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ES1330.1 PWM I/O Counter Board

User's Guide

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1 Introduction

This section contains information about the basic features and applications of the ES1330.1 PWM I/O Counter Board. A block diagram shows the schematic layout of the plug-in board.

Note

Some components of the ES1330.1 PWM I/O Counter Board may be damaged or destroyed by electrostatic discharges. Therefore, keep the board in its storage package until it is installed.
The board may only be taken from the storage package, configured and installed at a working place that is protected against static discharges.

1.1 Features

The ES1330.1 PWM I/O Counter Board is used to capture pulse widths and pulse duty factors in VMEbus systems. It also allows generating PWM signals of different frequencies and pulse duty factors.

The plug-in board has the following features:

- 12 digital PWM inputs
- 4 digital PWM outputs
- 12 digital PWM channels which can be used either as inputs or as outputs

Note

If 12 outputs are configured, only 12 inputs can be configured (see section 2.1.5 on page 11)!

- Counters with 16-bit resolution and a max. input frequency of 4 MHz
- Schmitt trigger and pre-decoder for the input channels
- VMEbus interface

The following figure shows the front panel and the position of the connectors.

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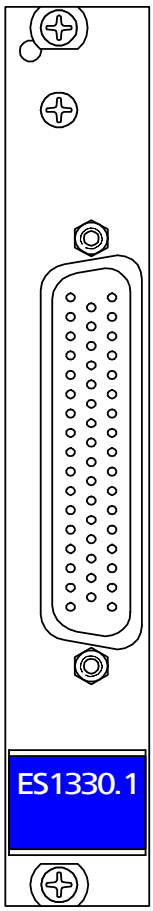


Fig. 1-1 Front Panel

1.2 Applications

The ES1330.1 PWM I/O Counter Board can be used in VMEbus systems where it is necessary to capture pulse widths and pulse duty factors in a medium frequency range. The board can also be used to generate PWM signals.

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Sample applications are:

- capturing the pulse duty factors or high/low periods when energizing solenoids
- simulation of PWM sensors, e.g., of speed signals

1.3 Block Diagram

The following figure shows a block diagram of the ES1330.1 PWM I/O Counter Board.

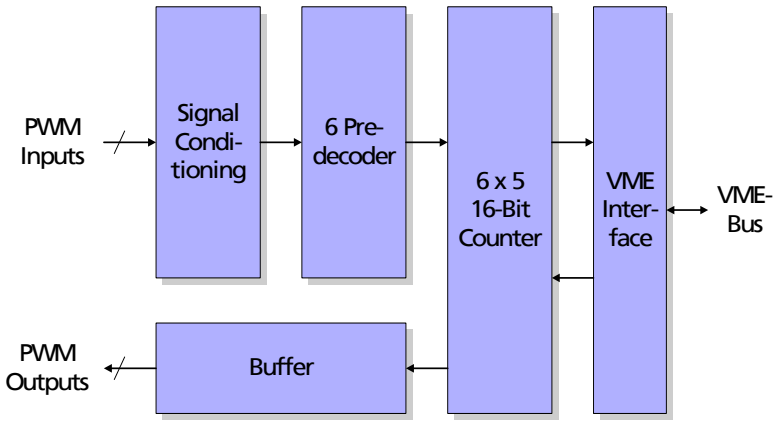


Fig. 1-2 Block Diagram

The ES1330.1 PWM I/O Counter Board is equipped with six counter devices (Am9513A). Each counter device provides five 16-Bit counters with a constant input frequency of 4 MHz. 30 counter inputs and 16 counter outputs are subdivided in six internal ports "Port 1...Port 6" on the ES1330.1. Each counter device uses one of these ports. Access to the ports is via the 24 PWM inputs and 16 PWM outputs of the front panel connector.

The digital inputs and outputs are visible on the left side of the front panel. The board has six input channels with four input signals each. The digital inputs are fed to the pre-decoder via Schmitt triggers. From the pre-decoder, the input signals pass to the release inputs of the counter modules.

The outputs of the counter modules are connected to the front panel ports via buffers.

At the right-hand border of the figure, you can see the VMEbus interface connecting the counter modules with the VMEbus.

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2 Hardware

This section contains a detailed functional description, information about the jumpers and solder straps, the pin allocation of the connectors, and the technical data of the ES1330.1 PWM I/O Counter Board.

