

CAN Triggering Using an Agilent 54620/40 Series Oscilloscope

Application Note 1429

Introduction

The Agilent 54620/40 Series oscilloscopes have added controller area network (CAN) triggering capabilities. Users can synchronize the scope acquisition to the start of CAN frames in their designs and look at other operations and signals that are correlated to CAN bus traffic. The triggering capability can be customized for the baud rate of the user system as well as for logic levels.

The Menu

CAN triggering can be activated by going to the **More** key in the triggering section of the oscilloscope front panel. Select **CAN** from the **Trigger** softkey. Once **CAN** is selected, go to the **Settings** sub-menu to configure the trigger.

Table of Contents

Introduction	1
The Menu	1
CAN Settings Menu	2
Other Trigger Modes	3
Potential Use Scenarios	4
Support, Services, and Assistance	5

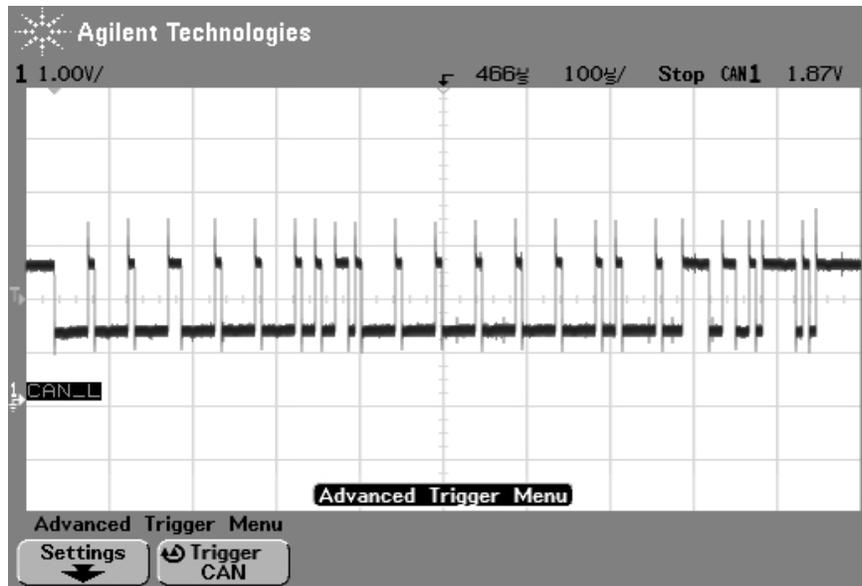


Figure 1. Easy activation of the CAN trigger using softkeys

CAN Settings Menu

The first softkey shown in the lower left corner in figure 2 allows the user to specify the **Baud Rate** of the system. There are a variety of baud rates allowed; most follow the CiA (CAN in Automation) trade association's recommended baud rates. This is important to set correctly for synchronization to the bus traffic.

The next softkey is the type of **Trigger**. This allows the user to easily synchronize to the start of a frame (SOF). The user can synchronize to any data frame, remote transfer request (RTR) frame, or overload frame. Since a frame of information usually is a known place in the operation of a CAN node, this softkey allows for a synchronous look at other signals in that CAN node. These signals are often the start of some action by the node (if it receives a message) or at the end of some action by the node (if it is transmitting a message).

The third softkey, the **Signal Type**, enables the user to specify which CAN-based signal is being monitored. It can be either of the differential CAN signals, **CAN_H** or **CAN_L**. This softkey is useful for monitoring the bus itself if that is the only signal the user has access to. It is also useful for looking at parametric information about these signals (noise spikes, ringing, timing, etc.). However, remember these are differential signals that result from the bus being designed for a noisy environment, and noise spikes may disqualify a CAN_H and CAN_L frame from the oscilloscope trigger.

