Introducing...

DRAGON DRIVERS™
Stepping Motor Controls

Module with Heatsink, for PCB mounting

Fire up your Stepper Motors with Dragon Drivers ™

Module on PCB with terminal blocks and track for mounting

System 29A55, complete with power supply, digital oscillator, . . . ready to wire and run.

Quality Features

- Simple to hookup and use.
- No external components required.
- Full, Half step and Wave drive capability.
- Inputs TTL/CMOS compatible.
- Chopper regulation of motor current.
- Programmable motor current (2.5A max).
- Wide voltage range (10-40 VDC).
- Selectable slow/fast current decay.
- Synchronization for multimotor applications.
- Remote inhibit/enable.
- Home position indicator.
- Over-temperature protection.
- Fully short circuit protected outputs.

Dragon Drivers are complete bipolar modules, incorporating all the small signal and power functions to allow the user to directly interface a microprocessor or other pulse source with any two-phase permanent magnet hybrid stepper motor.

Choose Three Convenient Packages:
- Module only, for P.C. mounting.
- Module on PCB, with terminal blocks for connections plus track for mounting.
- System, complete with power supply, digital oscillator and mounting track, ready to wire and run.

DRAGON DRIVERS™
LOW COST • HIGH POWER • COMPACT

DRAGON DRIVERS are very versatile, powerful, efficient, compact, low cost drivers for permanent magnet hybrid stepper motors. All step sequence logic functions are performed "on-board". All you need is to supply step and direction commands. In our System model, we even include an on-board oscillator for simple applications plus a power supply. Speeds up to 20,000 steps per second and a torque to 250 inch-ounces can be obtained with standard 2" and 3" diameter motors.

The heart of DRAGON DRIVERS is a module housed in a metal case, with shielding against radiated EMI. This module is packaged as Module only, Module with terminal block connections and Complete System which includes oscillator and power supply.

Goof-Proof & Completely Safe

DRAGON DRIVERS state-of-the-art drivers are goof proof. You can short the outputs to each other, to ground or to the voltage supply. You can't blow it! The control module is also over-temperature protected.

DRAGON DRIVERS are completely safe. If anything goes wrong, the module will shut itself down until power is removed. When power is restored, operation resumes automatically.
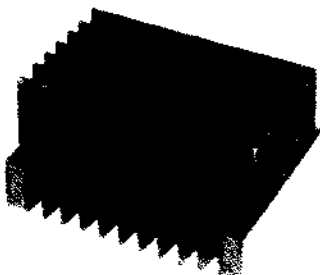
Rapid Acceleration

DRAGON DRIVERS are switch mode drivers employing a higher than normal voltage supply in relation to the motor's required voltage so the current can be increased quickly. The unlimited current rapidly increases through the winding until the current detector switches off the output. Motor voltage is not important as current through the winding is controlled. However, low voltage, low inductance motors provide optimum performance in most applications.

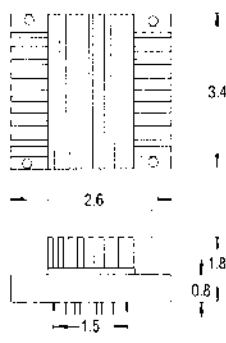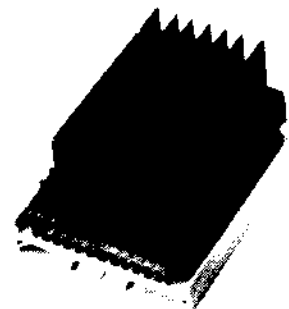## Module Only
Ready for Printed Circuit Board Mounting

Module Assembly
With Terminals & Fast Track Mounting

Same as Module Only model except for the addition of convenient screw terminal connections and fast track mounting.
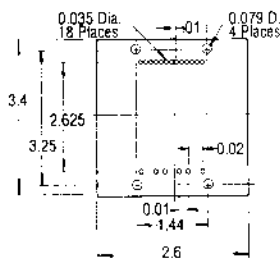
Typical Ratings-Module Only & Module Assembly

Vs	Supply voltage:	40 VDC
Vss	Logic Supply voltage:	5 V
Io	Peak output current:	2.5 A
Tstg	Storage temperature range:	-40 °C to +105 °C
Tcop	Operating case temperature range:	-20 °C to + 85 °C

