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# **SL1487A PC Software CCS Charging Protocol Trace Viewer SW Version 1.2.0**

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## Notices

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Do not proceed beyond a **DANGER** notice until the indicated conditions are fully understood and met.

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 **WARNING** A **WARNING** notice indicates a hazardous situation which, if not avoided, could result in death or serious injury.  
Do not proceed beyond a **WARNING** notice until the indicated conditions are fully understood and met.

---

 **CAUTION** A **CAUTION** notice indicates a hazardous situation which, if not avoided, could result in minor or moderate injury.  
Do not proceed beyond a **CAUTION** notice until the indicated conditions are fully understood and met.

---

**NOTICE** A **NOTICE** indicates to pay attention to an operating procedure, practice, or the like that, if not correctly performed or adhered to, could result in damage to the product or loss of important data.  
Do not proceed beyond a **NOTICE** until the indicated conditions are fully understood and met.

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**NOTE** A **NOTE** refers exclusively to application notes without any security relevance.

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# 1 Symbols

For this document, the following abbreviations apply:

<b>API</b>	Application Programming Interface
<b>CCS</b>	Combined Charging System
<b>CPT</b>	Charging Protocol Trace Viewer
<b>EXI</b>	Efficient XML Interchange
<b>GPL</b>	General Public License
<b>HAL</b>	Hardware Abstraction Layer
<b>NSS</b>	Network Security Services
<b>SDP</b>	Service Discovery Protocol
<b>TLS</b>	Transport Layer Security
<b>V2G</b>	Vehicle to Grid
<b>XML</b>	eXtensible Markup Language

## 2 License Management

The usage of the Keysight Charging Protocol Trace Viewer requires a valid license.

With order fulfillment, you should have received an email with instructions on how to register and redeem a license using the Keysight Software Manager (KSM).

For further assistance with the PathWave License Manager setup, please follow the proceeding defined in [Keysight Licensing Quick Start Guide](#).

For a comprehensive understanding, please consult the [Keysight Licensing Administrator's Guide](#).

## 3 Installation

This section describes how to install the CCS Charging Protocol Trace Viewer and the corresponding plugins for Wireshark.

### Requirements

The following requirements are needed for using this software:

- Windows 10/11 (64Bit)
- Wireshark Version 4.2.X (64Bit)
  - <https://www.wireshark.org/>
- WinPcap 4.1.3 or Npcap (Implicitly enabled during Wireshark installation, install in WinPcap API-compatible Mode)
  - <https://www.winpcap.org/>
- PathWave License Manager
  - **PathWave License Manager V2.7**
    - Please use Version 2.7 under Previous Versions and not 7.2

**NOTE**

**The Software was tested with the Wireshark Version 4.2.0 (v4.2.0-0-g54eedfc63953).**

**PathWave License Manager Version 2.7 was used.**

---



## Installing the Keysight Charging Protocol Trace Viewer - Decoder

### NOTICE

**If a previous version is already installed, make sure to uninstall it first to prevent update issues. Uninstallation can be done in Programs and Features in the Control Panel.**

To install the *Keysight Charging Protocol Trace Viewer - Decoder* software, please use the following procedure (see also [Figure 1](#) - [Figure 3](#)):

- 1 Double-click on the installation file to start the setup wizard and confirm the process with “*Next*” button.

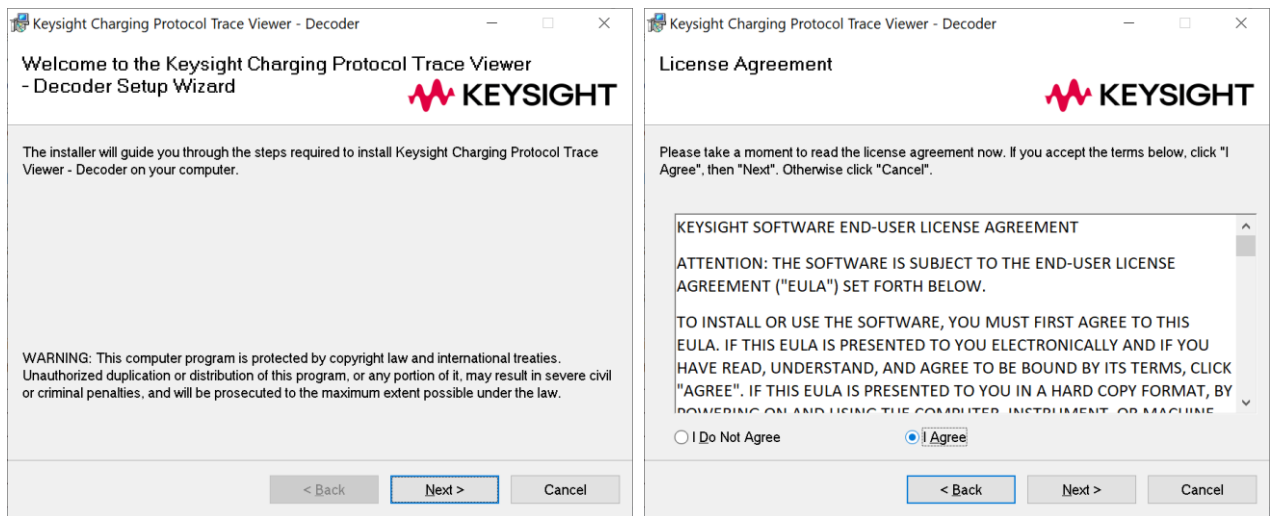


Figure 1: CPT - Decoder Installation - Welcome and EULA

- 2 Accept the license agreement with “*I Agree*” option and click on “*Next*” button.
- 3 Select the default installation path and click on “*Next*” button.

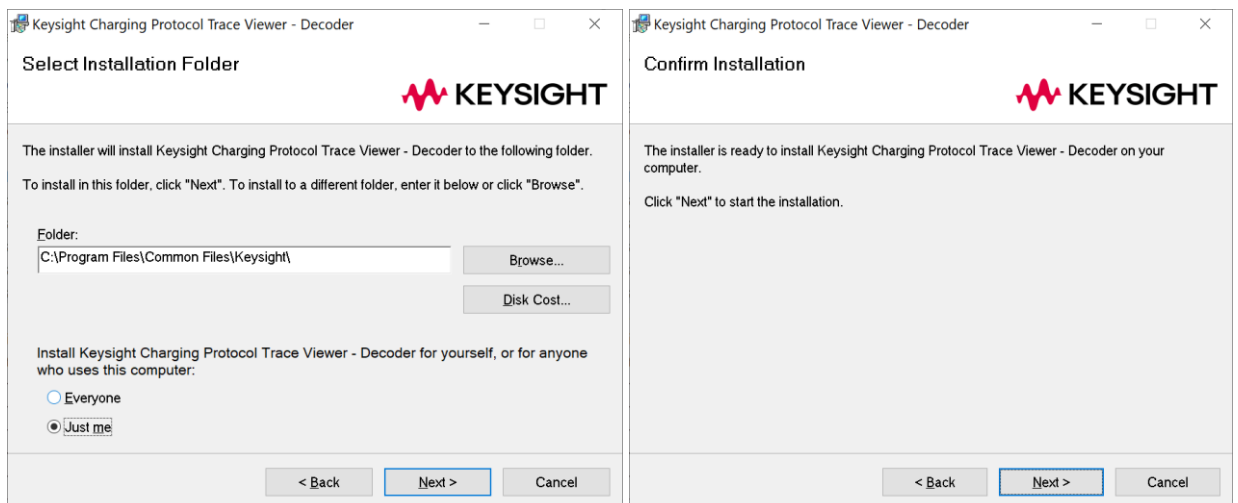


Figure 2: CPT- Decoder Installation - Installation folder selection

**NOTICE**

If the CPT Decoder is used with Wireshark, the default installation path must be used.

