

G216 MANUAL

STEP MOTOR INDEXER

The G216 is a 7A, 80VDC step motor drive with an integrated voltage-controlled oscillator (VCO). It can be used as a step and direction input motor drive or as a dual input speed controller, with user adjustable CW and CCW speeds and acceleration profile. The operating mode and mode related functions are set via the 10-position slide switch on side of the drive. The G216 has 2 opto-isolated inputs for use in VCO mode or Step and Direction mode. The function of the input/outputs is also determined by the selected operating mode. The features of these operating modes are described below.

STEP MOTOR DRIVE FEATURES

The G216 can operate as a conventional STEP and DIRECTION input step motor drive.

MICROSTEPPING: The G216 has a 10 microstep native resolution; each full step angle of the motor is divided into 10 equally spaced microsteps so a 200 step per revolution motor has 2000 stopping locations per revolution.

STEP PULSE MULTIPLIER: The G216 synthesizes 10 microstep pulses for every full-step pulse and 5 microstep pulses for half-step pulse. The G216 acts like a full or half-step drive but motor has the smoothness of a 10-microstep drive.

SUB-MICROSTEPPING: For the 10 microstep resolution, each input step pulse is divided into 32 sub-microsteps resulting in a motor smoothness equal to a 320 microstep drive.

MORPHING: The G216 morphs from sine-cosine motor currents at low speeds to square-wave currents at high speeds. This technique extracts the maximum possible power from the motor at higher speeds. Morphing begins at 240RPM and ends at 360RPM.

MID-BAND RESONANCE COMPENSATION: The G216 uses active second-order damping to completely suppress a step motor's tendency to resonate and stall at medium speeds (300RPM – 900RPM). This results in stable motor operation in this region.

LOW SPEED RESONANCE COMPENSATION: Low speed resonances are motor vibrations at speeds below 120 RPM caused by motor non-linearity. The PROFILE and ADJUST trimpots settings nulls these vibrations.

PROTECTION: The G216 is protected against motor to ground and motor to motor output short-circuits. It is also protected against reversed power supply polarity and power supply over-voltage. The internal fuse blows on polarity reversal and over-voltage.

AUTOMATIC STANDBY CURRENT: If enabled, the motor phase current is reduced to 70% of the set value and the G216 motor switching topology is changed to a low heating recirculating mode. This happens 1 second after the last step pulse is received.

VCO FEATURES

'ON THE FLY' MOTION CONTROL: Acceleration, velocity and destination can be changed even while the motor is in motion. The new values apply immediately.

CW and CCW LIMIT INPUTS: The G216 has an input for a limit switch on each end of travel. Once this switch is triggered the motor will decelerate to a stop and accelerate up to the opposite direction's set speed.

	S&D DRIVE MODE	VCO MODE
	1 DC GROUND	DC GROUND
	2 DC POSITIVE	DC POSITIVE
	3 PHASE A+	PHASE A+
	4 PHASE A-	PHASE A-
	5 PHASE B+	PHASE B+
	6 PHASE B-	PHASE B-
	7 DISABLE	RUN/STOP
	8 DIRECTION	CW JOG
	9 STEP	CCW JOG
	10 COMMON	COMMON
	11 FAULT OUT	MOTOR STOP
	12 N/C	N/C

POWER CONNECTOR ASSIGNMENTS

The terminal connection is broken into two blocks of six connections, with the first six being power and motor connections.

<u>Terminal</u>	<u>Name</u>	<u>Function</u>
1	GND	DC Power supply (-)
2	VDC+	DC Power supply (+)
3	A	Motor winding A
4	/A	Motor winding A
5	B	Motor winding B
6	/B	Motor winding B

TERMINAL 1: DC GROUND

Connect the power supply '-' to this terminal. This connection must be hard-wired to the power supply.

TERMINAL 2: DC POSITIVE

Connect the power supply '+' to this terminal. The power supply voltage must be between 18 VDC and 80 VDC and this connection must be hard-wired to the power supply. Do not use a switch, relay contact or any other device in series with this wired connection.

TERMINAL 3: PHASE A+

TERMINAL 4: PHASE A-

TERMINAL 5: PHASE B+

TERMINAL 6: PHASE B-

TRIMPOT ADJUSTMENTS

TRIM1 and TRIM2 are used to maximize motor smoothness at speeds below 50 RPM. The Digital Self-Test feature can be useful in making these adjustments. While the motor is turning, adjust TRIM1 for minimum motor vibration.