Catalog No. 29A65

Catalog No. 29A70

0.035 Dia. 18 Places   .01   0.079 D. 4 Places

3.4

2.625

3.25

0.02

0.01

1.44

2.6

Fig 2
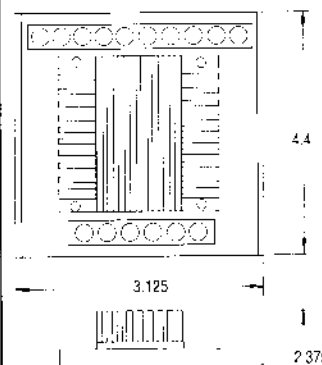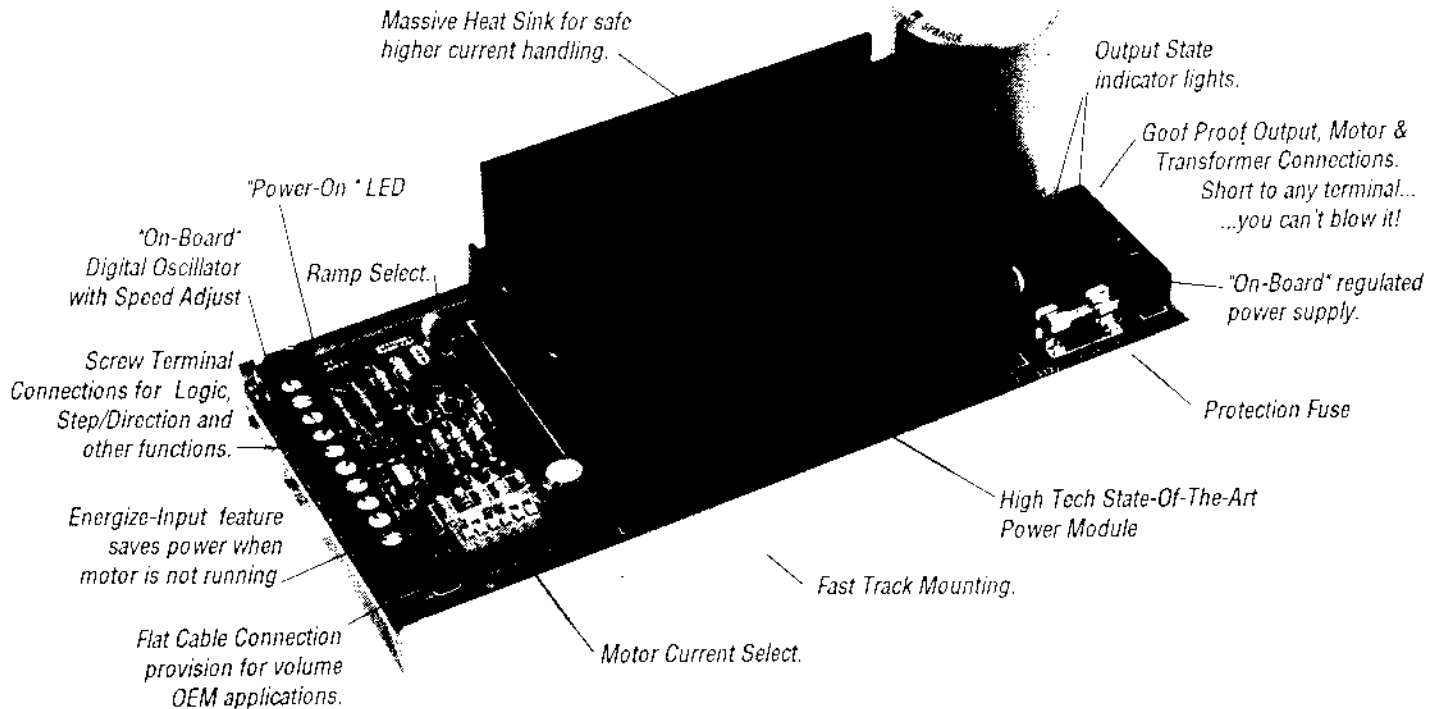
3.4

2.6

1.8

0.8

1.5

Fig. 1

4.4

3.125

2.375

Fig. 3

Catalog No. 29A70 includes a section of track for convenient mounting. Order three foot long track, Catalog No. ST1 for multiple module mounting.

