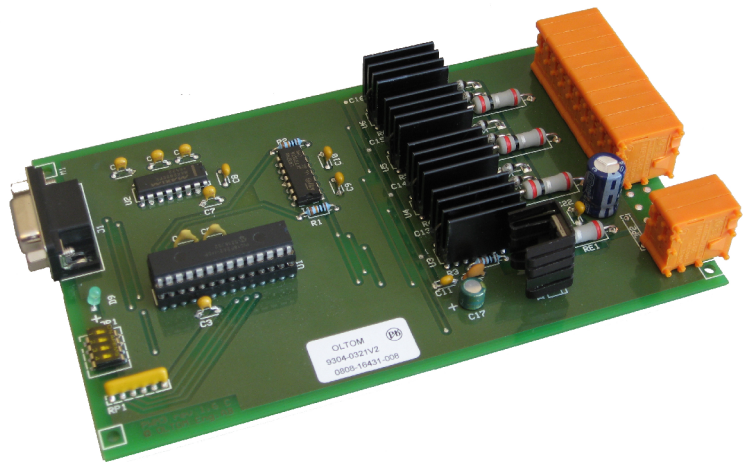




PWM3 Dual Stepper Motor Card



Introduction

The PWM3 is Eurocard-sized and contains separate drive circuits for two bipolar stepper motors with two windings each.

The winding currents are adjustable between 0.3-1.5 A for each motor, with a motor supply voltage of 10-40 V. The supply voltage can be unstabilized.

For easy communication with a control computer there is a RS232C-compatible asynchronous serial port. Up to five cards can easily be linked together with the integrated synchronous I2C-compatible bus.

The software delivered with the card consists of the graphical OLTOM SMCP LE program to control and sequence motor movement, and Windows and Linux dynamic link libraries (DLL) callable from other programs. Most programming languages and environments can be used.

In Windows the DLL is also accessible as a .NET or COM-object for easy programming from most applications, such as Excel.

The DLLs and subroutines handle all communication with the PWM3, and the user program does not need to handle any packet communication. The software platforms currently supported are Windows XP and later, or Linux x86 GLIBC2 and later versions.

It is also possible to write programs that communicate directly with the PWM3 using packets.

See the SMCP and driver documentation for more information about the software.

Model	Connector	Mounting
PWM3-21	Screw terminal	Corner holes
BOX-01	Screw terminal	Desktop or corner holes

Table 1. Ordering information

Key features

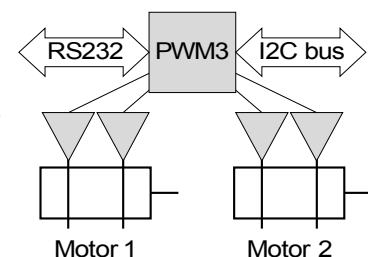
- Two separate motor drivers for two windings each for control of two axis.
- RS232C-compatible serial port for control.
- Built-in I2C serial bus: Link several cards.
- Synchronize commands on different cards.
- Full-step or smooth modified half-step operation.
- 1-4000 steps per second with acceleration.
- Programmable winding current 0.3-1.5 A.
- Single supply 10-40 V.
- Eurocard format 100x160 mm.
- Screw terminal connectors.
- Fault-tolerant communications.
- Easy programming with software DLL for Windows and Linux.
- Powerful Windows program for use of the cards without programming.
- Software included for Windows XP and later, or Linux GLIBC2 and later.

Theory of Operation

The system uses Pulse Width Modulation (PWM) of the winding current. This provides minimal power dissipation and maximizes torque. The switch frequency is approximately 32 kHz. To maximize the torque of the stepper motor each step consists of a steep current step, thanks to the relatively high modulation frequency.

A microcontroller takes care of step sequence generation, timing, communication with the host computer and other cards.

The controlling host computer communicates with the PWM3



using packets over a RS232-compatible serial cable. All timing, ramp generation, and sequencing is done by the PWM3. Thus, the control computer doesn't have to do real-time processing.

There is also built in fault-tolerance. Lost or damaged packets are automatically resent.

Supply Voltage

The supply voltage is used both for driving the motor windings, and for generating the internal logic voltage.

An integrated stabilized power supply generates the logic voltage, which also is used as the reference voltage for current control.