The rest of this user's manual is divided into two sections. Use the **G216 STEP MOTOR DRIVE MANUAL** if the G216 is used as a conventional step motor drive. Use the **G216 VCO MANUAL** if the G216 VCO is used.

G216 STEP MOTOR DRIVE MANUAL

This manual covers the G216 when it's used as a conventional STP/DIR input step motor drive. Go to the **G216 VCO MANUAL** if the G216 is used as a VCO and motor drive.

SWITCH SETTINGS AND CONNECTOR WIRING

 = SW is 'ON'

 = SW is 'OFF'

 = SW is not used to set current

WARNING! THE DIP SWITCHES MUST BE SET BEFORE THE MOTOR IS CONNECTED TO THE G216. VERIFY THE CURRENT SETTING BEFORE INITIAL POWERUP!

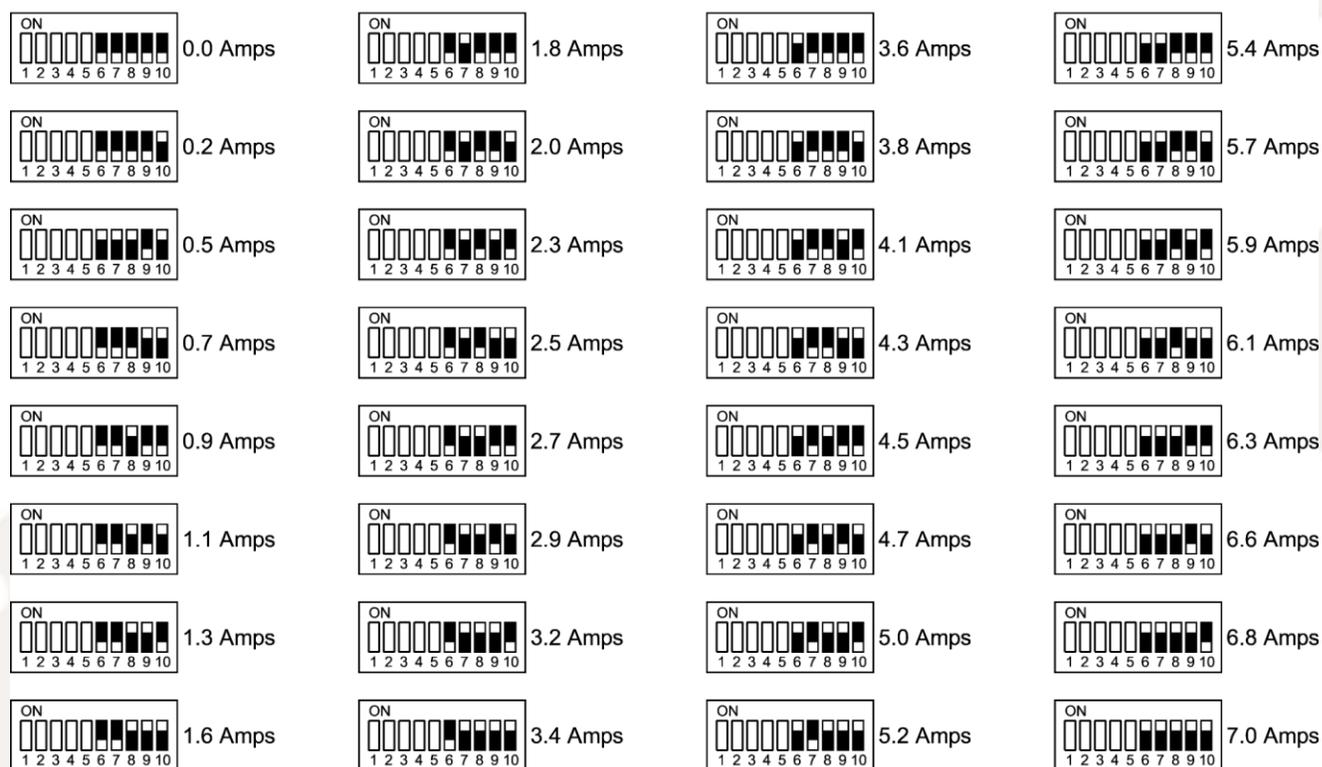


Figure 1.

