

AN105 – Valve Controller Truth Tables

Introduction

This application note explains how the Truth Tables in the AX020510, and other Axiomatic Devices work in a variety of applications.

Truth Table

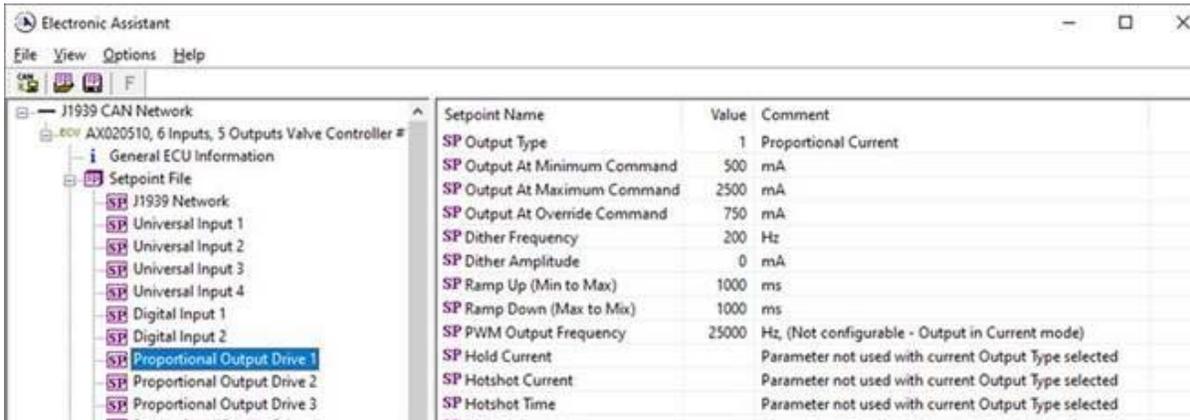
The Truth Table block implements a four-input truth table. Each of the four inputs is user selectable, with source and number setpoint pairs from available control sources. For each input there are “Switch On Point” and “Switch Off Point” setpoints to determine how to interpret input signals. When the selected input is equal to or above the ‘Switch On’ value, it is interpreted to be TRUE(1), and when the input is equal to or below the ‘Switch Off’ value, it is interpreted to be FALSE(0). This interpretation does not change in between switching points. If the switching points are set to be equal, the input is interpreted as being TRUE(1) when its value is equal to the switching points. By default, all inputs are disabled and 0 is used as the value of the input signals.

Input A	Input B	Input C	Input D	Output
0	0	0	0	Row1
0	0	0	1	Row2
0	0	1	0	Row3
0	0	1	1	Row4
0	1	0	0	Row5
0	1	0	1	Row6
0	1	1	0	Row7
0	1	1	1	Row8
1	0	0	0	Row9
1	0	0	1	Row10
1	0	1	0	Row11
1	0	1	1	Row12
1	1	0	0	Row13
1	1	0	1	Row14
1	1	1	0	Row15
1	1	1	1	Row16

For each condition row of the Truth Table, there is an output source and a number setpoint pair. When a condition of a row is evaluated to be TRUE, the selected output source is set as the output of the Truth Table. By default, all outputs are disabled, and the output of the Truth Table is 0.