The supply voltage can thus be un-stabilized, as long as it is within the operating limits.

For the motor windings the supply voltage determines the maximum voltage that can be applied over the winding. Ensure that the supply voltage never dips below the voltage required to drive the winding at the desired current.

In most cases the motor will have better torque and performance if the supply voltage is significantly higher than the minimum required for the desired winding current.

DB9 Serial Port

The serial port is configured as female DCE. (For connection to a standard personal computer, use a straight through cable, or modem cable.) The only pins actually used for communication are transmit data, receive data and signal ground. However, DTE ready (also know as DTR - Data Terminal Ready) is connected to DCE ready, clear to send and carrier detect with a local loop. This ensures that applications which require these additional signals will have them present.

The default data rate is 115 kbit/s, 8 bits, no parity.

The inputs are direct logic inputs with no optocouplers or other protection. Care must be taken to keep the ground of the controlling device at the same level as the PWM3. Otherwise the circuit may fail to function or be permanently damaged.

Thermal management

Operating temperature is 0 C to 70 C. Storage temperature is -55 C to 150 C. The motor drive circuits have thermal overload protection, and will shut down if overheated.

The type of heat dissipation system needed is strongly depended of the selected motor current and the applied voltage.

For calculations of cooling see the table 20 with heat dissipation with different motor currents.

Motor winding current	Motor supply voltage	Power per driver IC	Power per Card
A	V	W	W
1.5	36	3.4	19
1.5	12	3.1	17
1.0	36	2.0	13
1.0	12	1.8	12
0.5	36	1.1	9
0.5	12	0.8	8

Table 2. Maximum power dissipation per driver IC. The card power includes the logic circuits.

Power dissipation per driver IC	Maximum ambient temperature	Drive voltage	Motor Current
W	°C	V	A
3.4	70	36	1.5
5.0	25	36	1.8

Table 3. Maximum ambient temperature with default heatsinks

Interference

One cause of interference is the resonance frequency of the stepper motor. When the modulation of the stepping signal is near the resonance frequency the motor will start oscillating. One way to avoid this is to make a jump in the stepping frequency close to the motor resonance frequency. For most motors this should not be a problem. Check the available motor specifications from the manufacturer for the resonance frequency.

Always use twisted pair cables for motor winding connection. This will minimize interference caused by the current switching.

For compliance with EMC-directives the PWM3 and associated circuits must be mounted in an appropriate enclosure. The required type of enclosure is dependent on

application, and EMC-compliance must be separately verified for each enclosure type.

Major Commands

The following are the major commands available. Check the OLTOM Card Driver Manual for a complete list of commands.

Move relative. Move the given number of steps relative to the current position.

Set Current. Set the winding current. Valid current range is 0.3-1.8 A. The power on default current is 0.3 A. Each motor can use different currents.

Set speed. Set the maximum motor speed in half steps per seconds from 1 up to 4000 steps/s.

Set acceleration. Set the acceleration and deceleration in steps per second squared. The motor will smoothly ramp up to the maximum speed and decelerate and the end of the movement.

Inquiry. Return busy status of motor.

Wait. Wait for the specified number of milliseconds.

Reset. Reset card to power on state.

All commands can be sequenced in the provided software, for complex movements.

Synchronize. Start several devices at the same time.

Addressing

Each PWM3 card contains three addressable subdevices, two motors and the RS232 port. Several cards can be linked together on an I2C-bus.

The communication protocol requires all commands to be correctly addressed. Note that the SMCP program automatically detects connected cards and their addresses, so no special user interaction is required in that case.

PWM3 addresses are one byte long (8 bits). Each address starts with a three bit address prefix 010_2 in the most significant bits (MSB).

The prefix is common for all PWM3 cards. Other card types may use another prefix.

The next three bits are the card address, set by the DIP-switch on the card. Available addresses are 000_2 to 011_2 and 111_2 , for a total of five different card addresses.

DIP4 and DIP3 set the most significant bit, DIP2 the next bit, and DIP1 the least significant bit (LSB).

Note that both DIP4 and 3 must be set to the same position, as they also control the I2C-termination. One and only one card on each I2C-bus must be terminated. The only valid switch settings for a terminated card are all ON, for a base address of $5C_{16}$.