G216 SETUP FOR MOTOR DRIVE MODE

CAUTION:

Perform the following steps with the power supply turned 'OFF' until a step says it is OK to turn the power supply 'ON'. Do not change the current set switches after setup while the motor is powered.

The following switch settings and their function only applies to the Motor Drive Mode. The same switches have completely different functions in the VCO Mode.

STEP 1: SELECT MOTOR DRIVE MODE

SW1 'ON' Select step motor drive mode operation. In this mode the G216 acts like a STEP / DIRECTION motor drive and the internal VCO isn't used.

STEP 2: SELECT MOTOR CURRENT

Use the following chart to set the G216 to the motor's phase current rating. If a motor has a rated current that isn't listed in the table below, set the current to the first setting that is greater than the motor's rated current.

STEP 3: SELECT MOTOR SIZE

Switch 5 must be set to the motor frame size.

SW5 'ON' The motor is a NEMA-23 size or smaller.

SW5 'OFF' The motor is a NEMA-34 size or larger.

STEP 4: SELECT STEP SIZE

The G216 can move in full-step, half-step or 10-microstep increments.

FULL-STEP

SW3 'ON'

SW4 'ON'

Every step pulse will move a 1.8 degree motor 1.8 degrees. The motor will move with 10-microstep smoothness which greatly limits low speed vibration.

HALF-STEP

SW3 'ON'

SW4 'OFF'

Every step pulse will move a 1.8 degree motor 0.9 degrees. The motor will move with 10-microstep smoothness to limit low speed vibration.

10-MICROSTEP

SW3 'OFF'

SW4 'ON'

Every step pulse will move a 1.8 degree motor 0.18 degrees. The motor will move with 320-microstep smoothness which makes the motor's motion continuous instead of step-wise even at very low speeds (less than 1 full-step per second).

STEP 5: SELECT STANDBY CURRENT REDUCTION

Standby Current Reduction is a method of reducing motor heating while a motor is idle and not moving. This is accomplished reducing motor current to 70% of the set value if this setting is enabled. The only adverse effect is the motor's holding torque is reduced to about 75% of its nominal value. If the motor has a back-driving load such as holding up a weight against gravity, this selection may not be advisable.

When enabled, the current reduction goes into effect 1 second after the last step pulse is received. The motor stays in this state until a new step pulse sent, at which time full current is restored very quickly.

SW2 'ON' enables current standby. The current is reduced while a motor is idle.

SW2 'OFF' disables current standby. An idle motor will stay at full current.

THIS COMPLETES THE SWITCH SETUP

LOGIC CONNECTOR ASSIGNMENTS

Connector terminals 6 through 12 are used for command inputs in the Step Motor Drive mode. Terminals 7, 8 and 9 are common cathode opto-isolated inputs with 200 Ohm current limit resistors. The inputs work with 2.5V, 3.3V and 5V logic levels. Logic 1 input current is 2 mA. The output is an open collector opto-isolator that has a 10 mA current sink rating.

<u>Terminal</u>	<u>Function</u>	<u>I/O</u>
7	DISABLE IN	INPUT
8	DIRECTION	INPUT
9	STEP	INPUT
10	COMMON	EXTERNAL GROUND
11	FAULT OUT	OUTPUT
12	N/C	

TERMINAL 7: DISABLE IN

The motor drive is ENABLED when this input is unused or has a logic 0 applied. The motor drive is DISABLED when this input has a logic 1 (+5V) applied. When DISABLED, the motor current goes to zero, there is no switching activity on the motor outputs and the motor free-wheels (detent torque). The motor position is restored if no step pulses have been sent while disabled.

TERMINAL 8: DIRECTION

The state of this input determines the direction a motor will move when a step pulse is received. The DIRECTION logic level must be stable 250ns before the active edge of the step pulse.

TERMINAL 9: STEP

A positive edge on this input (logic 0 to logic 1) causes the motor to move one increment of motion. The minimum logic 1 time is 1 microsecond and the minimum logic 0 time is 3 microseconds.

TERMINAL 10: COMMON

This is the ground terminal for the DISABLE, DIRECTION and STEP inputs and the FAULT output. It must go to the ground terminal of the controller that generates these inputs.

