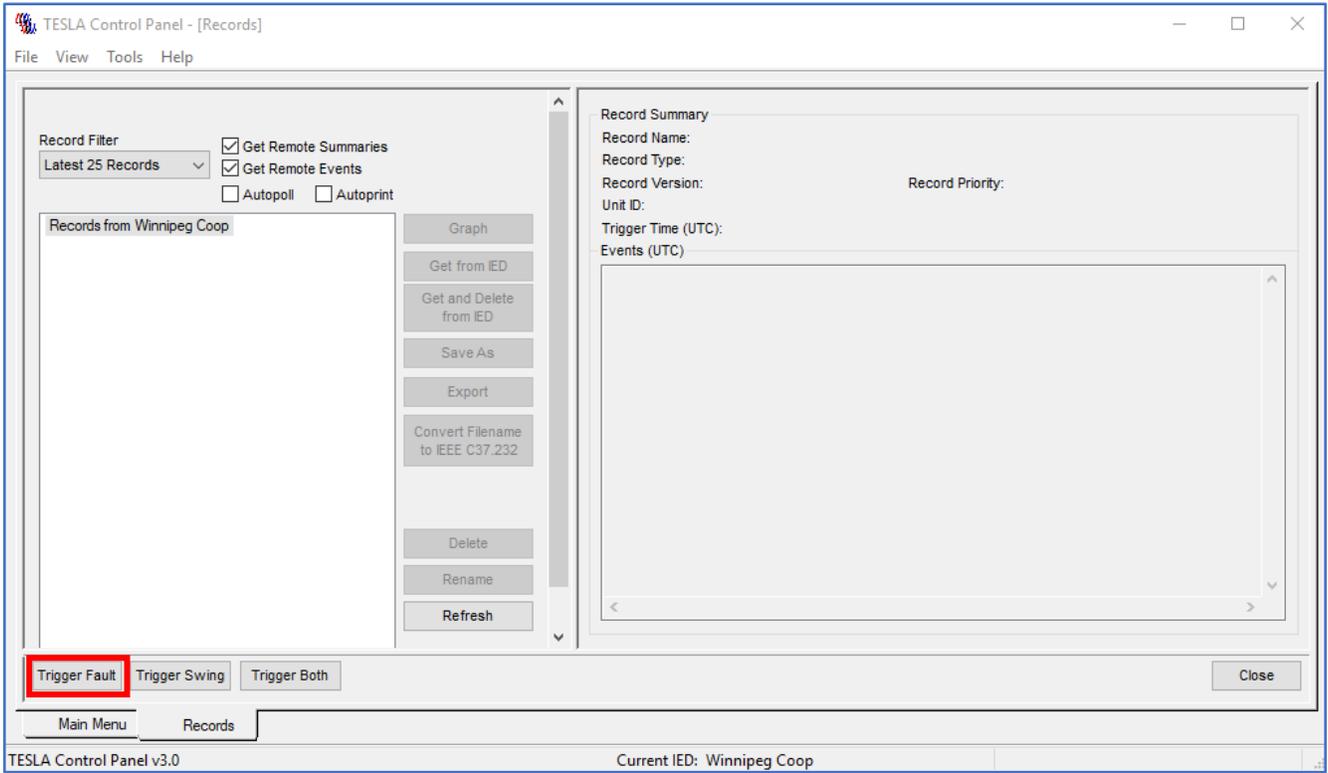
Figure 11 – Manual Trigger
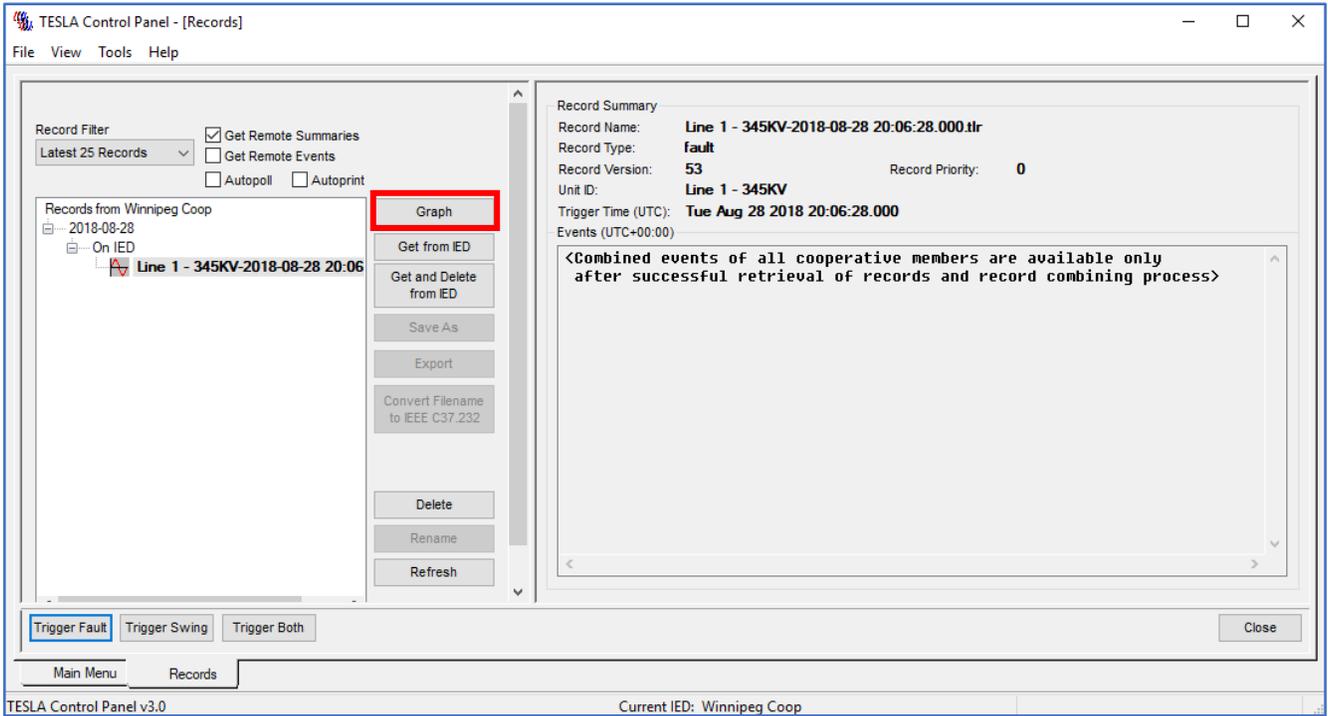
Select the record and select "Graph".