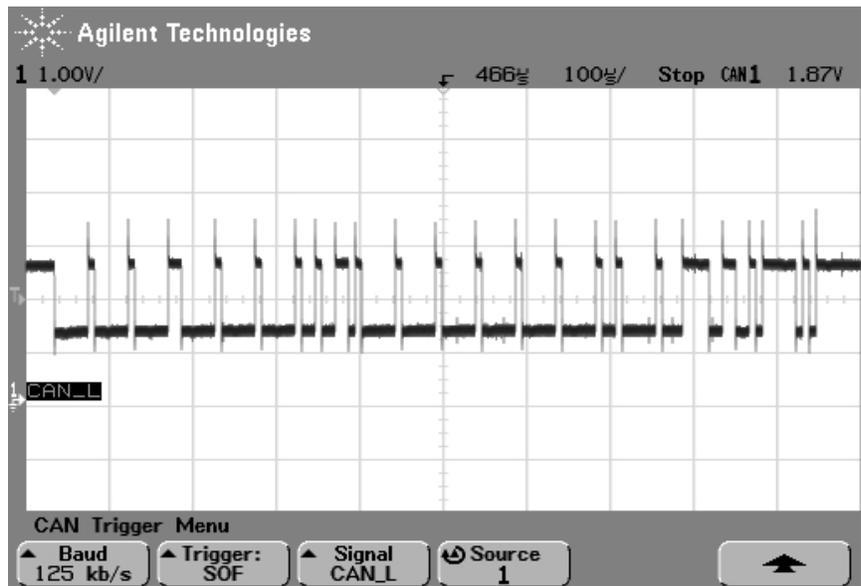


Figure 2. Softkeys for configuring the CAN trigger

To counter this, the user can use a differential probe, such as the Agilent N2772A 20 MHz Differential Probe, to look at the actual noise-immune signal. There is a signal type selection 'Differential' for this case. Make sure the signal polarity is connected properly so that the trigger will work.

Other signals to probe are **Rx** and **Tx** on the digital side of the transceiver signals. **Rx** gives a view of all of the traffic on the bus and is included for ease of access. It should not be susceptible to noise/level drift on the physical bus line CAN_H and CAN_L. The **Tx** line is interesting and more powerful because it only has activity on it when the source node is sending a message on the

bus. Using this can help isolate the traffic to only that sourced by a particular node.

The last softkey in the Setting Menu is the **Source** channel for the trigger. The user can select any of the analog channels (and digital channels if the scope is a mixed-signal oscilloscope). This allows the use of only one of the channels to synchronize to the CAN frame and leaves up to 17 other channels to provide a broader view into the design. These 17 channels, coupled with the Agilent Technologies **MegaZoom deep memory**, allow an unparalleled breadth and depth of insight into complex embedded CAN node designs and interactions.

Other Trigger Modes

The new version 2.0 software for the Agilent 54620/40 Series of oscilloscopes delivers some other powerful trigger capabilities for R&D engineers responsible for serial communication designs. Revision 2.0 software includes the following new capabilities:

- **Serial Peripheral Interface (SPI) triggering** – users can specify the number of data bits that are to be transferred and the bit pattern of interest to trigger on for the desired peripheral.
- **Basic Universal Serial Bus (USB) triggering** – users can synchronize the scope to the start of the USB packet (SOP) or the end of the USB packet (EOP) transmitted across the bus. This supports USB 1.1 specification speeds (low=1.5 Mb/s and full=12 Mb/s).
- **Additional I2C triggering** – the I2C triggering capability has been extended to include a restart trigger, a missing acknowledge trigger, 10-bit write, and EEPROM read.

QuickHelp

The 54620/40 Series offers built-in QuickHelp to describe the operation of this advanced CAN trigger. Figures 3 and 4 show example screens for CAN triggering.