---

- 4 Start the installation with the “Next” button, and the software will be installed on your machine. Once the installation is complete, you can close the window.

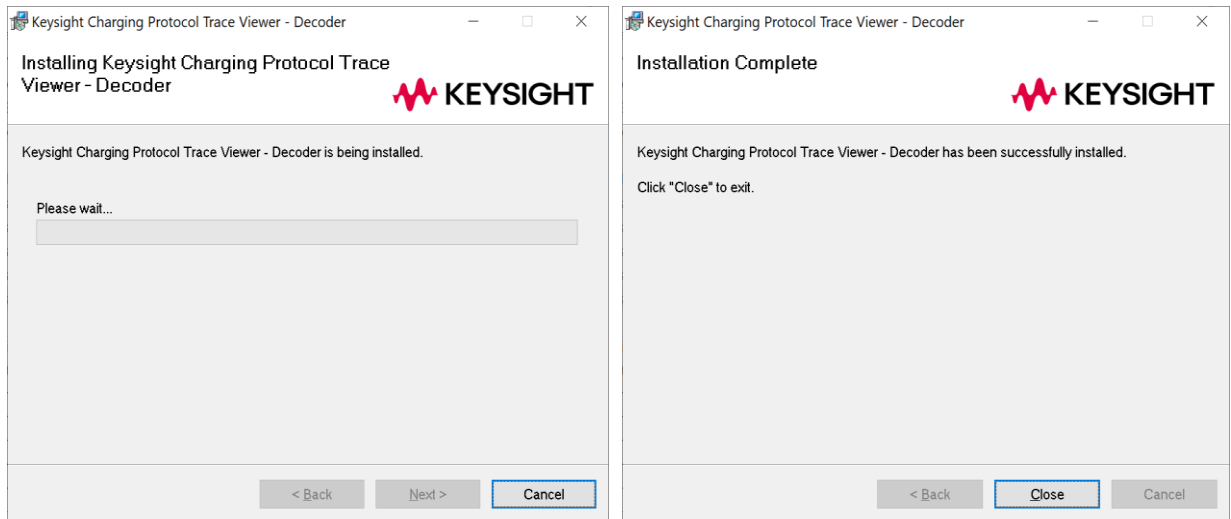


Figure 3: CPT - Decoder Installation - Installation progress and completion window

## Installing the Keysight Charging Protocol Trace Viewer

**NOTICE**

If a previous version is already installed, make sure to uninstall it first to prevent update issues. Uninstallation can be done in Programs and Features in the Control Panel.

---

To install the *Keysight Charging Protocol Trace Viewer*, please use the following procedure (see also [Figure 4 - Figure 7](#)):

- 1 Double-click on the installation file to start the setup wizard and confirm the process with “*Next*” button.

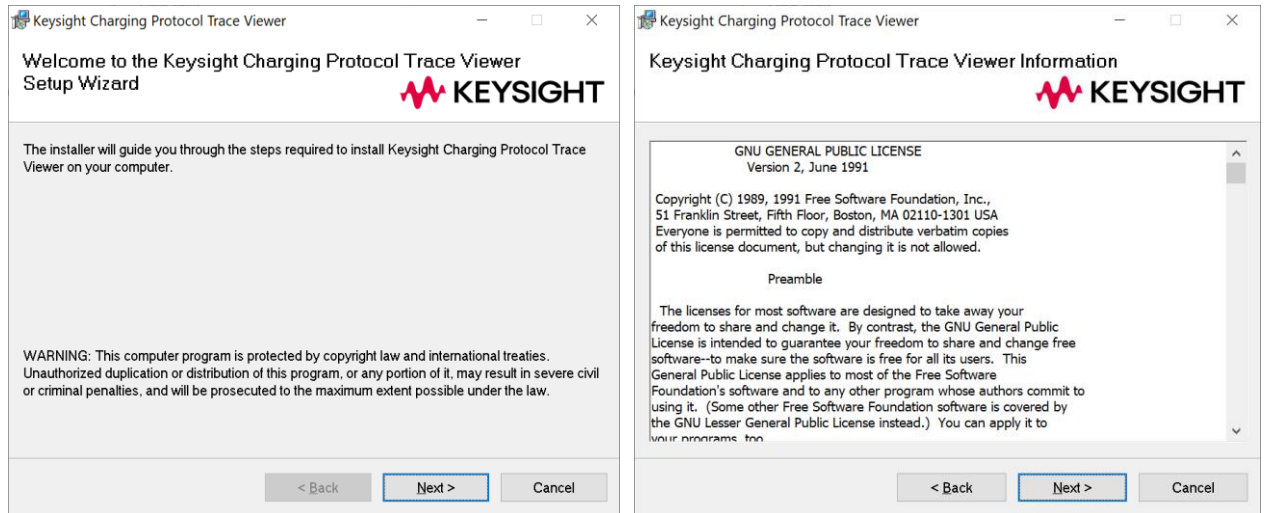


Figure 4: Keysight CPT Installation - Welcome and GNU GPL 2 license notice

- 2 Confirm the GNU GPL v2 license notice with “*Next*” button.
- 3 Select the default installation path and click on “*Next*” button.