Figure 12 – Retrieve Record

When opening the graph, records will be retrieved from each member of the cooperative group. In this case, see Member 1 (Figure 13) and Member 2 (Figure 14) records being retrieved.
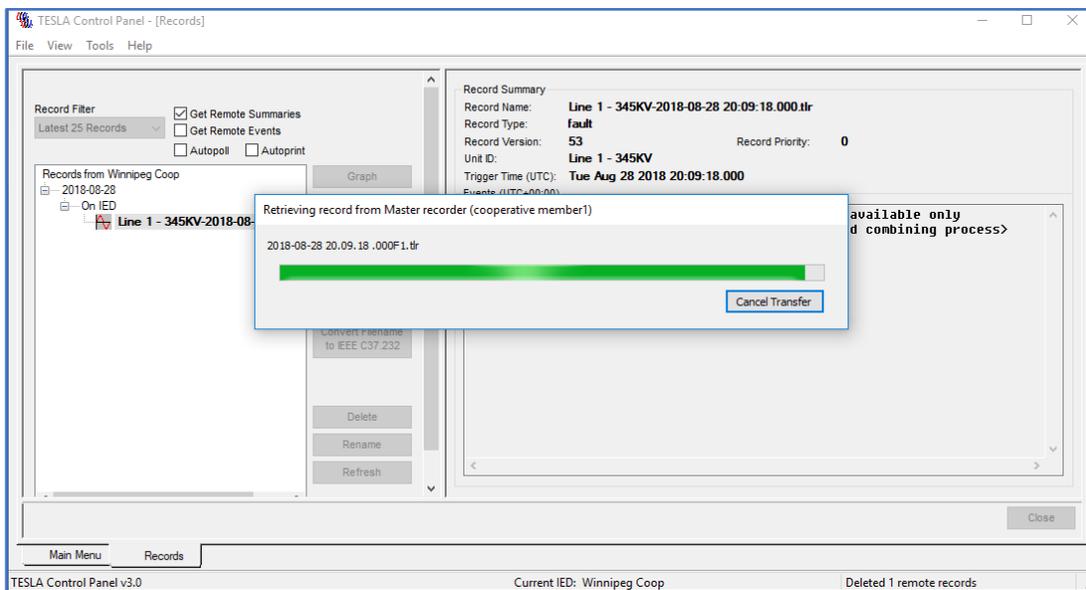