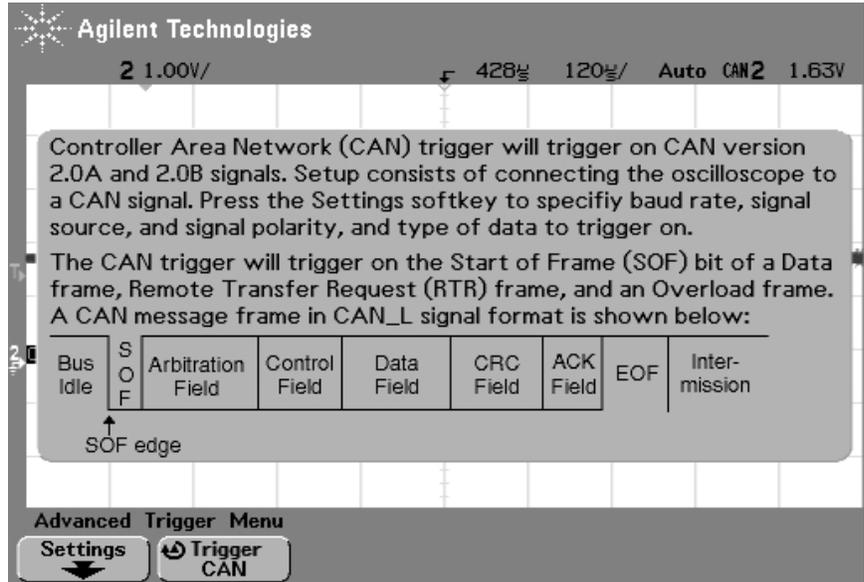


Figure 3. QuickHelp message for connecting the oscilloscope to the CAN signal

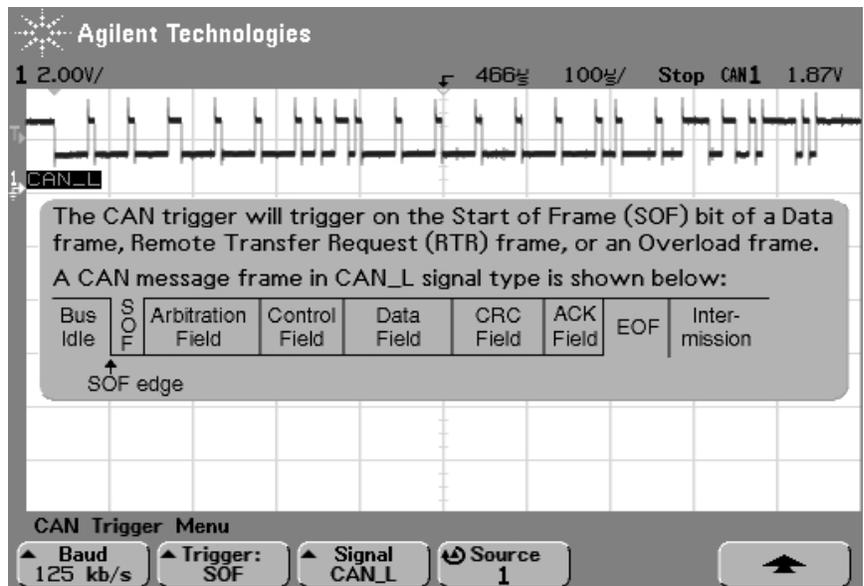


Figure 4. QuickHelp message for specifying the type of CAN trigger

Potential Use Scenarios

1. General synchronization

The activity of a node is synchronous with the reception or transmission of a CAN frame. There are many examples of this. One example is a message that causes a motor to start and also causes noise from that motor to be induced into the system. This noise would be synchronous to the SOF and hard to isolate. With CAN triggering, the user can always trigger at the beginning of any frame.

2. Transmit for read-only nodes (like a sensor)

For example, assume a node only transmits after receiving a Remote Transmit Request (RTR) – a sensor node operates this way. The user can trigger on the transmit and use the 54620/40 Series **MegaZoom deep memory** to see the whole transaction all of the way back to the original RTR and all activity on the target node as it reacts to that RTR.

3. User-controlled stimulus frame

Oftentimes the user can control the traffic seen by the node being tested. This trigger mode allows easy synchronization to the CAN traffic the user is sending under this test case.

4. Implied frame type

Since RTR frames are shorter than most data frames (at least in a system that does not mix standard and extended ID's), synchronizing to the SOF and looking out over a time window of 31 to 100+ bits can give the user an idea of how often (or if) a RTR frame is occurring.

5. Implied bus loading

By looking at the time prior to the SOF over multiple triggers, the user can get a feel for how heavily the CAN bus loading is and what the heaviest BURST loading is (by looking at distribution idle time in front of the SOF).

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