Note: Nominal dimensions in inches

GENERAL CONTROLS ELECTRONICS • 2350 Brickvale Drive, Elk Grove Village, IL 60007 • (847) 595-2152 • Fax: (847) 595-2271

Stepping Motor Controls

Massive Heat Sink for safe higher current handling.

Output State indicator lights.

Goof Proof Output, Motor & Transformer Connections. Short to any terminal... ...you can't blow it!

"Power-On" LED

"On-Board" Digital Oscillator with Speed Adjust

Ramp Select.

"On-Board" regulated power supply.

Screw Terminal Connections for Logic, Step/Direction and other functions.

Protection Fuse

Energize-Input feature saves power when motor is not running

High Tech State-Of-The-Art Power Module

Fast Track Mounting.

Flat Cable Connection provision for volume OEM applications.

Motor Current Select.

Complete System
Includes Module, On-board Digital Oscillator & Power Supply & Fast Track Mounting

Ready to run, including an "on-board" power supply and a digital oscillator with two remote speed selectable ranges. Screw terminal or ribbon cable connection. Minutes after unpacking you are ready to run.

Characteristics-System

Vs	Supply voltage (Input):	40 VDC max. or 28/120/220VAC via stepdown transformer.
Ts	Storage Temperature:	-40 °C to +105 °C
To	Operating Temperature:	-20 °C to + 85 °C

Features of the System Model

✓ No external components required for load dropping.
✓ Full/Half step selection.
✓ Inputs TTL/CMOS compatible.
✓ Chopper regulation of motor current.
✓ Motor current dip switch selectable to 2.5 Amps.
✓ Motor Current Save feature reduces power when motor not running.
✓ Short circuit protection.
✓ Over-temperature protection.
✓ On board D.C. Supply.
✓ On board Digital Oscillator.
✓ On board Ramping.
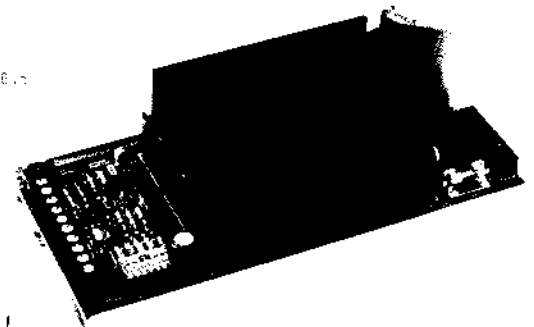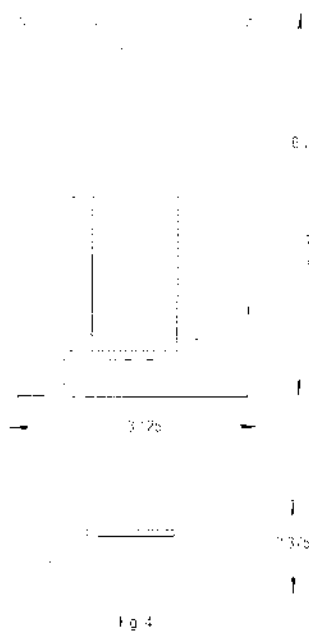
Catalog No. 29A55
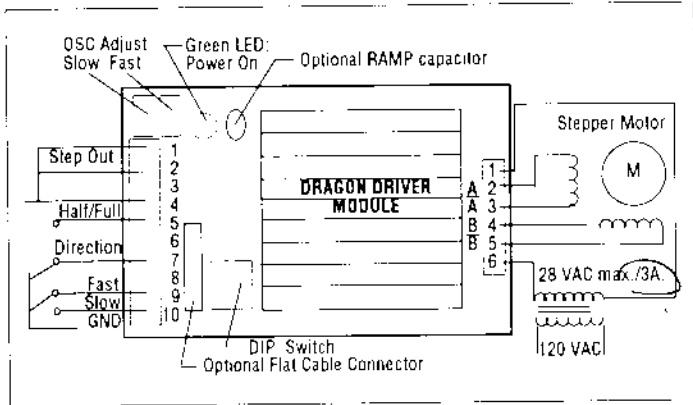
Nominal dimensions in inches

Fig. 5. Typical application for the System model.