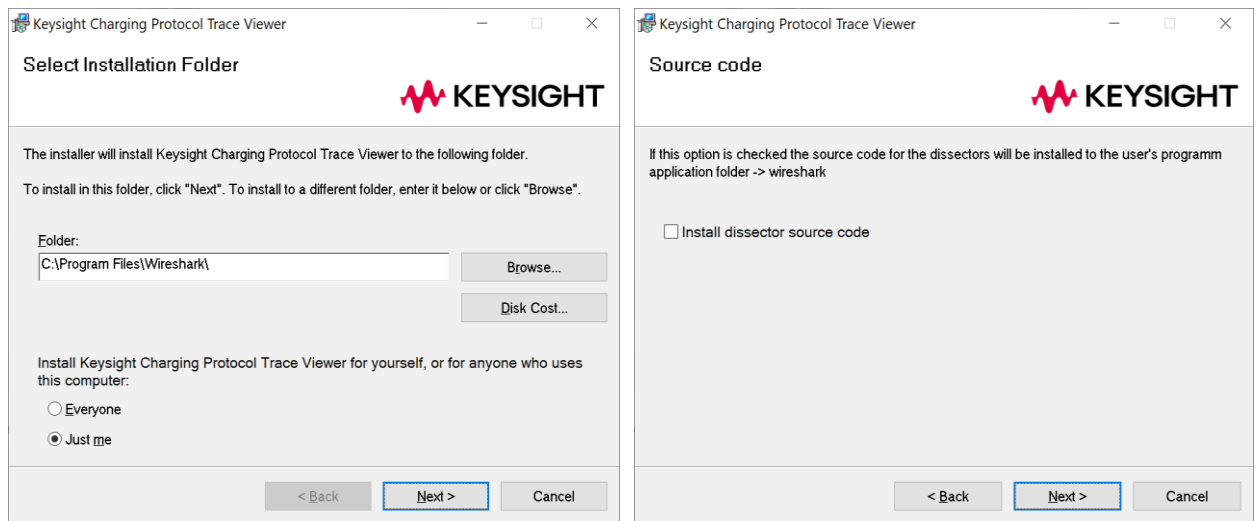


Figure 5: Keysight CPT Installation - Installation path and source code

#### NOTICE

**When prompted, select the installation path of Wireshark on your machine. If the wrong path is used, the dissectors cannot be used correctly.**

- 4 As an option, the source code of the dissector can be installed under **C:\Users\Username\AppData\Roaming\Wireshark\Source\_Code\_Wireshark\_Dissector** by enabling the checkbox “Install dissector source code”.

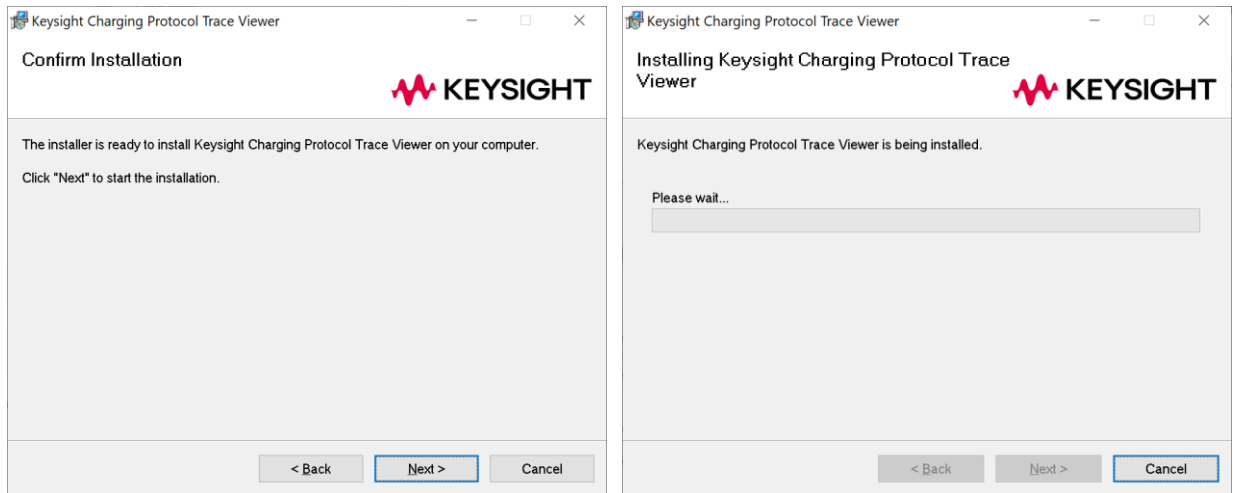


Figure 6: Keysight CPT Installation - Installation progress

- 5 Start the installation with “Next” button, and the software will be installed on your machine. Once the installation is complete, you can close the window.

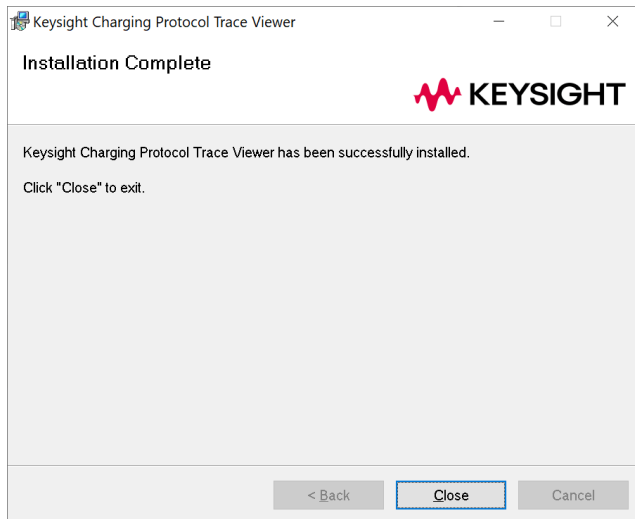


Figure 7: Keysight CPT Installation - Completion window

## 4 Keysight Charging Protocol Trace Viewer

### Charging Protocol Trace Viewer

After the installation of the *Keysight Charging Protocol Trace Viewer* the plugin can be used in Wireshark. The CPT Decoder will always be executed with Wireshark on the startup. The decoder is started on port 1111 by default but can be changed to any number between 1023 and 65535 in the corresponding settings under **Tools** → **Keysight CPT Plugin** → **Keysight CPT Settings**. Besides that, the current decoder status is illustrated in the dissector settings as can be seen in Figure 8.

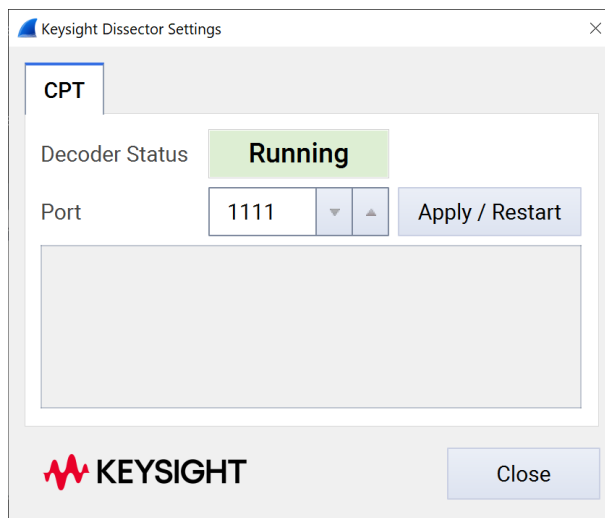


Figure 8: Dissector settings for the CPT Decoder

#### NOTE

**A port change terminates all previous decoder processes and restarts them on the new port. This process may take a few seconds.**

### HAL Protocol

The CPT Decoder supports proprietary messages defined for the hardware abstraction layer (HAL). HAL messages consist of two parts: A header and a payload field. The protocol is used in the following scenarios:

- Internal VERISCO configuration messages for the CCS Hardware Test Adapter
- IEC 61851-1:2017 Control Pilot configuration and event messages related to PWM signal characteristics
- IEC 61851-1:2017 Proximity configuration and event messages

**NOTICE**

**.pcap files with HAL messages that belong to previous Software versions released before 2021 are not displayed correctly due to major changes in the HAL library.**

The screenshot shows the Keysight Charging Protocol Trace Viewer interface. The top menu includes File, Edit, View, Go, Capture, Analyze, Statistics, Telephony, Wireless, Tools, and Help. Below the menu is a toolbar with various icons. A display filter is set to '<Ctrl>+'. The main window displays a list of network packets with columns for Time, Source, Destination, Protocol, Length, and Info. The selected packet (Time: 72.896612) is highlighted in green. The packet details pane shows the following information:

```

> Frame 781: 60 bytes on wire (480 bits), 60 bytes captured (480 bits)
> Ethernet II, Src: MS-NLB-PhysServer-32_03:00:00:00:05 (02:23:00:00:00:05), Dst
  VERISCO HAL Protocol
  HAL Header
    Component: CONTROL_PILOT
    Sub Component: MEAS_STATUS_SUB
    Command: WATCH_PERIODIC_STATUS
    Mode: MODE_EV
    Ack: ACK_SUCCESS
    Timestamp: : Jan 1, 1970 01:00:00.001179663 Mitteleuropäische Zeit
    Payload Size: 18
  HAL Payload
    frequency: 1000.000
    dutyCycle: 5.000
    posVoltage: 8.597
    negVoltage: 11.658
    proximity: 1457
    cpState: STATE_B
  
```

The packet list shows several VERISCO HAL messages, including WATCH\_PERIODIC\_STATUS, SET\_TEMPERATURE\_CHECK\_1\_REQ, SET\_TEMPERATURE\_CHECK\_1\_RES, SET\_TEMPERATURE\_CHECK\_2\_REQ, SET\_TEMPERATURE\_CHECK\_2\_RES, RESET\_ALL\_ERRORS\_REQ, and RESET\_ALL\_ERRORS\_RES. The selected packet is a SessionSetupReq (COMMON\_Message) with a length of 134 bytes. The packet details pane shows the SessionSetupReq structure with fields for frequency, dutyCycle, posVoltage, negVoltage, proximity, and cpState.

Figure 9: Example for HAL message decoding

## V2G Protocol

The CPT Decoder supports message decoding of Combined Charging System (CCS) charging protocols according to DIN 70121, ISO 15118-2/-20. All relevant messages are listed in the following:

- DIN 70121:2014
  - SDP Messages
  - EXI-encoded SupportedAppProtocol messages
  - EXI-encoded V2G Protocol messages
- ISO 15118-2:2014
  - SDP messages
  - EXI-encoded SupportedAppProtocol messages
  - EXI-encoded V2G Protocol messages
- ISO 15118-20

- o SDP messages
- o EXI-encoded V2G messages

**NOTE**

All EXI-encoded V2G messages are dissected to human-readable plain XML data format

**NOTE**

In case of TLS, V2G messages can only be dissected, when the randomly generated shared TLS session key is available (see section

### Homeplug AV Extended Protocol

This dissector extends the regular Homeplug AV dissector which is part of Wireshark already. In this build there are the following messages that are being able to be decoded further, or to hold some extra information.

Message type	Description
VS_ATTEN_CHAR (Qualcomm)	Displays the gr filed.
VS_GET_PWM_STATS.IND (Vertexcom)	Displays inform
VS_HOST_ACTION.REQ (Qualcomm)	Displays additic

Table 1: Supported messages by the Homeplug AV Extended dissector

**NOTICE**

If the Ethernet Frame containing the Home using the optional VLAN tag inside the header for 2 more bytes.

To still be able to decode the messages go "Edit → Preferences... → Protocols → Hon and check the box "VLAN Tag is used by E

TLS Session Master Key).