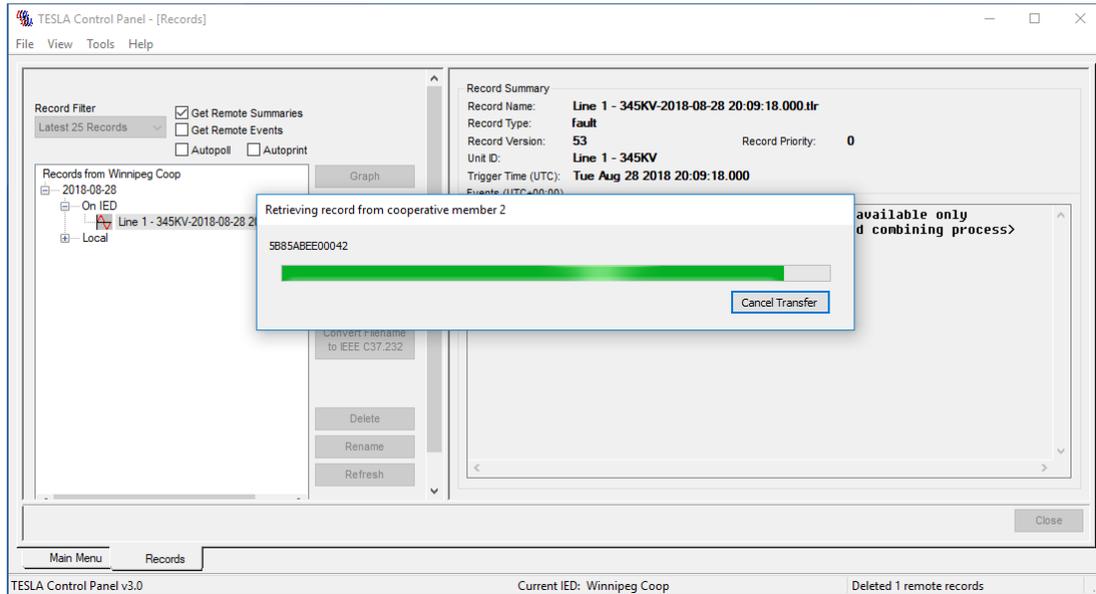Figure 13 – Member 1 Record Retrieval

Figure 14 – Member 2 Record Retrieval

Once the data has been retrieved, the Events screen displays the cooperative group record activity. See Figure 15 and note that in this case a manual trigger also created a group trigger.
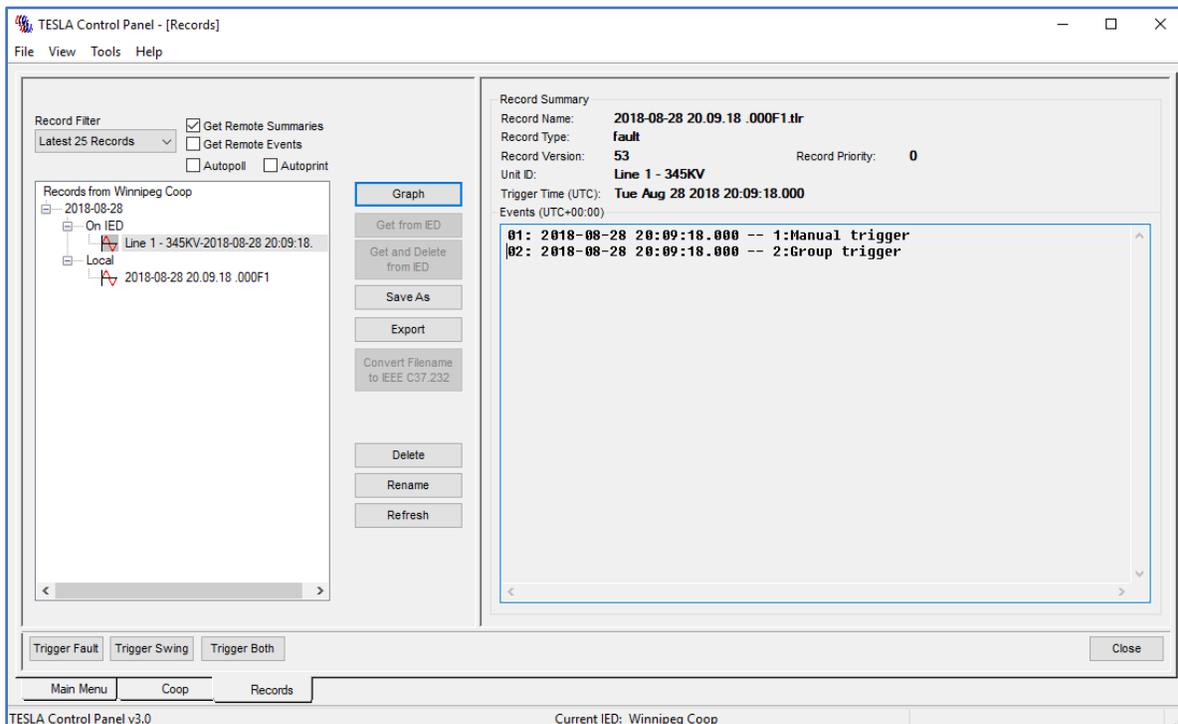