The factory default switch settings are

Address in Binary									
Address Prefix	Card Address			Subdevice Address		Address in Hex	Card ID	Subdevice	Comment
	DIP4,3	DIP2	DIP1						
0 1 0	0	0	0	0	0	40	0	RS232	
0 1 0	0	0	0	0	1	41	0	Motor 1	
0 1 0	0	0	0	1	0	42	0	Motor 2	
0 1 0	0	0	1	0	0	44	1	RS232	
0 1 0	0	0	1	0	1	45	1	Motor 1	
0 1 0	0	0	1	1	0	46	1	Motor 2	
0 1 0	0	1	0	0	0	48	2	RS232	
0 1 0	0	1	0	0	1	49	2	Motor 1	
0 1 0	0	1	0	1	0	4A	2	Motor 2	
0 1 0	0	1	1	0	0	4C	3	RS232	
0 1 0	0	1	1	0	1	4D	3	Motor 1	
0 1 0	0	1	1	1	0	4E	3	Motor 2	
0 1 0	1	1	1	0	0	5C	7	RS232	I2C-termination active on this card
0 1 0	1	1	1	0	1	5D	7	Motor 1	I2C-termination active on this card
0 1 0	1	1	1	1	0	5E	7	Motor 2	I2C-termination active on this card

Table 4. Addressing and DIP-switch settings

OFF.

The two least significant bits in the address byte select the subdevice on each card. 00₂ is the RS232 serial port, 01₂ is motor 1 and 10₂ is motor 2.

The controlling computer has the address of the serial port it is connected to: This address is used by PWM3 for acknowledge and status replies, and is usually not directly addressed by the control computer.

For example, to send a command to motor 2 on card 3, using a computer attached direct to the RS232 serial port, send a packet from the RS232 port at address 010 011 00₂ (4C₁₆) to the motor at 010 011 10₂ (4E₁₆).

See table 4 for more information.

Synchronization

Command synchronization between different cards utilize the I2C bus.

The delay between command execution for different devices depends the number of cards and motors per card used at the same time.

The measured maximum delay for the worst case scenario when starting two motors per card on several cards is 0,3 milliseconds.

The maximum delay when starting two motors on the the *same* card is 0,1 milliseconds.

Contact

For more information, please contact

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Appendix A. Tables

Voltage	Min	Typ	Max	Unit
Logic Supply	0	+5.0	+5.5	V
Motor Supply	0	N/A	+40	V
Serial Port	-30	±12	+30	V
Current				
Logic Supply			1.0	A
Motor Supply			7.2	A
Motor Winding			1.5	A
Temperature				
Operating	0	+25	+70	C
Storage	-55		+150	C
Power				
Total Dissipation PWM3-x0	5		25	W
Total Dissipation PWM3-x1	12		32	W
Data Rate				
Serial	115	115	115	kbit/s
I2C	100	100	100	kbit/s

Table 5. Maximum ratings

Pin	Function
1,2	motor 1 winding 1 +
3,4	motor 1 winding 1 -
5,6	motor 1 winding 2 +
7,8	motor 1 winding 2 -
9,10	motor 2 winding 1 +
11,12	motor 2 winding 1 -
13,14	motor 2 winding 2 +
15,16	motor 2 winding 2 -
17,18	Motor supply voltage
19,20	Motor voltage ground
21,22	No Connection
23,24	No Connection
25,26	Logic supply voltage
27,28	Logic ground
29,30	I2C clock
31,32	I2C data

Table 6. Backplane/screw terminal connector

Pins	Signal name	Connection	Direction	Comment
1	Carrier Detect	Pin 4		
2	Receive Data	Serial out	Host <- PWM3	
3	Transmit Data	Serial in	Host -> PWM3	
4	Data Terminal Ready	Pin 1, 6, 8	Host -> PWM3	Pin 4 is ignored by PWM3, but is connected to the listed pins in order to provide expected control signals.
5	Signal Ground	Logic Ground	Host <- PWM3	
6	Data Set Ready	Pin4		Host <- PWM3
7	Request to Send	No Connection		
8	Clear to Send	Pin 4	Host <- PWM3	
9	Ring Indicator	No Connection		

Table 7. Serial Port Connector