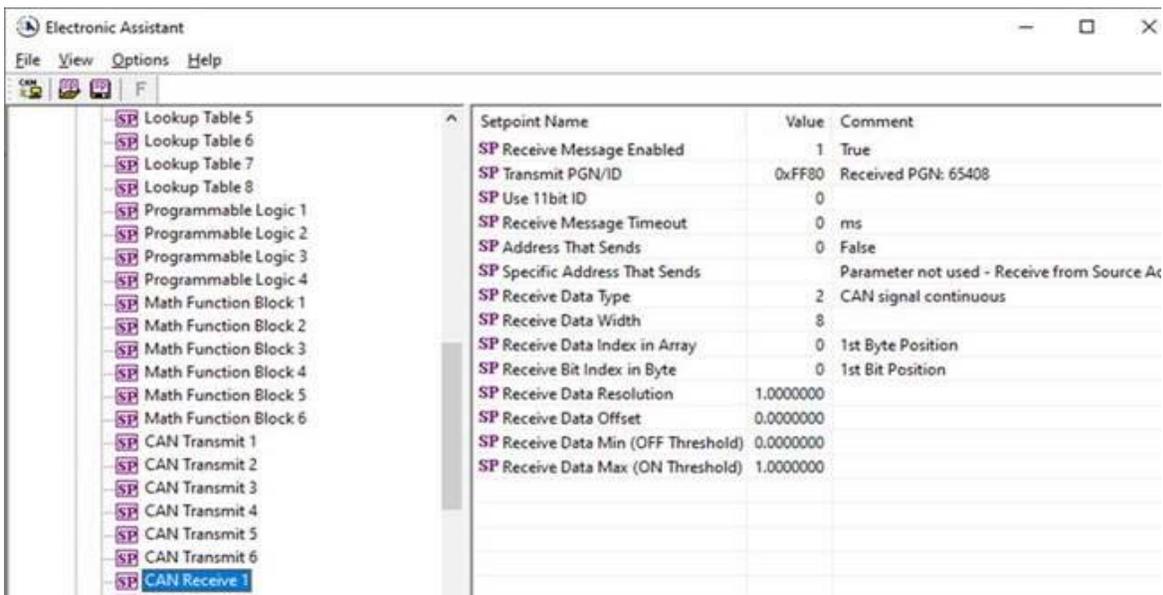
An Example of using Truth Tables

The figure below provides an example of how to use the Truth Table to **enable** the proportional output drive 1. This simple example provides a good base for building more complex control schemes.



CAN Receive Message

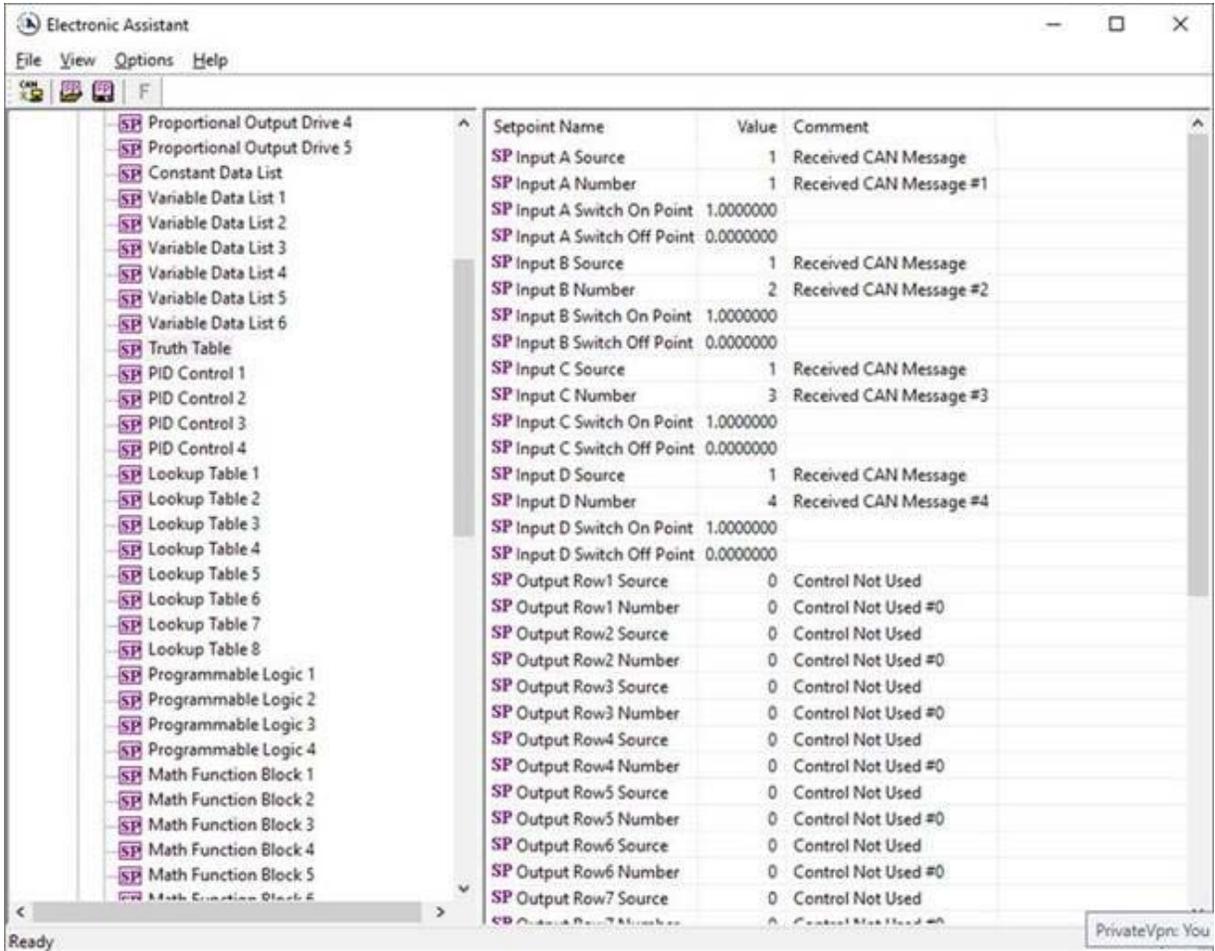
CAN Receive 1 to 4 are set up as a discrete control, using PGN 0xFF80 bytes 1 to 4 respectively.



