Rev.0.1 0725

PCM-1B SERIES USER MANUAL

TIME PROPORTIONING / BURST FIRING
ZERO CROSS SCR DRIVER BOARD PCM-1B

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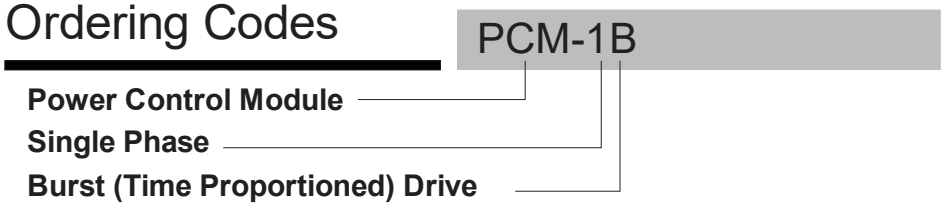
1. Ordering Codes



2. Description

The PCM-1B is a Zero Cross Time Proportioned Power Control Driver Board designed for use with high power back to back SCR modules driving resistive loads. The power delivered to the load is proportional to the command input signal. The gate drive technique used in the PCM-1B is DC drive for the reliable firing.

Features:

- **True DC SCR Gate Drive**
- **Time Proportioning/Burst Firing**
- **Zero Cross Firing for Low EMI**
- **High Resolution Fast Synchronous Burst Output**
- **Suitable for resistive Loads**
- **4-20mA, 0-10V, 0-5V, Pot, PWM Inputs**
- **50/60Hz and 100 – 265VAC operation**
- **Adjustable Power limit**
- **LED power, output and limit indicators**

3. Installation / Safety Information

Responsibility for determining suitability for use in any application / equipment lies solely on the purchaser, OEM and end user. Suitability for use in your application is determined by applicable standards such as UL, cUL and CE and the completed system involving this component should be tested to those standards.

WARNING: FIRE HAZARD!! Even quality electronic components CAN FAIL KEEPING FULL POWER ON! Provide a SEPARATE (redundant) OVER TEMPERATURE SHUTDOWN DEVICE to switch the power off if safe temperatures are exceeded.

WARNING: HIGH VOLTAGE!! This control board has high voltage on it that can cause death. This control must be installed in a GROUNDED enclosure by a qualified electrician in accordance with applicable local and national codes including NEC and other applicable codes. Provide a safety interlock on the door to remove power before gaining access to the device.

3.1 Mounting Instructions

The PCM-1B mounts using four #6 screws. See the mechanical dimensions section for more details. The PCB should be mounted at least 0.500” from any surface.

3.2 Electrical Connections

See the WIRING DIAGRAMS at the end of this document. Make sure the unit ordered is the correct unit for the application before wiring. Before wiring the unit, all Dip Switch settings for the command input and special features should be setup properly per the Dipswitch Configuration Section.

3.3 SCR Output Snubbers and Transient Protection

3.3.1 Commutation Problems

When an SCR or TRIAC is used to control an inductive load, the load current lags the mains voltage. When the device turns off at zero current, the rate of rise of the reapplied voltage can retrigger the device and produce half cycling and blown fuses. To limit this rate of rise and obtain reliable commutation, an R-C (resistor–capacitor) snubber circuit should be connected in parallel with the SCR/TRIAC.

3.3.2 dv/dt Problems

When voltage transients occur on the mains supply or load of an SCR/TRIAC it can cause the device to turn on unexpectedly due to the fast rate of rise of voltage (dv/dt). This can result in false firing and half cycling of the load that can cause blown fuses when driving inductive loads. An R-C snubber circuit will help to limit the dv/dt seen by the device and will produce more reliable firing.

3.3.3 Snubber Sizing

When an SCR using an R-C snubber turns on, the capacitor is discharged through the resistor into the device resulting in high peak currents. It is critically important when sizing your snubber to make sure that the resistor value does not become so low that the ratings of the SCR are exceeded when the capacitor is discharged. Careful attention should also be given to the power dissipation that will develop in the snubber resistor.

3.3.4 MOV Protection

Metal Oxide Varistors are used on SCRs to suppress voltage spikes that can occur across the devices and damage them. Snubbers are not a substitute for MOVs and vice versa. Snubbers and MOVs should be used together to get reliable performance and long life from the SCR/TRIAC application. External MOV must be installed across SCRs to limit peak voltages seen by the PCM-1B to ~800VDC.