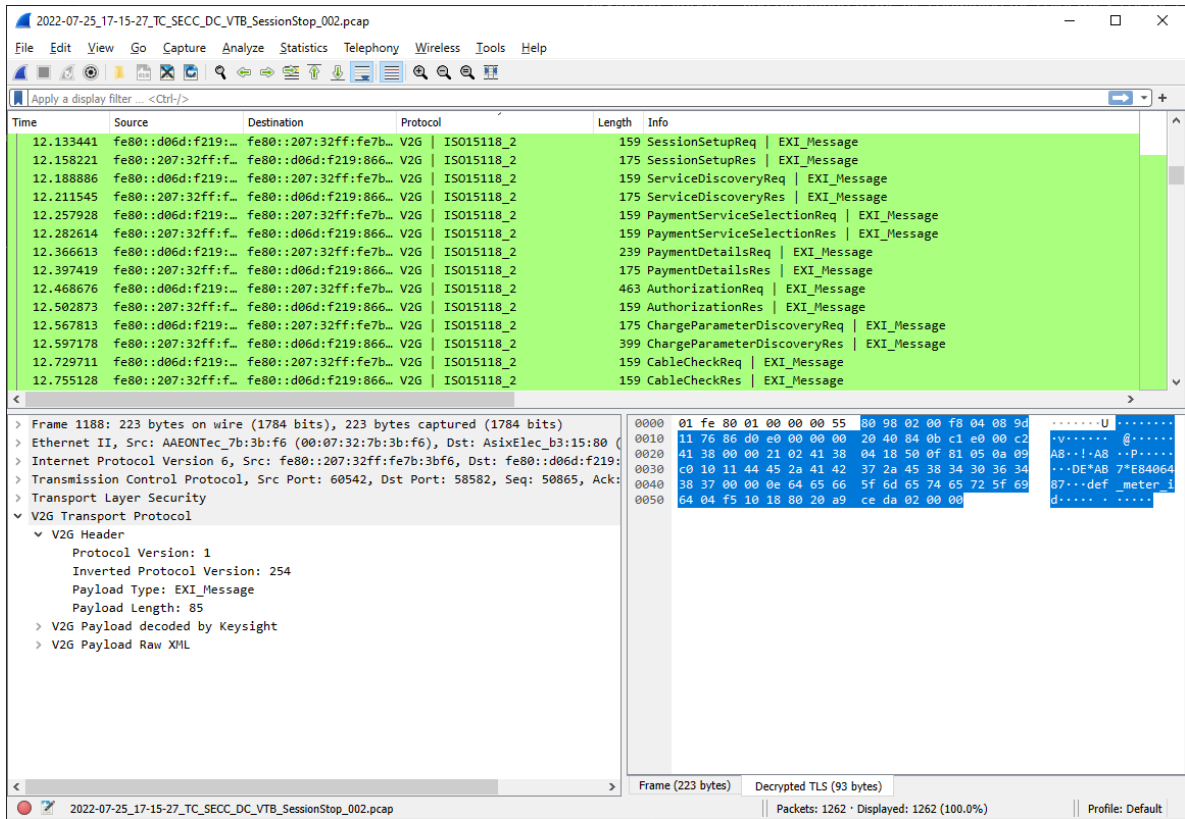
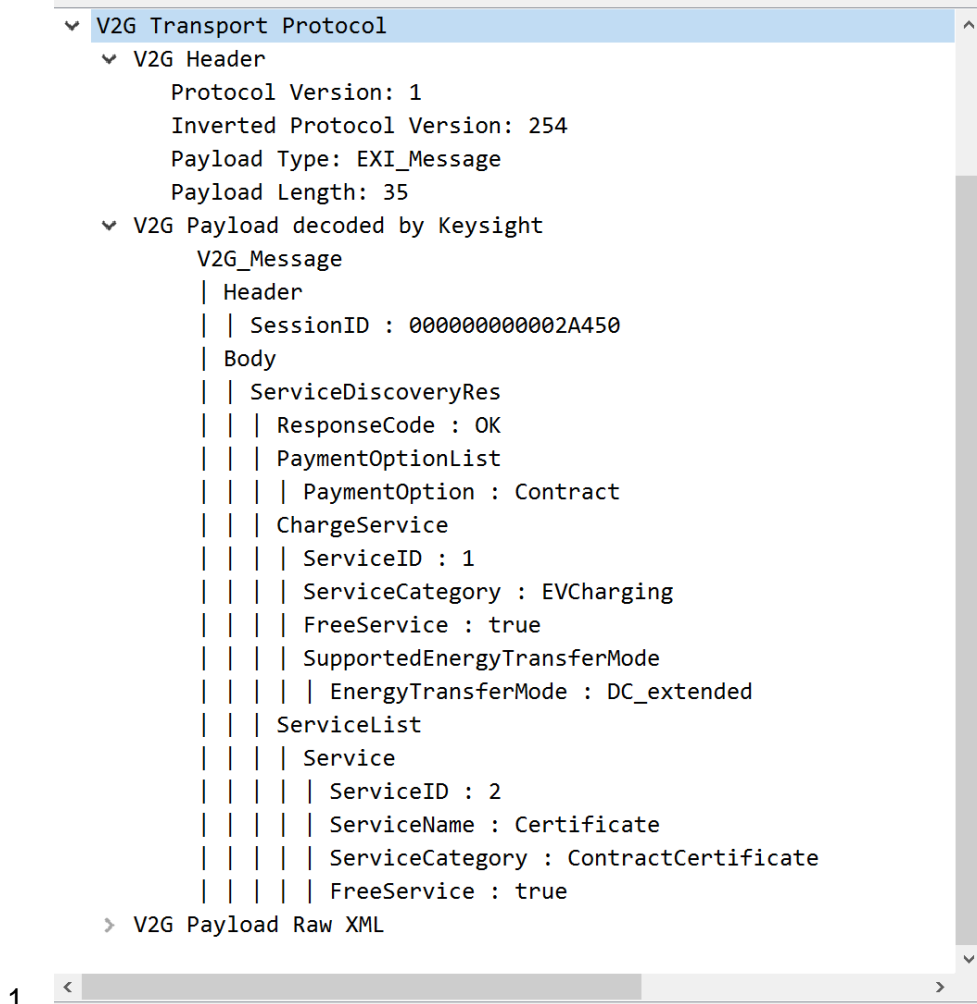


Figure 10: Example for V2G message decoding

There are two different views for decoded V2G messages:

- 1 V2G payload as a Key Value Pair representation (see [Figure 11](#)). This view can be used to get a quick overview of the data that is exchanged via the V2G protocol.





1.

Figure 11: Decoded V2G payload with the Key Value Pair representation

- 2 V2G payload in the RAW XML format (see [Figure 12](#)). This view shows the unfiltered XML messages that are used for the V2G communication.

```

  ▾ V2G Payload Raw XML
    <?xml version="1.0" encoding="UTF-8"?>
    <ns7:V2G_Message xmlns:ns7="urn:iso:15118:2:2013:MsgDef" xmlns:xsi="http://
    # " xmlns:ns5="urn:iso:15118:2:2013:MsgBody" xmlns:ns6="urn:iso:15118:2:20:
    <ns7:Header>
      <ns8:SessionID>000000000002A450</ns8:SessionID>
    </ns7:Header>
    <ns7:Body>
      <ns5:ServiceDiscoveryRes>
        <ns5:ResponseCode>OK</ns5:ResponseCode>
        <ns5:PaymentOptionList>
          <ns6:PaymentOption>Contract</ns6:PaymentOption>
        </ns5:PaymentOptionList>
        <ns5:ChargeService>
          <ns6:ServiceID>1</ns6:ServiceID>
          <ns6:ServiceCategory>EVCharging</ns6:ServiceCategory>
          <ns6:FreeService>true</ns6:FreeService>
          <ns6:SupportedEnergyTransferMode>
            <ns6:EnergyTransferMode>DC_extended</ns6:EnergyTransferMode>
          </ns6:SupportedEnergyTransferMode>
        </ns5:ChargeService>
        <ns5:ServiceList>
          <ns6:Service>
            <ns6:ServiceID>2</ns6:ServiceID>
            <ns6:ServiceName>Certificate</ns6:ServiceName>
            <ns6:ServiceCategory>ContractCertificate</ns6:ServiceCategory>
            <ns6:FreeService>true</ns6:FreeService>
          </ns6:Service>
        </ns5:ServiceList>
      </ns5:ServiceDiscoveryRes>
    </ns7:Body>
  </ns7:V2G_Message>

```

Figure 12: Decoded V2G payload with the Raw XML representation

## Homeplug AV Extended Protocol

This dissector extends the regular Homeplug AV dissector which is part of Wireshark already. In this build there are the following messages that are being able to be decoded further, or to hold some extra information.

Message type	Description
<b>VS_ATTEN_CHAR (Qualcomm)</b>	Displays the groups + average attenuation in the info filed.
<b>VS_GET_PWM_STATS.IND (Vertexcom)</b>	Displays information that the Sniffer took
<b>VS_HOST_ACTION.REQ (Qualcomm)</b>	Displays additional info about the payload

Table 1: Supported messages by the Homeplug AV Extended dissector

**NOTICE**

If the Ethernet Frame containing the Homeplug AV Protocol is using the optional VLAN tag inside the header, this will extend the header for 2 more bytes.

To still be able to decode the messages go to:  
**“Edit → Preferences... → Protocols → Homeplug AV Extended”**  
 and check the box **“VLAN Tag is used by Ethernet Frame”**.

## TLS Session Master Key

This section outlines the usage of a TLS Session Master Key and automated decryption of V2G messages encrypted with TLS. An example of a TLS Session Master Key message is shown in [Figure 13](#).