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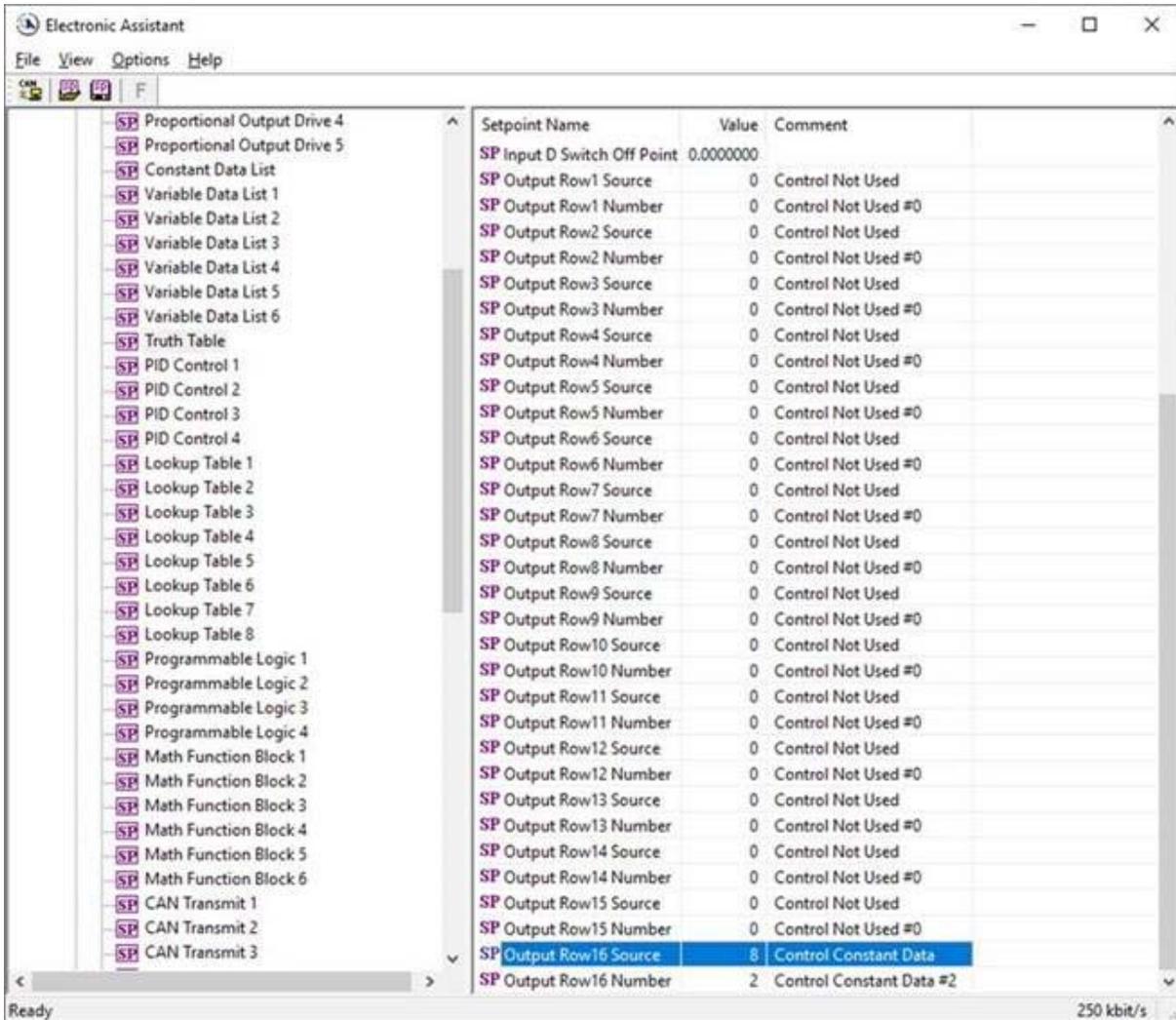
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The Received CAN Messages #s 1 to 4 are used as the Input A to D source for the Truth Table, with the Switch On point = "1", and the Switch Off point = "0".