3.4 Limited Warranty

NuWave Technologies, Inc. warrant this product to be free from defect in workmanship and materials for a period of one (1) year from the date of purchase.

1. Should unit malfunction, return it to the factory. If defective it will be repaired or replaced at no charge.
2. There are no user serviceable parts on this unit. This warranty is void if the unit shows evidence of being tampered with or subjected to excessive heat, moisture, corrosion or other misuse / misapplication.
3. Components which wear or damage with misuse are excluded, e.g. relays.
4. NuWave Technologies, Inc. shall not be responsible for any damage or losses however caused, which may be experienced as a result of the installation or use of this product. NuWave Technologies, Inc. liability for any breach of this agreement shall not exceed the purchase price paid E. & O.E.

4. Operation

4.1 Power Supply

The PCM-1B power supply requirement is 90-265VAC 47-63Hz. The line synchronization for the zero cross firing is derived from the power supply input.

4.2 Power Fusing

A 100mA user serviceable fuse is provided. Under normal circumstances this fuse should not open. If it opens, one of the following conditions may have caused it:

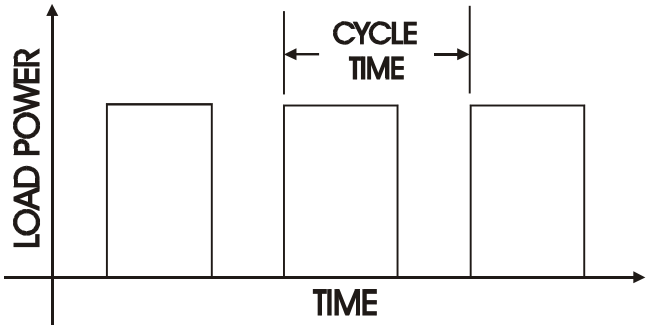
1. A large power line transient occurred.
2. The PCM-1B was wired incorrectly and excess voltage was applied.
3. The PCM-1B malfunctioned and requires service.

4.3 Command Input

The PCM-1B can accept 4-20mA, 0-20mA, 0-10V, 2-10V, 0-5V, 1-5V, Potentiometer and TTL PWM inputs. All analog commands are isolated from the power line and SCR drive outputs. The type of command input can be configured via the dipswitch. The default setting is 0-5V/potentiometer. Connecting the power to any part of the command input or SCR drive outputs will cause damage to the unit.

4.4 Cycle Times

The cycle time refers to the total time between an on and off cycle.



The PCM-1B has 4 available cycle times settable via the dipswitches.
The cycle times are specified below in # of cycles and can be correlated to their respective times using the table below for both 50 and 60 Hz Line frequencies.

Dip Switch 5	Dip Switch 1	#of cycles	Cycle Time (60Hz)	Cycle Time (50Hz)	Resolution (% of FS)
*OFF	*OFF	~16	266mS	320mS	~1%
ON	OFF	60	1S	1.2S	1.66%
OFF	**ON**	600	10S	12S	0.166%
ON	**ON**	6000	100S	120S	0.0166%