Getting started with the System model is fast and easy! Here's the procedure.

1. TRANSFORMER CONNECTIONS TO THE DRIVE

Connect the terminals on the primary side of the step-down transformer to a 120 or 220 Volts AC source. Connect the transformer's secondary terminals to terminals 1 and 6 of the small terminal block. This supplies the module with 28 VAC maximum.

2. MOTOR CONNECTIONS

This drive can be used with any two-phase permanent magnet hybrid stepping motor. 4-6-8 Lead configurations are shown following. You will get the best performance with a low voltage (2-4 volts) low inductance motor (Suggested motor types are shown elsewhere in this brochure). Choose series or parallel connections based on the torque or speed characteristics you need. Try different combinations - you may be interested in the top output speed/torque performance changes obtainable based on motor type and application.
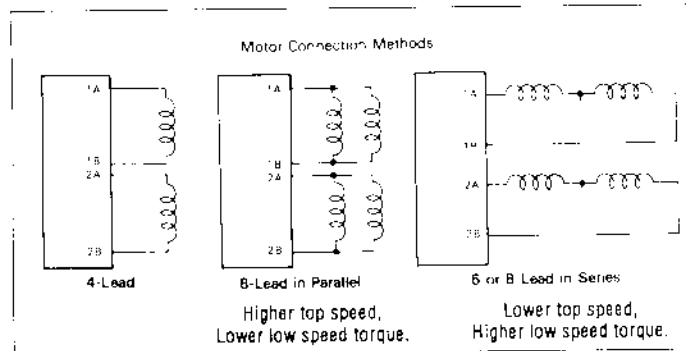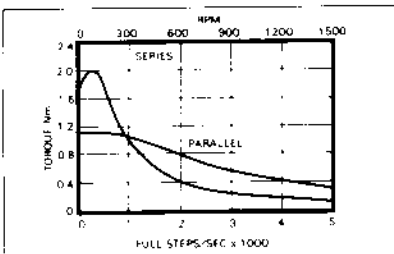

Fig. 6 . Typical Motor Connections.

Note: We have done extensive testing of all motor manufacturers and can supply you with connection information for any brand of motor. Ask for our data sheet.

Fig. 7. Advantages of Series vs Parallel connections.

3. LOGIC & CONTROL CONNECTIONS

The module is accessible through a 10-screw Terminal Block for normally needed control features, or a 14 pin .10 x .10 Flat Cable Connector header for every available control feature. They are connected in parallel. Either may be used to connect signals to the module. Connection using the Terminal Block is as follows.

Terminal Block Number	Function
1	Step Out
2	Step In
3	+5 V Out
4	Half/Full Step Select
5	CW/CCW Select
6	Enable
7	Ground (OV)
8	Fast Osc Select
9	Slow Osc Select
10	Ground (OV)

Note: For Flat Cable Connections, see Fig. 8, page 5.

STEP PULSE OUT: This terminal generates a step pulse out. It may be connected to the STEP PULSE IN terminal. The internal on-board digital oscillator will produce pulses that are controlled by the fast or slow pots.

STEP PULSE IN: Connect the STEP PULSE OUT to this terminal or connect an external pulse source such as a microprocessor or indexer. See page 5 of this catalog for exact pulse height, width etc., if an external pulse source is used.

+5 VOLTS OUT: A 5 Volt source that can be used to power opto isolators or logic modules such as Crydom or Opto 22 is provided for your convenience.

SLOW: Connect to OV to run the SLOW internal oscillator. The slow speed pot will control motor speed from 70 steps per second to 5000 steps per second, approximately.

FAST: Connect to OV to run the FAST internal oscillator. The fast speed pot will control motor speed from 1800 steps per second to 20,000 steps per second, approximately.

CW/CCW: Connect to OV to make the motor rotate counterclockwise. Leave the input open to make the motor rotate clockwise. Physical direction of motor rotation also depends on connection of the windings. Interchange the two wires on one winding and the motor will run in the opposite direction.