2.1 Functional Description

This section provides a detailed overview of the features of the ES1330.1 PWM I/O Counter Board. You will find information on the following subjects:

- signal conditioning of the input signals
- pre-decoder
- counter modules
- output signals
- VMEbus interface

2.1.1 Signal Conditioning

The input signals carry standard TTL levels. They are buffered via Schmitt trigger inverters. The four input signals of each input channel pass from the input buffers to the pre-decoder.

Note

The inputs of the pre-decoder are inverted to the inputs on the front panel.

2.1.2 Pre-Decoder

The pre-decoder can be used in two modes:

- loop-through of the input signals
- logical combination of the first two input signals

In the first pre-decoder mode, the four input signals of each channel are fed to the four release inputs of the first four counters of the associated counter module.

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In the second mode, the four logical states of the first two input signals of each channel are decoded, passing the result to the release inputs of the counter modules. The following table shows the relationship between the two input signals and the four release signals of the counters.

Input 0	Input 1	Release signal
0	0	0
0	1	1
1	0	2
1	1	3

Tab. 2-1 Mapping between input signal and release

The figure below illustrates the timing of the release signals based on the two input signals.

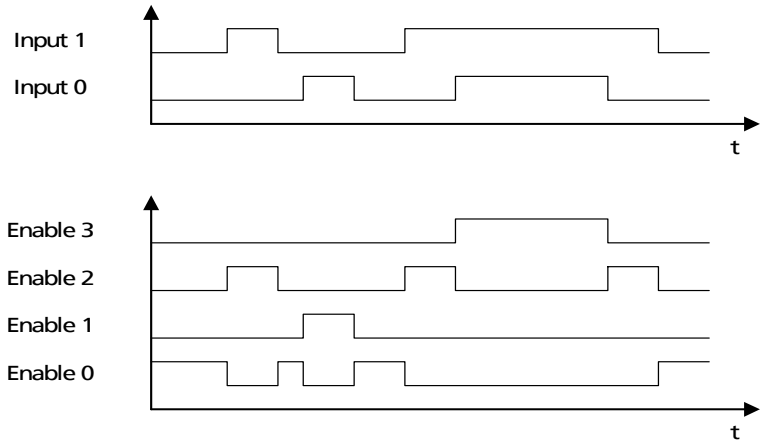


Fig. 2-1 Release signals based on the input signals

The pre-decoder allows determining the time of the particular input combination for each of the four possible input combinations.

The pre-decoder mode is controlled by software from the VMEbus.

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2.1.3 Counter Modules

Each of the six input channels has its own counter module. Each counter module contains five 16-bit counters.

The release inputs of the first four counters are controlled by the pre-decoder. The fifth counter is used as a pre-divider for the constant input frequency of 4 MHz. This divided input frequency serves as the clock signal for the first four counters.

The mode of the counter modules can be programmed from the VMEbus.

2.1.4 Output Signals

The output signals of some counters are fed to the front panel connector via open-collector drivers. There are a total of 16 counter outputs.

The open-collector buffers have pull-up resistors on the ES1330.1 PWM I/O Counter Board. The supply voltages for the pull-up resistors can be provided externally or from the VMEbus. This configuration is set via a jumper.

2.1.5 Configuring the Counters to Generate or Measure Signals

All 24 counter modules which can be accessed via the front-facing connector can be used as inputs for measuring PWM signals. There are also 16 outputs for generating PWM signals. There are, however, restrictions on the use of the individual counter modules which are listed in the table below.

Counter Module	**1**	**2**	**3**	**4**
1	In	In	In	In or Out
2	In	In	In	In or Out
3	In	In	In	In or Out
4	In	In	In	In or Out
5	In or Out	In or Out	In or Out	In or Out
6	In or Out	In or Out	In or Out	In or Out

This means that a maximum of 24 inputs or 12 inputs and 16 outputs can be configured. Please consult Tab. 2-6 on page 16 for details of which input or output is at which pin of the connector on the front panel.

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2.1.6 Calculating the Output Frequencies

The clock frequency of the internal counter module is 4 MHz. The actual counter frequency is the quotient of the internal clock frequency and the prescaler value:

Counter frequency = internal clock cycle / prescaler

The prescaler can be either 1, 10, 100, 1000 or 10000 and is determined by the "Counter *X* Prescaler" RTIO parameter (X = counter module number).

