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INDUSTRIAL CONTROL COMMUNICATIONS, INC.

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# Host - Network Pass-Through Driver Manual

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# 1 Host - Network Pass-Through

## 1.1 Overview

This driver configures the device to tunnel communications between its host and network ports. Conceptually, the device internally connects the receive data pin of one port to the transmit data pin of the other port. This allows a host to communicate directly to the network. This driver is useful for situations where direct communications to the host is necessary, such as updating firmware or using proprietary communications.

Two modes are available for controlling the network port's RS-485 data enable output: Automatic Mode and GPIO Mode.

The Automatic Mode asserts the data enable signal when data is detected and keeps the signal asserted for a short period of time after the last character has been sent. The length of time that the data enable signal is asserted can be adjusted using the Minimum Baud Rate setting.

The GPIO Mode allows the host to control the network port's RS-485 data enable signal directly. This is done by connecting the host's RS-485 data enable output to a GPIO pin on the device. The driver can then be configured to internally connect the desired GPIO pin to the network port's RS-485 data enable pin.

Some notes of interest are:

- Two modes are available for controlling the network port's RS-485 data enable output.
- The host port's RS-485 data enable output is always controlled automatically.
- Adjustable timing for automatically asserting the RS-485 data enable signal.
- Supports both full-duplex and half-duplex operation.
- Ultra-low latency.
- When the driver starts on the network port, it automatically stops any protocol driver which may have been running on the host port.
- While the driver is running, all other device functionality is disabled, excluding USB communications.



## 1.2 Settings

The settings below affect the behavior of the driver's RS-485 data enable signal, and therefore, are only applicable for RS-485 networks. If an RS-485 network is not used with this driver, these settings should be left at their default values.

### **Minimum Baud Rate**

Selects the minimum baud rate of the network. This setting controls the length of time that the RS-485 data enable signal is asserted when the signal is controlled automatically.

### **RS-485 Data Enable Input**

Selects how the network port's RS-485 data enable signal is controlled. Select the GPIO pin that the host's RS-485 data enable signal is connected to, if applicable. Otherwise, select Automatic to allow the driver to control the signal automatically.

### **Force Half-Duplex**

Check this option to disable receiving characters while the port is transmitting. This is useful for ignoring echoed transmissions when using a 2-wire RS-485 network. Note that the port is considered to be transmitting until the port's RS-485 data enable signal is no longer asserted.

### 1.3 Determining Optimal Settings for RS-485 Circuits

There are various settings for the Host - Network Pass-Through driver which control the behavior of the driver when used with RS-485 networks. The optimal values for these settings depend on the hardware connections made in the RS-485 circuitry and the expected baud rates the driver will be used with. The following outline details the necessary settings for possible RS-485 circuits and the effects of different values for the Minimum Baud Rate setting.

- Network RS-485 Transceiver's Receive Enable: *Always Enabled*
  - **Force Half Duplex:** *Yes*
  - **Network Data Enable Input:** *Automatic*
    - **Minimum Baud Rate:** *Actual Baud Rate of Network*
      - *No issues.*
    - **Minimum Baud Rate:** *Minimum Baud Rate Lower than that of the Network*
      - *Low possibility of bus contention due to DE signal still being asserted when replies are sent.*
    - **Minimum Baud Rate:** *Baud Rate Higher than that of the Network*
      - *High possibility that DE signal will be deasserted during transmission of characters.*
  - **Network Data Enable Input:** *GPIO*
    - Uses RS-485 Transceiver to Host
      - **Host Data Enable Input:** *Fixed at Automatic*
      - **Minimum Baud Rate:** *Actual Baud Rate of Network*
        - *No issues.*
      - **Minimum Baud Rate:** *Minimum Baud Rate Lower than that of the Network*
        - *Low possibility of bus contention due to DE signal still being asserted when replies are sent.*
      - **Minimum Baud Rate:** *Baud Rate Higher than that of the Network*
        - *High possibility that DE signal will be deasserted during transmission of characters.*
    - Uses TTL to Host
      - **Host Data Enable Input:** *Fixed at Automatic*
      - **Minimum Baud Rate:** *Actual Baud Rate of Network*
        - *No issues.*
      - **Minimum Baud Rate:** *Minimum Baud Rate Lower than that of the Network*
        - *Low possibility of bus contention due to DE signal still being asserted when replies are sent.*
      - **Minimum Baud Rate:** *Baud Rate Higher than that of the Network*
        - *No issues.*