If the dissector identifies an UDP package matching the standards from the [NSS Key Log Format](#) the transmitted key will be saved in a log file located in **“C:\Users\username\AppData\Roaming\Wireshark\TLS\_Keys”**.

The screenshot displays a Wireshark capture of a TLS Session Master Key message. The packet list pane shows a packet of length 239 bytes. The packet details pane shows the key: CLIENT\_RANDOM 5FABC517552DBA291508A192FD80330593CF060. The packet bytes pane shows the raw hex data of the key.

Time	Source	Destination	Protocol	Length	Info
27.026649	fe80::230:abff:f...	ff02::1	VERISCO TLS Session Master Key	239	TLS Session Master Key
27.070197	fe80::230:abff:f...	fe80::c132:6f38:8f4...	TLSv1.2	175	Application Data
27.079670	fe80::c132:6f38:...	fe80::230:abff:fe29...	TLSv1.2	143	Application Data
27.089493	fe80::230:abff:f...	fe80::c132:6f38:8f4...	TCP	74	49153 → 53525 [ACK] Seq=373 Ack=1892 Win=16
27.095243	fe80::230:abff:f...	fe80::c132:6f38:8f4...	TCP	74	[TCP Window Update] 49153 → 53525 [ACK] Seq=
27.149438	fe80::230:abff:f...	fe80::c132:6f38:8f4...	TLSv1.2	159	Application Data
27.156216	fe80::c132:6f38:...	fe80::230:abff:fe29...	TLSv1.2	175	Application Data
27.164850	fe80::230:abff:f...	fe80::c132:6f38:8f4...	TCP	74	49153 → 53525 [ACK] Seq=458 Ack=1993 Win=16
27.169814	fe80::230:abff:f...	fe80::c132:6f38:8f4...	TCP	74	[TCP Window Update] 49153 → 53525 [ACK] Seq=
27.210112	fe80::230:abff:f...	fe80::c132:6f38:8f4...	TLSv1.2	159	Application Data
27.220426	fe80::c132:6f38:...	fe80::230:abff:fe29...	TLSv1.2	175	Application Data

Frame 185: 239 bytes on wire (1912 bits), 239 bytes captured  
 Ethernet II, Src: DeltaNet\_29:c5:be (00:30:ab:29:c5:be), Dst:  
 Internet Protocol Version 6, Src: fe80::230:abff:fe29:c5be, D  
 User Datagram Protocol, Src Port: 53185, Dst Port: 53186  
 TLS Session Master Key  
 Key: CLIENT\_RANDOM 5FABC517552DBA291508A192FD80330593CF060

```

0000 33 33 00 00 00 01 00 30 ab 29 c5 be 86 dd 60 00 33 .....0 ..).....
0010 00 00 00 b9 11 40 fe 80 00 00 00 00 00 00 02 30 .....@.....0
0020 ab ff fe 29 c5 be ff 02 00 00 00 00 00 00 00 00 .....).....
0030 00 00 00 00 00 01 cf c1 cf c2 00 b9 9f ac 00 00 .....
0040 43 4c 49 45 4e 54 5f 52 41 4e 44 4f 4d 20 35 46 CLIENT_R ANDOM 5F
0050 41 42 43 35 31 37 35 35 32 44 42 41 32 39 31 35 ABC51755 2DBA2915
0060 30 38 41 31 39 32 46 44 38 30 33 33 30 35 39 33 08A192FD 80330593
0070 43 46 30 36 30 45 37 32 36 32 37 41 41 34 38 44 CF060E72 627AA48D
0080 37 45 41 32 31 36 34 31 41 38 42 30 35 43 20 36 7EA21641 A8B05C 6
0090 38 39 41 37 31 34 43 38 32 34 34 31 42 38 32 43 89A714C8 2441B82C
00a0 39 46 30 31 33 46 45 45 46 37 42 41 44 39 42 46 9F013FEE F7BAD9BF
00b0 44 46 45 33 46 34 37 34 36 34 35 34 45 45 36 32 DFE3F474 6454EE62
00c0 31 32 38 30 43 39 46 30 44 35 44 33 31 35 30 44 1280C9F0 D5D3150D
00d0 33 31 36 36 30 30 45 38 30 33 45 32 44 35 34 38 316600E8 03E2D548
00e0 34 46 30 34 31 33 33 37 37 32 46 32 33 39 42 4F041337 72F239B
  
```

Key: (tls.session\_masterkey\_key), 175 bytes | Packets: 254 · Displayed: 254 (100.0%) | Profile: Default

Figure 13: Example for a TLS Session Master Key message

Additionally, an empty Debug.txt file will be created to log potential issues. If a TLS Master Key message is detected in the pcap trace, the TLS decryption can be enabled by selecting

the corresponding protocol as defined in the following proceeding (see also [Figure 14](#)):

- 1 Right-click on one of the encrypted TLS packages and select "Decode as".
- 2 Select "V2G" from the dropdown menu and confirm the selection with "OK".

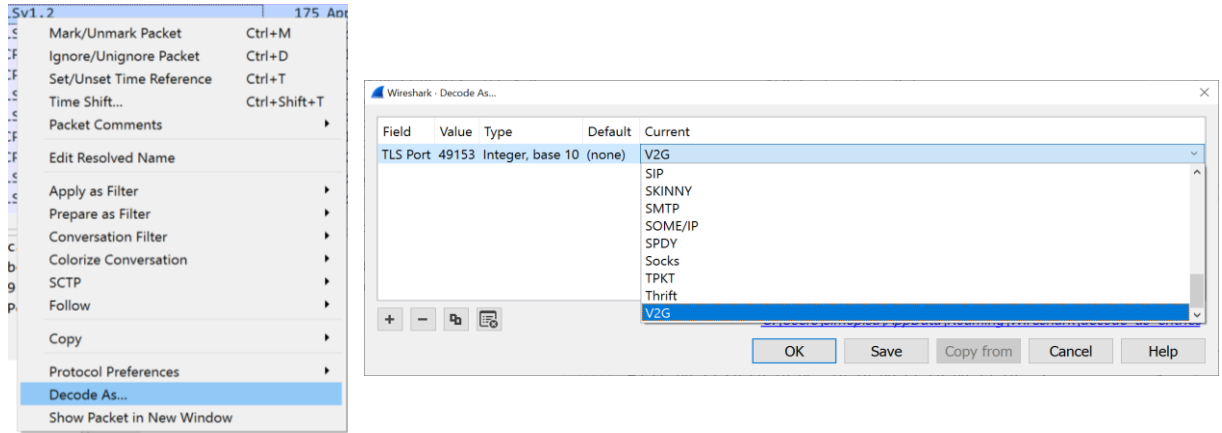


Figure 14: Context menu to specify a decoding protocol

Afterwards, the pcap trace will be reloaded with the decrypted V2G data content (see [Figure 15](#)).