The minimum and maximum output frequencies can be calculated (depending on the duty cycle) as follows (specification of the duty cycle in %):

Duty cycle ≥ 50%	
Maximum output frequency:	(1 - duty cycle/100) * counter frequency
Minimum output frequency:	(duty cycle/100) * (counter frequency / 65535)

Duty cycle ≤ 50%	
Maximum output frequency:	duty cycle * counter frequency /100
Minimum output frequency:	(1 - duty cycle/100) * counter frequency / 65535

Example: Prescaler = 1 → counter frequency = 4 MHz

With a duty cycle of 80%, the maximum output frequency is 800 kHz and the minimum output frequency is approximately 49 Hz.

2.1.7 VMEbus Interface

For the VMEbus, the board has a slave interface with 16 or 24 address lines and 16 data lines. The base address of the board is set via a jumper. In addition to this base address, four address offsets can be set via jumpers.

The board can *not* generate interrupts on the VMEbus.

2.2 Hardware Configuration

This section contains the information on configuring the jumpers of the ES1330.1 PWM I/O Counter Board. The jumpers (board Rev. 1.0) and the hex switch (Board Rev. 1.1) are used to configure the following settings:

- VME bus base address
- offset from the base address
- voltage supply of pull-up resistors

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The figures below show the position of the jumpers and of the hex switch on the component side of the board.

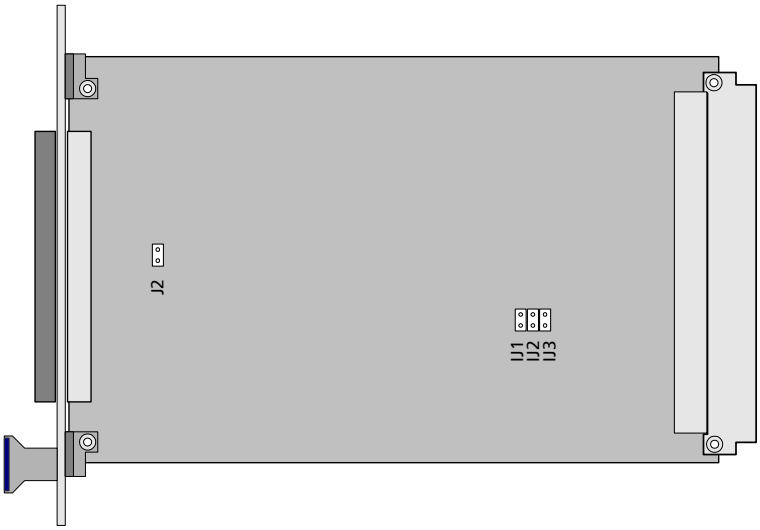


Fig. 2-2 Position of the jumpers (board Rev. 1.0, component side)



Fig. 2-3 Position of the jumper and the hex switch (board Rev. 1.1, component side)

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2.2.1 Base Address (Board Rev. 1.0)

The base address of the ES1330.1 PWM I/O Counter Board is selected by the jumper IJ1.

The board occupies an address range of 256 words from the base address.

Note

*Make sure that the address range of the ES1330.1 PWM I/O Counter Board does **not** overlap the address ranges of other boards in your system.*

The default base address of the board is 0xC00000.

Jumper	open	closed
IJ1	0xC00000 (default setting)	

Tab. 2-2 Setting the base address

Note

The jumper IJ1 must not be closed.

2.2.2 Offset from Base Address (Board Rev. 1.0)

The offset from the base address is determined by the jumpers IJ2 and IJ3.

IJ2	IJ3	Offset
open	open	0x000
open	closed	0x100
closed	open	0x200
closed	closed	0x300

Tab. 2-3 Setting the offset from the base address

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2.2.3 Base Address and Offset (Board Rev. 1.1)

With the boards of Rev. 1.1 the address is set with a hex switch.

Hex Switch Setting	Address
0	0xC00000
1	0xC00100
2	0xC00200
3	0xC00300

Tab. 2-4 Setting the address

2.2.4 Voltage Supply of Pull-Up Resistors

The jumper J2 determines the voltage supply of the pull-up resistors for the output signals.