- Network RS-485 Transceiver's Receive Enable: *Tied to Data Enable Signal*
  - **Force Half Duplex:** *No*
  - **Network Data Enable Input:** *Automatic*
    - **Minimum Baud Rate:** *Actual Baud Rate of Network*
      - *No issues.*
    - **Minimum Baud Rate:** *Minimum Baud Rate Lower than that of the Network*
      - *Low possibility of bus contention due to DE signal still being asserted when replies are sent.*
    - **Minimum Baud Rate:** *Baud Rate Higher than that of the Network*
      - *High possibility that DE signal will be deasserted during transmission of characters.*
  - **Data Enable Input:** *GPIO*
    - Uses RS-485 Transceiver to Host
      - **Host Data Enable Input:** *Fixed at Automatic*
      - **Minimum Baud Rate:** *Actual Baud Rate of Network*
        - *No issues.*
      - **Minimum Baud Rate:** *Minimum Baud Rate Lower than that of the Network*
        - *Low possibility of bus contention due to DE signal still being asserted when replies are sent.*
      - **Minimum Baud Rate:** *Baud Rate Higher than that of the Network*
        - *High possibility that DE signal will be deasserted during transmission of characters.*
    - Uses TTL to Host
      - **Host Data Enable Input:** *Fixed at Automatic*
      - **Minimum Baud Rate:** *Irrelevant*
      - *No issues.*

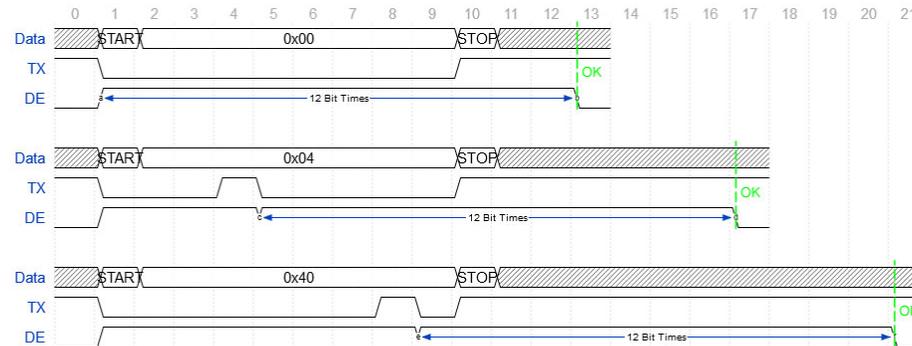
## 1.4 Analyzing the Effects of the Minimum Baud Rate Setting

Selecting the proper Minimum Baud Rate setting for the driver is important for reliable operation. When the RS-485 data enable signal is controlled automatically, the driver uses a 12 bit-time timer when asserting the data enable signal. The Minimum Baud Rate setting controls the bit-time of the 12 bit-time timer. This timer is reset when a falling edge is detected on the other port's RX line, just before the falling edge is sent on the port's TX line. When the timer expires, the data enable signal is deasserted.

Typically, setting the Minimum Baud Rate value to the minimum baud rate supported by the host device is sufficient. However, under certain circumstances, bus contention can occur, causing communication errors. This section demonstrates the effects that the Minimum Baud Rate setting has on transmitting and receiving characters on an RS-485 network and shows some possible issues that could arise.

### 1.4.1 Minimum Baud Rate Equal to Actual Baud Rate of Network

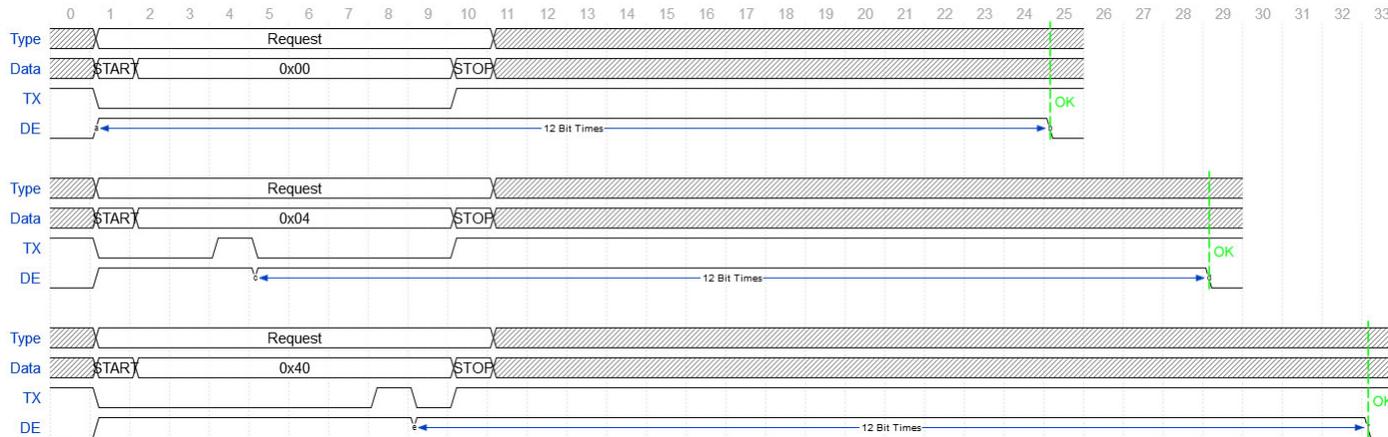
Figure 1 below shows the transmission of three different characters when the Minimum Baud Rate setting matches the actual baud rate of the network. Note that the data enable signal, DE, is deasserted after 12 bit-times from the last falling edge of the TX line.