Setpoint Name	Value	Comment
SP Input A Source	1	Received CAN Message
SP Input A Number	1	Received CAN Message #1
SP Input A Switch On Point	1.0000000	
SP Input A Switch Off Point	0.0000000	
SP Input B Source	1	Received CAN Message
SP Input B Number	2	Received CAN Message #2
SP Input B Switch On Point	1.0000000	
SP Input B Switch Off Point	0.0000000	
SP Input C Source	1	Received CAN Message
SP Input C Number	3	Received CAN Message #3
SP Input C Switch On Point	1.0000000	
SP Input C Switch Off Point	0.0000000	
SP Input D Source	1	Received CAN Message
SP Input D Number	4	Received CAN Message #4
SP Input D Switch On Point	1.0000000	
SP Input D Switch Off Point	0.0000000	
SP Output Row1 Source	0	Control Not Used
SP Output Row1 Number	0	Control Not Used #0
SP Output Row2 Source	0	Control Not Used
SP Output Row2 Number	0	Control Not Used #0
SP Output Row3 Source	0	Control Not Used
SP Output Row3 Number	0	Control Not Used #0
SP Output Row4 Source	0	Control Not Used
SP Output Row4 Number	0	Control Not Used #0
SP Output Row5 Source	0	Control Not Used
SP Output Row5 Number	0	Control Not Used #0
SP Output Row6 Source	0	Control Not Used
SP Output Row6 Number	0	Control Not Used #0
SP Output Row7 Source	0	Control Not Used
SP Output Row7 Number	0	Control Not Used #0

'Output Row 16 Source' is then enabled to use a Control constant Data source (#2) = "1" as an output.



The screenshot shows the 'Electronic Assistant' software window. On the left is a tree view of various control blocks, including Proportional Output Drives, Variable Data Lists, Truth Tables, PID Controls, Lookup Tables, Programmable Logic, Math Function Blocks, and CAN Transmits. On the right is a table of setpoints with columns for Setpoint Name, Value, and Comment. The 'SP Output Row16 Source' row is highlighted in blue, showing a value of 8 and a comment of 'Control Constant Data'. The 'SP Output Row16 Number' row below it shows a value of 2 and a comment of 'Control Constant Data #2'.