Figure 15 – Record Event

RecordGraph Viewing

Now view the contents from the cooperative group. Line 1 was configured as the Master and Line 2 was configured as a Member. Here the record data from the cooperative group has been appended into one record and made available for the different view configurations inside RecordGraph.
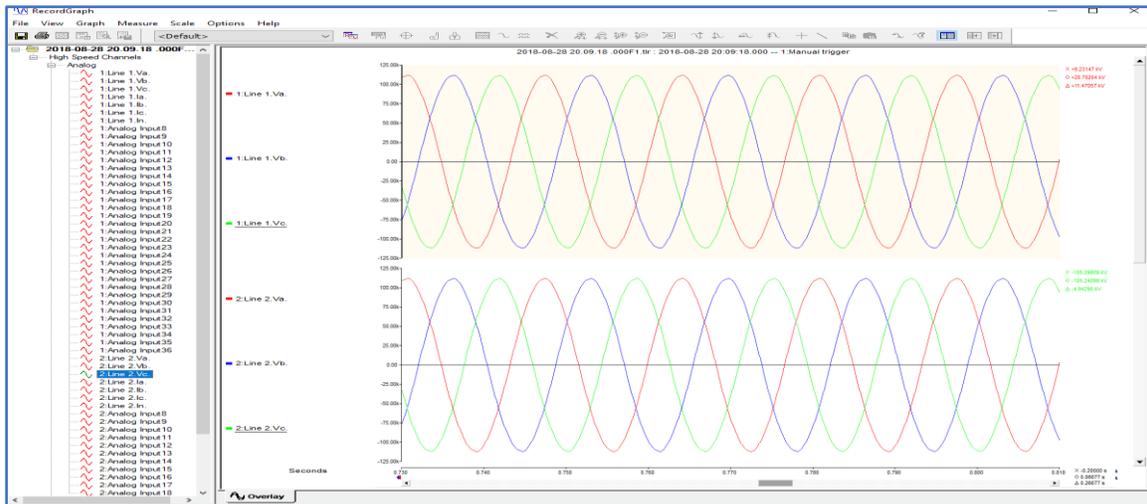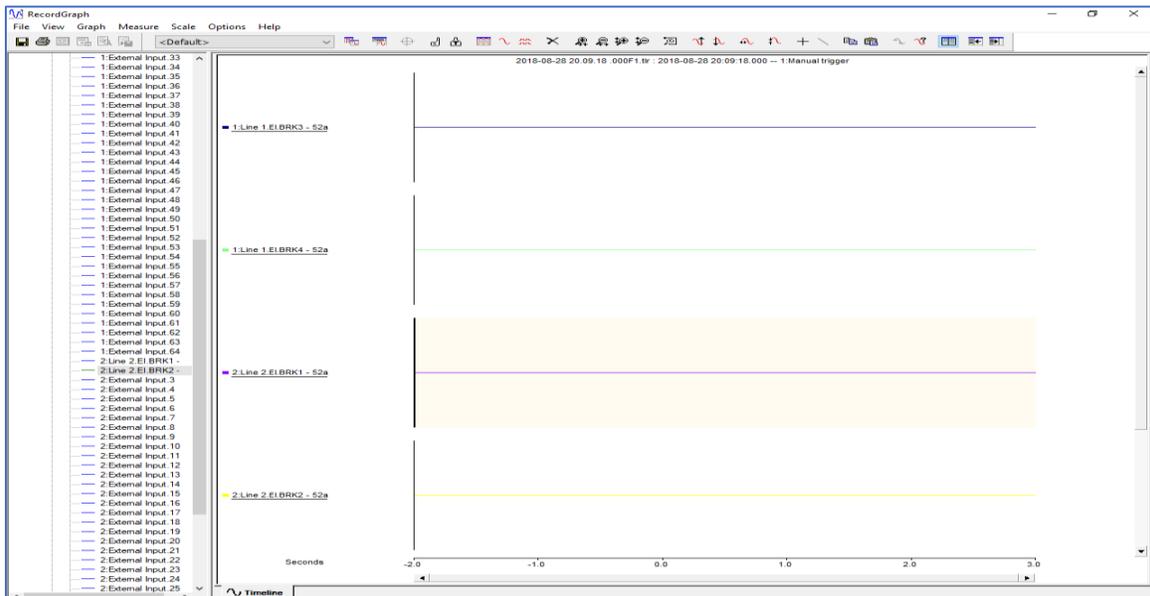

Figure 16 – Coop Mode Record – Analog Inputs Record

Figure 17 – Coop Mode Record – Digital Inputs Record