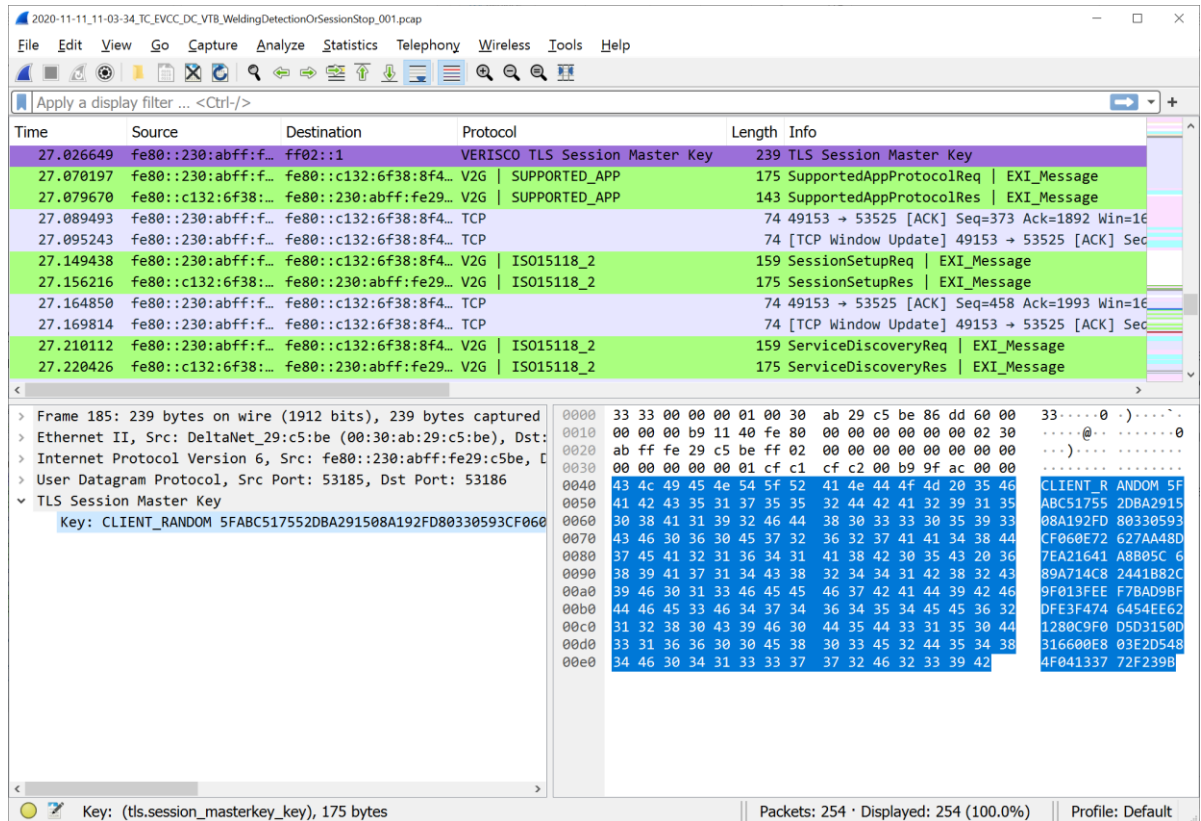


Figure 15: Decrypted V2G messages using the TLS Session Master Key

**NOTICE**

If multiple charging sessions with different TLS keys are located in a single .pcap file, this could lead to a decryption failure for the TLS messages that are not similar to the first key/charging session. In that case the charging sessions should be split to their own .pcap files.

Select all packets needed in Wireshark then click on:  
“File -> Export Specified Packets...” Enter a new file name and select the option “Selected packets only”, hit “Save” and open the new .pcap file and decode a above.

---

**NOTICE**

In case of a packet loss (TCP segment not captured, TCP retransmission, etc.) this could lead to a behavior where some TLS messages are not decrypted.

A possible solution for this is to active the option  
“Message Authentication Code (MAC), ignore “mac failed”  
Found in: “Edit -> Preferences... -> Protocols -> TLS”

---

**NOTE**

Example PCAP-Traces can be found in the following path:  
“C:\Users\USERNAME\AppData\Roaming\Wireshark\Example PCAPs”.

---

## Coloring rules

For better readability, each protocol is assigned to a different color. To apply the coloring rules used in this document, the user can import them as defined in the following:

- 1 Go to the menu and open “View” → “Coloring Rule”.
- 2 Click on “Import” to select pre-defined filters.
- 3 Navigate to the file that contains the color rules. For the CPT protocols, this file can be found at: “C:\Users\username\AppData\Roaming\Wireshark\Colorfilter\_CPT”.

After importing, the new rules will appear at the bottom. To display packets in the correct color, select the imported rules and drag them to the top. The order defines the priority of the color rule. Your coloring rules should now look like [Figure 16](#) below for the first four entries. To change the displaying colors simply click on “Foreground” / “Background” and choose a color you would like.

- 4 Click “OK” to apply changes.