*Synchronous Firing Method

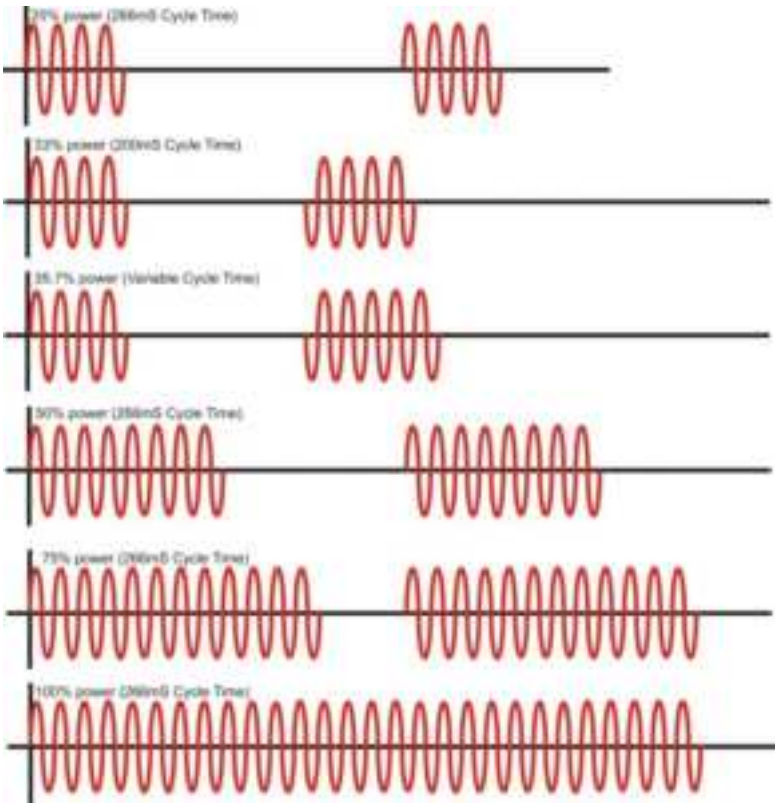
When burst firing AC with conventional PWM, there is a tradeoff between resolution and cycle time. Generally the cycle time should be chosen based on the mass of the load to be controlled; the larger the load mass, the longer the cycle time can be. For the best possible resolution, it is standard practice to choose the longest cycle time that can be used without causing process ripple. Longer cycle times generally provide greater control resolution, but the Fast Synchronous Burst setting provides excellent resolution with a fast cycle time.

4.5 Cycle Times – 266mS Selection (Fast Synchronous Burst Firing)

When the PCM-1B cycle time is set to 266mS (320mS @ 50Hz) the Fast Synchronous Burst Firing mode is turned on. The cycle time becomes longer near zero and full power levels to provide improved control resolution. For Example, since the PCM-1B generally modulates 16 AC cycles, the lower limit in power that will maintain the cycle time is 1/16 or 6.25%. The PCM-1B will use increased off periods below 6.25% power and above 94.75% power.

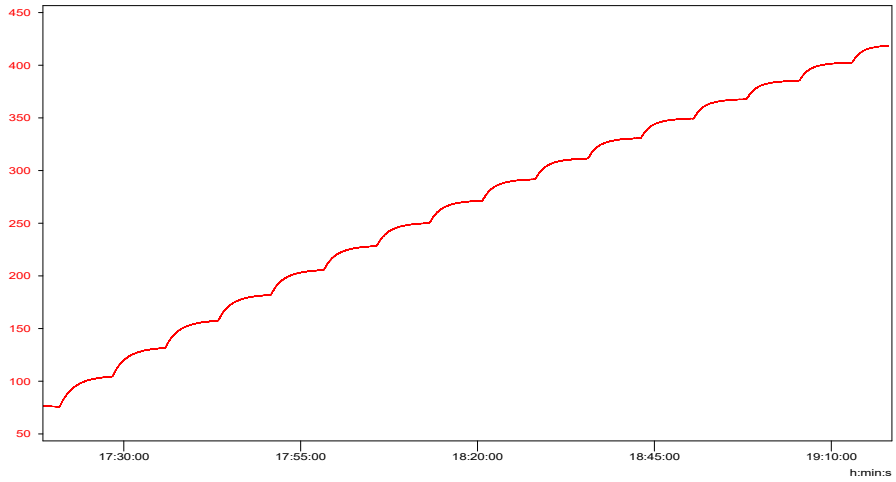
4.5.1 Fast Synchronous Burst Firing Mode

As shown below, the PCM-1B Fast Synchronous Burst Firing mode selectively fires fractional numbers of cycles. Since pulse width modulation alone would limit the resolution to 16 steps or 6.25% when modulating 16 AC cycles, a proprietary algorithm is employed to provide improved control resolution. In this firing mode, the cycle time is varied as well as the on time. To select the Fast Synchronous Burst Firing Mode set Diswitches 1 and 5 to the off position.