**Figure 1: Minimum Baud Rate Equal to Network Baud Rate**

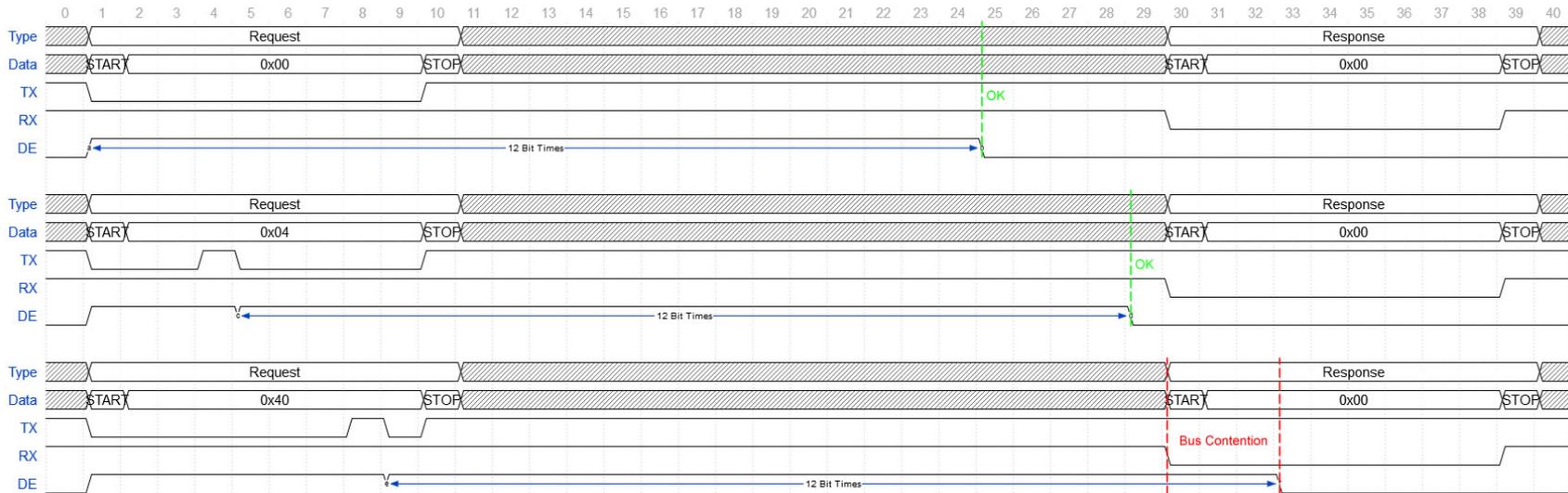
### 1.4.2 Minimum Baud Rate Less than Actual Baud Rate of Network

Figure 2 below shows the transmission of three different characters when the Minimum Baud Rate setting is half of the actual baud rate of the network. Note that the data enable signal, DE, is deasserted after 12 bit-times (24 bit-times relative to the actual baud rate of the network) from the last falling edge of the TX line.



**Figure 2: Minimum Baud Rate Half of Network Baud Rate**

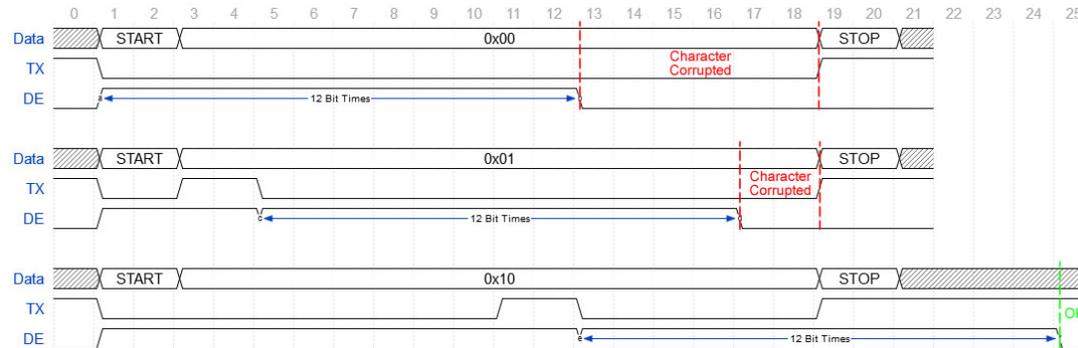
Figure 3 below shows the transmission of same three characters as in Figure 2, but also shows the response from another device on the network. Note that in the last character transmission, the data enable signal, DE, is still asserted at the beginning of the response, causing bus contention. Keep in mind, however, that this example represents an extreme case in which the responding device begins to transmit extremely quickly. In this case, the response time is a mere 20 bit-times relative to the network baud rate.



**Figure 3: Minimum Baud Rate Half of Network Baud Rate with Response**

### 1.4.3 Minimum Baud Rate Greater than Actual Baud Rate of Network

Figure 4 below shows the transmission of three different characters when the Minimum Baud Rate setting is incorrectly configured as double the actual baud rate of the network. Note that in the first two character transmissions, the data enable signal, DE, is deasserted before the entire character has been transmitted. This causes the RS-485 transceiver to stop driving the bus prematurely, resulting in the most-significant bits of the characters to appear as 1's to other devices on the network (due to idle-state network biasing).



**Figure 4: Minimum Baud Rate Double Communication Baud Rate**



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