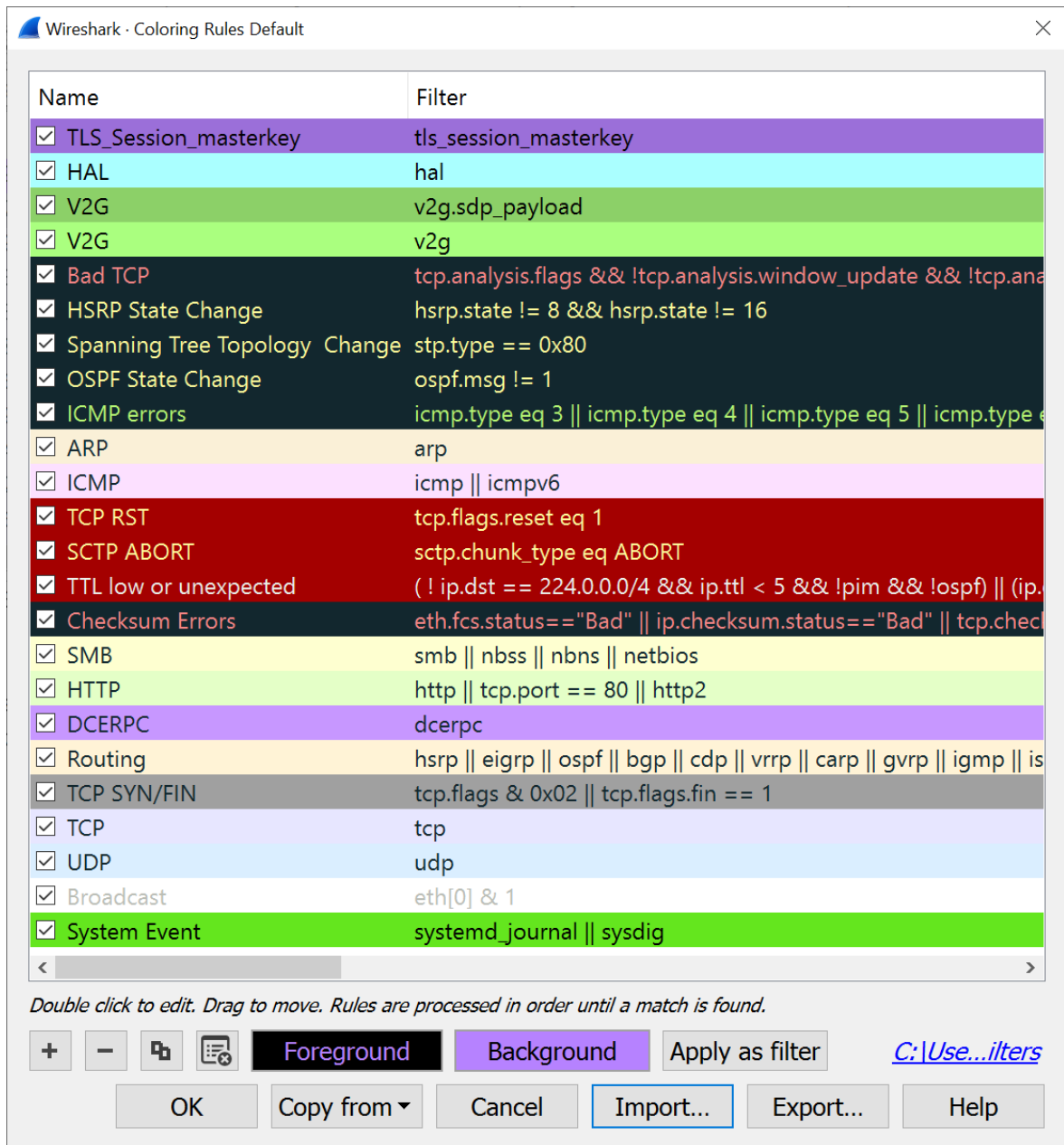


Figure 16 - Coloring Rules

## 5 Charging Protocol Trace Viewer – Decoder

To start the CPT Decoder, please use the following procedure:

- 1 Open a console window (cmd.exe).
- 2 Navigate to the charging\_protocol\_decoder.exe and press enter. The executable file can be found in the following path:  
**C:\Program Files\Common Files\Keysight\Charging Protocol Trace Viewer**

### NOTICE

The path can be different if the default installation path has been changed during installation. In this case, the CPT Decoder cannot be used within Wireshark.

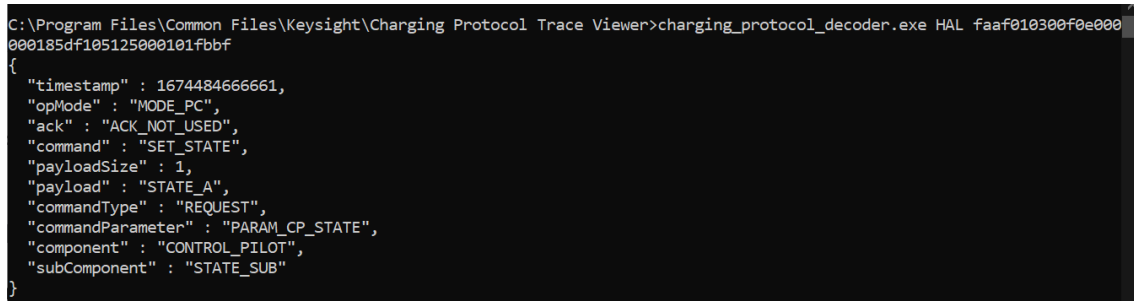
## 2.

In general, the CPT Decoder can be used in two modes.

### Standalone decoding via console

To use the decoder in simple application mode, the user must specify a protocol and the encoded hex data as can be seen in the following examples (see also [Figure 17](#) - [Figure 18](#)):

**Command: C:\Path\to\my\File\charging\_protocol\_decoder.exe HAL faaf010300f0e000000185df105125000101fbbf**



```
C:\Program Files\Common Files\Keysight\Charging Protocol Trace Viewer>charging_protocol_decoder.exe HAL faaf010300f0e000000185df105125000101fbbf
{
  "timestamp" : 1674484666661,
  "opMode" : "MODE_PC",
  "ack" : "ACK_NOT_USED",
  "command" : "SET_STATE",
  "payloadSize" : 1,
  "payload" : "STATE_A",
  "commandType" : "REQUEST",
  "commandParameter" : "PARAM_CP_STATE",
  "component" : "CONTROL_PILOT",
  "subComponent" : "STATE_SUB"
}
```

Figure 17: Example for HAL message decoding

**Command: C:\Path\to\my\File\charging\_protocol\_decoder.exe V2G 01fe80020000001380940433f88205a4d3eed3898dac6f8dd30228**

```

C:\Program Files\Common Files\Keysight\Charging Protocol Trace Viewer>charging_protocol_decoder.exe V2G 01fe80020000013
80940433f88205a4d3eed3898dac6f8dd30228
{
  "protocolVersion" : 1,
  "invProtocolVersion" : 254,
  "payloadTypeRaw" : 32770,
  "payloadType" : "COMMON_Message",
  "payloadLength" : 19,
  "payloadData" : "g3QEM/iCBaTT7t0JjaxvjdMCKA==",
  "decoder" : "ISO15118_20",
  "payload" : "<?xml version='1.0' encoding='UTF-8'?><ns5:SessionStopReq xmlns:ns5='urn:iso:std:iso:15118:-20:CommonMessages' xmlns:xsi='http://www.w3.org/2001/XMLSchema-instance' xmlns:ns3='http://www.w3.org/2001/XMLSchema' xmlns:ns4='http://www.w3.org/2000/09/xmldsig#' xmlns:ns6='urn:iso:std:iso:15118:-20:CommonTypes'><ns6:Header><ns6:SessionID>67F1040B49A7DDA7</ns6:SessionID><ns6:TimeStamp>1674484755736</ns6:TimeStamp></ns6:Header><ns5:ChargingSession>Terminate</ns5:ChargingSession></ns5:SessionStopReq"
}

```

Figure 18: Example for V2G message decoding

Any invalid data input will result in an exception or error message containing further information.

## Decoding as a WebSocket service

To use the decoder as a WebSocket service, the user must add a port number to the command line as can be seen in the following example:

**Command: C:\Path\to\my\File\charging\_protocol\_decoder.exe 1234**

Afterwards a WebSocket application is started on the local host and the defined port address. This approach is used by the *Keysight Charging Protocol Trace Viewer* as defined in the next section.

```

C:\Program Files\Common Files\Keysight\Charging Protocol Trace Viewer>charging_protocol_decoder.exe 1234
12:51:21.904 INFO MainDecoder - Starting decoder on 127.0.0.1:1234
12:51:21.929 INFO WebSocketServer - WebSocket server started on /127.0.0.1:1234
WebSocket server started on /127.0.0.1:1234

```

Figure 19: Example for a WebSocket based decoder