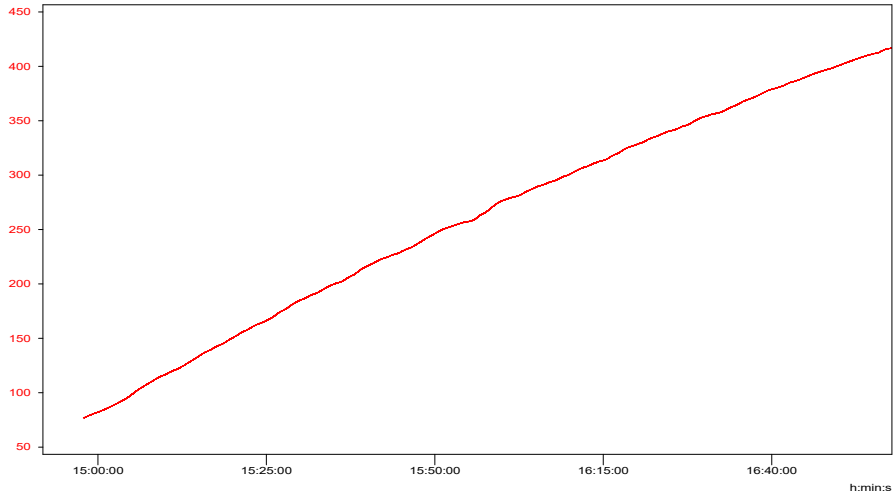


4.5.2 Fast Synchronous Burst Firing Advantages

The two plots below are actual data for a 425 degF capable 10KW resistive heater ramped from 0-100% power over two hours. The first plot shows straight 16 cycle, 266mS cycle time PWM. Note the nonlinearity humps due to poor resolution. The second plot shows the linearity improvement with the Fast Synchronous Burst. Any visible overall curvature is a normal heater characteristic.



Fast PWM of zero cross fired loads can result in poor linearity / resolution (above)



NuWave Fast Synchronous Burst algorithm results in excellent linearity / resolution (above)

4.5.3 PWM Command Input

The PWM input is designed to accept a push-pull 5V/TTL level drive at a frequency of 1KHz-100KHz.

4.5.4 Input Fail-safe Protection

If the signal sent to the PCM-1B's command input becomes electrically open the control output will be forced to a low output power state.

4.1 Power Limit

This feature will clip the command signal to a level set by the on-board potentiometer. The Voltage Limit is adjustable from 0% to 100% of the max load voltage. When the PCM-1Bis actively holding back or “limiting” the command via voltage limit, the RED “LIMIT” LED will become energized.

CT Turns Ratio	Max Measured Current (full scale load current)
1:500	100A RMS
1:1000	200A RMS
1:2000	400A RMS
1:4000	800A RMS
1:5000	1000A RMS

Other combinations of primary and secondary turns ratios may be used as long as the 200mA RMS and 5V peak of the CT input are not exceeded.

4.2 Configuration Dipswitch

The configuration dipswitch is used for setting up the command input, line soft start and limit as follows:

Command Input	2	3	4
0-5V (Default)	OFF	OFF	OFF
Potentiometer	OFF	OFF	OFF
0-10V	**ON**	OFF	OFF
4-20mA	OFF	**ON**	**ON**
1-5V	OFF	OFF	**ON**
2-10V	**ON**	OFF	**ON**

5	1	#of cycles	Cycle Time (60Hz)	Cycle Time (50Hz)	Resolution (% of FS)
OFF	OFF	~16	266mS	320mS	~1%
ON	OFF	60	1S	1.2S	1.66%
OFF	**ON**	600	10S	12S	0.166%
ON	**ON**	6000	100S	120S	0.0166%

4.3 Indicator LEDs

4.3.1 Power LED

The Green Power LED will illuminate when power is applied.

4.3.2 SCR Drive LEDs

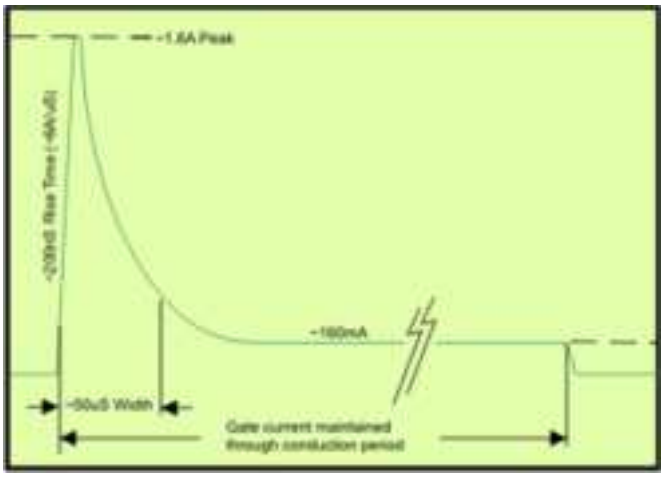
The RED SCR Drive LEDs will turn on when the SCR drive output is on. If the SCR gate is not wired properly or not connected, the LED will not illuminate. The LED should only be used as a rough indication of SCR Drive and not actual power output.