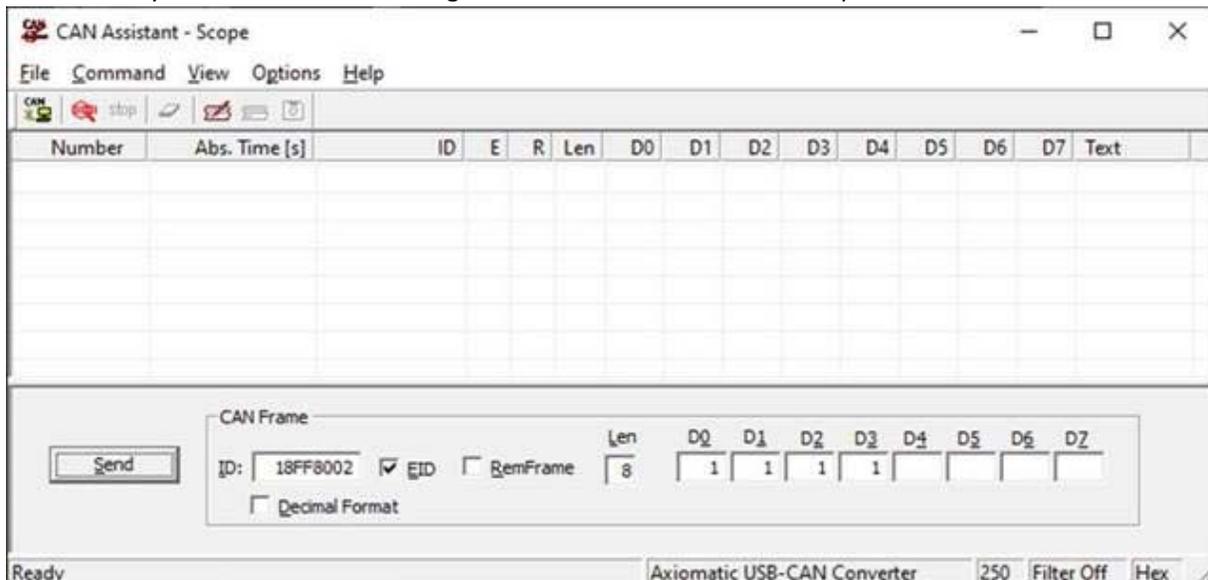
Setpoint Name	Value	Comment
SP Input D Switch Off Point	0.0000000	
SP Output Row1 Source	0	Control Not Used
SP Output Row1 Number	0	Control Not Used #0
SP Output Row2 Source	0	Control Not Used
SP Output Row2 Number	0	Control Not Used #0
SP Output Row3 Source	0	Control Not Used
SP Output Row3 Number	0	Control Not Used #0
SP Output Row4 Source	0	Control Not Used
SP Output Row4 Number	0	Control Not Used #0
SP Output Row5 Source	0	Control Not Used
SP Output Row5 Number	0	Control Not Used #0
SP Output Row6 Source	0	Control Not Used
SP Output Row6 Number	0	Control Not Used #0
SP Output Row7 Source	0	Control Not Used
SP Output Row7 Number	0	Control Not Used #0
SP Output Row8 Source	0	Control Not Used
SP Output Row8 Number	0	Control Not Used #0
SP Output Row9 Source	0	Control Not Used
SP Output Row9 Number	0	Control Not Used #0
SP Output Row10 Source	0	Control Not Used
SP Output Row10 Number	0	Control Not Used #0
SP Output Row11 Source	0	Control Not Used
SP Output Row11 Number	0	Control Not Used #0
SP Output Row12 Source	0	Control Not Used
SP Output Row12 Number	0	Control Not Used #0
SP Output Row13 Source	0	Control Not Used
SP Output Row13 Number	0	Control Not Used #0
SP Output Row14 Source	0	Control Not Used
SP Output Row14 Number	0	Control Not Used #0
SP Output Row15 Source	0	Control Not Used
SP Output Row15 Number	0	Control Not Used #0
SP Output Row16 Source	8	Control Constant Data
SP Output Row16 Number	2	Control Constant Data #2

In this specific example, the condition in the Truth Table configured for Row 16 (Inputs A-D: 1,1,1,1 = 1) is represented by a logic AND gate, as per the picture below:



A	B	C	D	A.B.C.D
0	0	0	0	0
0	0	0	1	0
0	0	1	0	0
0	0	1	1	0
0	1	0	0	0
0	1	0	1	0
0	1	1	0	0
0	1	1	1	0
1	0	0	0	0
1	0	0	1	0
1	0	1	0	0
1	0	1	1	0
1	1	0	0	0
1	1	0	1	0
1	1	1	0	0
1	1	1	1	1

If the message below is sent using the CAN Assistant Scope the 'Proportional Output 1' will output 500mA. Set the Imin = 500mA so that there is a noticeable change when the output is enabled. Note that any of the other 15 remaining combinations will disable the output.



Any valid combination of sources can be mapped as the Truth Table source; CAN Rx, Voltage, Current, Discrete, etc., each with its own switch on/switch off thresholds.

The output value of the truth table can be a constant, analog, discrete value, or the output from another block (Lookup Table, Math, Logic block, etc.).

The Truth Table output can also be used as an input for other functional blocks (Lookup Table, Math, Logic block, etc.).

Notes:

When using the Look Up Tables, the Time response works such that:

1. The unit is first powered.
2. The output then cycles through the changes in the Look up Table once.
3. The output finally returns to 0mA.

If the Look up Table is set to 'Data response,' the output will respond in proportion to the input and the values in the Look up Table.

Version	Date	Author	Comments
1.00	June 9, 2021	Lawrence Durham/ Sue Thomas / Kiril Mojsov	Initial release