Jumper	open	closed
J2	External voltage supply of the pull-up resistors	Voltage supply of the pull-up resistors from the VME bus

Tab. 2-5 Setting the voltage supply of the pull-up resistors

Note

The jumper J2 connects the external port for the voltage supply of the pull-up resistors with the +5 V supply of the VME bus.
Therefore, if the jumper J2 is set, the pins 1 and 34 of the front panel connector must ***not*** *be used.*
Using the pins 1 or 34 of the front panel connector of the board when the jumper J2 is set may cause failure of or damage to the entire VME bus system.

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2.3 Pin Allocation

This section describes the pin allocations of the ES1330.1 PWM I/O Counter Board.

2.3.1 Connector X1: Digital Inputs and Outputs

The 50-pin connector X1 contains all external ports of the ES1330.1 PWM I/O Counter Board.

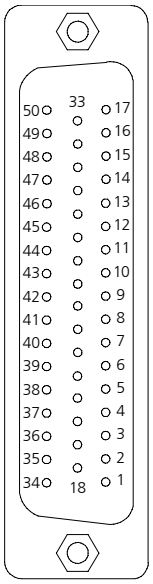


Fig. 2-4 Connector X1

The table below contains the pin allocations.

Port/Counter Device	Counter	Function	X1 Pin
Port 1	Counter 1	Input	33
Port 1	Counter 2	Input	32
Port 1	Counter 3	Input	31
Port 1	Counter 4	Input	30
Port 1	Counter 4	Output	45
Port 1	Counter 5	Output	46

Tab. 2-6 Pin allocation of connector X1 on the front panel

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Port/Counter Device	Counter	Function	X1 Pin
Port 2	Counter 1	Input	10
Port 2	Counter 2	Input	11
Port 2	Counter 3	Input	12
Port 2	Counter 4	Input	13
Port 2	Counter 4	Output	47
Port 2	Counter 5	Output	48
Port 3	Counter 1	Input	21
Port 3	Counter 2	Input	20
Port 3	Counter 3	Input	19
Port 3	Counter 4	Input	18
Port 3	Counter 4	Output	39
Port 3	Counter 5	Output	40
Port 4	Counter 1	Input	14
Port 4	Counter 2	Input	15
Port 4	Counter 3	Input	16
Port 4	Counter 4	Input	17
Port 4	Counter 4	Output	49
Port 4	Counter 5	Output	50
Port 5	Counter 1	Input	26
Port 5	Counter 1	Output	41
Port 5	Counter 2	Input	27
Port 5	Counter 2	Output	42
Port 5	Counter 3	Input	28
Port 5	Counter 3	Output	43
Port 5	Counter 4	Input	29
Port 5	Counter 4	Output	44
Port 6	Counter 1	Input	6
Port 6	Counter 1	Output	35
Port 6	Counter 2	Input	7

Tab. 2-6 Pin allocation of connector X1 on the front panel (cont.)

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Port/Counter Device	Counter	Function	X1 Pin
Port 6	Counter 2	Output	36
Port 6	Counter 3	Input	8
Port 6	Counter 3	Output	37
Port 6	Counter 4	Input	9
Port 6	Counter 4	Output	38
		Voltage supply of pull-up resistors	1
		GND	2
		GND	3
		open	4
		open	5
		open	22
		open	23
		open	24
		open	25
		Voltage supply of pull-up resistors	34

Tab. 2-6 Pin allocation of connector X1 on the front panel (cont.)

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2.4 Technical Data

This section contains the technical data of the ES1330.1 PWM I/O Counter Board in tabular form.

Inputs

Level	HCT Schmitt trigger, TTL level
Overvoltage protection	max. 7 V

Outputs

Output circuit	TTL open collector with internal pull-up resistor 1 kΩ
Voltage supply of pull-up resistors	Selected by jumpers: internal +5 V, external max. 30 V
Output current	low max. 40 mA

VMEbus

Type	Slave interface
Address and data lines	24-bit address and 16-bit data, or 16-bit address and 16-bit data
Base address	0xC00000
Offset from base address	0x000, 0x100, 0x200 or 0x300 selected by jumpers

Power Supply

Basic board	+5 V DC, ±5%, max. 1400 mA

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Environmental Conditions

Ambient temperature during operation	0 °C to +70 °C
Storage temperature	-55 °C to +85 °C
Relative humidity	0 to 90%, no condensation

Connectors

Backplane	96-pin DIN 41612 C
Front panel	50-pin Submin-D

Physical Dimensions

Circuit board	100 x 160 mm²
Front panel	Height: 3 U Width: 4 HP

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