4.3.3 Limit LED

The RED Current Limit LED will illuminate when the Power limit is actively limiting the command input.

5. Electrical Specifications

5.1 SCR Gate Drive Profile



SCR Gate Drive Profile

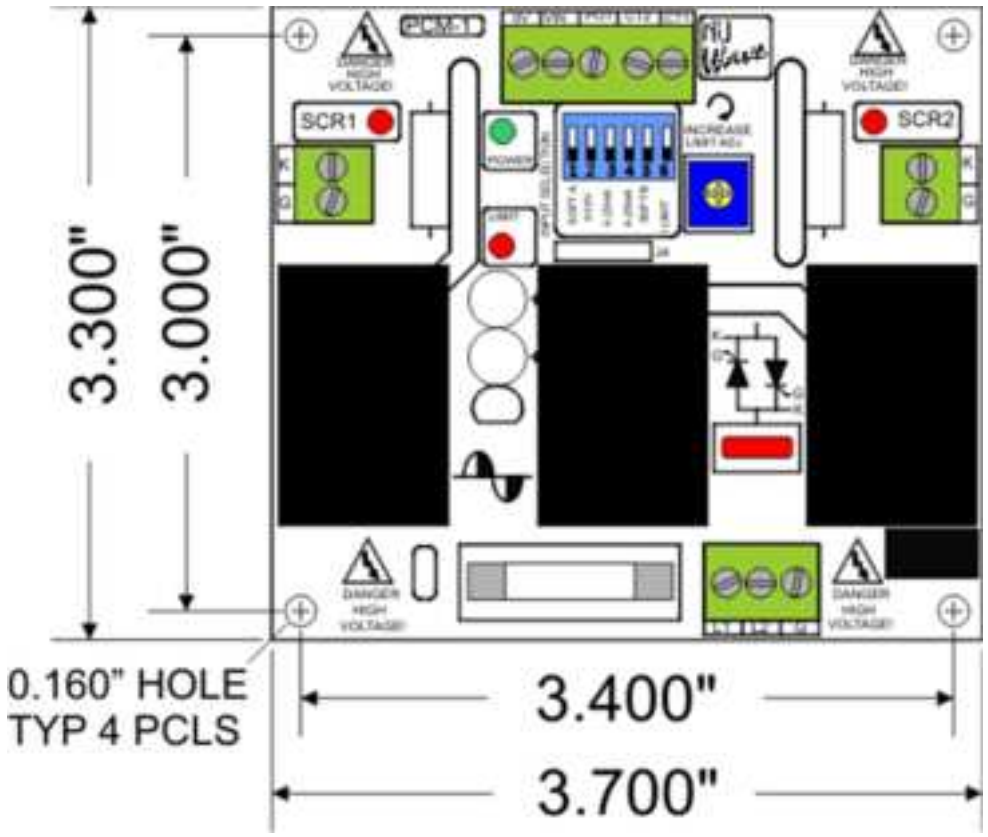
5.2 Input Specifications

Command Inputs	4-20mA, 0-20mA, 0-10V, 2-10V, 0-5V, 1-5V, Pot, PWM
Input Impedance	10K Ω (0-10V), 250Ω (4-20mA), 100KΩ (0-5V)
Response Time	<16mS (or Cycle Time Selection)
PWM Input Frequency	1KHz-100KHz
PWM Input Level	5 VDC TTL Level
External Potentiometer Res.	1KΩ-25KΩ
Command to Mains Isolation	2500Vrms
Command to SCR Drive Isolation	2500Vrms

5.3 Output Specifications

Control Range	0 – 98% power
Output Linearity	2%
Power Limit Range	0-100% of max load power
Ambient Temperature Range	0 to 50 °C
Power Supply	100-265VAC 50mA max.
Line Frequency Range	47 to 63Hz
SCR Gate Drive Characteristics	Initial pulse peak current of 1.6A rise time of ~200nS, maintain current of 160mA; See the SCR gate drive profile section for more detail.
SCR Drive / Mains Isolation	2500Vrms
SCR to SCR Isolation	2500Vrms

5.3.1 Mechanical Dimensions



MAX HEIGHT = 0.8”

6. WIRING DIAGRAM - SINGLE PHASE