TERMINAL 11: FAULT OUT

This output goes to a logic 1 when the drive goes into protective shutdown because of over-voltage, over-current or over-temperature. Once the cause for the FAULT is corrected, the FAULT output can be cleared by cycling the power supply or the DISABLE input. The FAULT LED blink code is below:

BLINK CODE	STATE INDICATED
Solid Green	Step and Direction Mode: Power is applied. VCO Mode: Power applied and speed is set to zero.
Solid Red	Step and Direction Mode: Drive is disabled, motor is freewheeling.
GREEN-GREEN-GREEN-OFF	VCO Mode: Motor rotation is CW
RED-RED-RED-OFF	VCO Mode: Motor rotation is CCW

Table 1

When finished with the switch setup and wiring, it is OK to turn on power supply.

END OF G216 STEP MOTOR DRIVE MANUAL

G216 SETUP FOR VCO MODE

CAUTION: The following switch settings and their function only applies to the VCO Mode. The same switches have completely different functions in the Step Motor Drive mode. Turn the power supply 'OFF' and take care to set the switches to their correct settings when changing the operating mode.

STEP 1: SELECT MOTOR DRIVE MODE SW1 'OFF' Select VCO mode operation.

STEP 2: SELECT MOTOR SIZE SW5 'ON' The motor is a NEMA-23 size or smaller.
SW5 'OFF' The motor is a NEMA-34 size or larger.

STEP 3: SELECT SPEED RANGE The G216 has three speed ranges, each adjusting the sensitivity and range of TRIM4 and TRIM5.

LOW SPEED (0 – 234 RPM)

SW3 'ON'
SW4 'ON'

TRIM4 and TRIM5 will have a maximum speed of 234 RPM when turned fully CW. Fully CCW will get zero speed from the motor.

MEDIUM SPEED (0 – 937 RPM)

SW3 'ON'
SW4 'OFF'

TRIM4 and TRIM5 will have a maximum speed of 937 RPM when turned fully CW. Fully CCW will get zero speed from the motor.

HIGH SPEED (0 – 3750 RPM)

SW3 'OFF'
SW4 'ON'

TRIM4 and TRIM5 will have a maximum speed of 3750 RPM when turned fully CW. Fully CCW will get zero speed from the motor.

STEP 4: SET ACCELERATION TRIM3 will set the trapezoidal ramping profile for CW and CCW speed.

This trimpot will set the acceleration time for the CW and CCW velocities. This time is proportional to the amount the trimpot is turned, with a minimum acceleration and deceleration time of 128 milliseconds and a maximum acceleration and deceleration time of 32 seconds. This is an analog setting and will typically be empirically derived.

LOGIC CONNECTOR ASSIGNMENTS

Terminals 7, 8 and 9 are opto-isolator LED anode inputs in series with 200 Ohm current limit resistors. The LED cathodes go to the COMMON terminal. The inputs work with 2.5V, 3.3V and 5V logic levels. Minimum logic 1 input current is 2 mA. Terminals 5, 6 and 7 are three opto-isolated collector outputs that have a 10 mA current sink rating and their emitters go to the COMMON terminal.

Terminal	Function	I/O
7	RUN/STOP	INPUT
8	CW RUN	INPUT
9	CCW RUN	INPUT
10	COMMON	EXTERNAL GROUND
11	FAULT OUT	OUTPUT
12	N/C	

TERMINAL 7: RUN/STOP

This input is the only way to control VCO mode on or off. Applying +5VDC to TERMINAL 7 will cause the motor to accelerate to the speed set at the CW and CCW trim pots. Removing +5V will cause the motor to decelerate to a stop.

TERMINAL 8: CW RUN

This input is a CW RUN input. Applying +5V to this input will accelerate and run the motor to the speed set on TRIM4.

TERMINAL 9: CCW RUN

This input is a CCW RUN input. Applying +5V to this input will accelerate and run the motor to the speed set on TRIM5.

TERMINAL 10: COMMON

This terminal serves as the COMMON shared GND for the RUN/STOP, CW RUN, and CCW RUN +5V inputs.

TERMINAL 11: MOTOR STOPPED

This open-collector output will go to a logic "0" when the motor is stopped. The time between signaling the motor to stop and this output going low will be equal to the deceleration time. This output will only go low when the motor is no longer moving.

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MANUAL CHANGE LOG

DATE	CHANGES MADE
7/17/2018	G216 Rev-A Manual Published
2/9/2022	G216 REV1 Manual Published, with updated diagrams
5/2/2022	G216 REV2 Manual Published, pinout clarifications and standardized format