HALF/FULL STEP: Connect to OV to select FULL STEP mode. Leave unconnected for HALF STEP. For your convenience, this input is wired in parallel with position 6 of the dip switch. Place the switch in half or full step and leave it. Once most applications are set up, they do not require a change. Half step provides smooth shaft motion, reducing motor resonance. Most applications use the half step mode.

INPUT FUNCTION TABLE

Function	High (N.C.)	Low (GND)
Half Step	X	
Full Step		X
CW	X	
CCW		X
Enable	Active	Inhibited

GROUND (OV): Connect ground for return signal path.

4. MOTOR CURRENT SETTING (Via DIP Switch)

This feature is provided as a convenience so that you do not have to
select and wire externally. Use the following table to set the motor
current you desire:

Current	Switch	Position
.5A	1, 2, 3	On
.55A	1, 2	On
.6A	1	On
1.2A	2, 3	On
1.4A	2	On
1.6A	3	On
2.24A	4	On
2.4A	5	On
2.5A	4, 5	On
2.0A	1-5	Off

Position 6 selects Full or Half Step. See paragraph 3, page 4..

5. OPTIONAL RAMP CAPACITOR

Stepping motors cannot start and stop at high speeds. The speeds at
which they stop/start is dependent on many things such as motor size
and inductance, the load, and the voltage applied to the motor. The
standard ramp built into the internal oscillator is about 20 microsec-
onds long. You may extend the ramp by putting additional capacitors
in parallel. Two holes are provided on the board for this purpose.
Try various size capacitors. A larger value will start the motor s
lower. The table below will give you some very general guidelines.
Remember, if you use your own pulse source, you may have to ramp
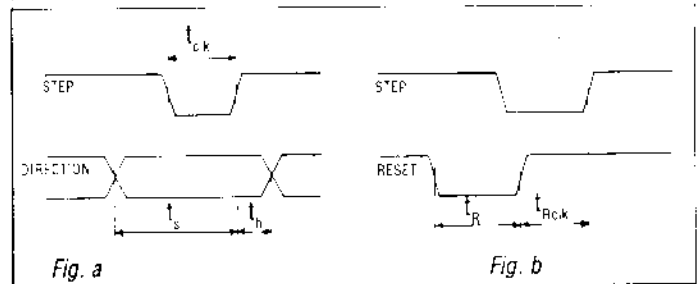to reliably control your motor.

Ramp Time Approximations

TOTAL CAPACITANCE uF	ACCELERATION/ DECELERATION mS
5	25
10	50
15	65
20	90
25	110
35	155
45	200
55	230
65	270
220	1050

ELECTRICAL CHARACTERISTICS
for the DRAGON DRIVER Module

Parameter		Pin No.*	Test Conditions	Min.	Typ.	Max.	Unit
Vs	Supply voltage	18		12	--	46	V
Vss	Supply voltage	12		4.75	5	5.25	V
Is	Quiescent supply current, Iout=0	18	Vs=35V	--	15	30	mA
Iss	Quiescent supply current Iout-0	12	All inputs high Vss=5V		30	--	mA
Vi	Input voltage	3,4,6, 7,10,11	low high	-- 2.0	-- --	0.8 Vss	V V
Ii	Input current	3,4,6, 7,10	low high	-- --	-- --	0.6 10	mA uA
Ien	Enable input current	11	Ven=low	--	--	8	mA
Vhome	Home output voltage Ihome=5mA	5	low high	-- 2.0	-- --	0.4 Vss	V V
Vsat	Source saturat. voltage	14,15, 16,17	Io=2A	--	--	1.5	V
Vsat	Sink saturat. voltage	14,15, 16,17	Io=2A	--	--	1.5	V
fc	Chopper freq.			--	17	--	kHz
tclk	Stepclk width	6, Fig. a		0.5	--	--	us
ts	Set up time	Fig a		1.0	--	--	us
th	Hold time	Fig. a		1.0	--	--	us
tR	Reset width	Fig. b		1.0	--	--	us
tRclk	Reset to clock set up time	Fig. b		1.0	--	--	us

*Pin numbers refer to 'Stand-alone' Dragon Driver modules 29A65 & 29A70 shown in Figures 9 & 10, page 6.

Fig. a   Fig. b

Fig. 8. Connection & Feature Diagram for Complete System.

PROCEDURE FOR QUICK SET-UP & CHECK

1. Connect the transformer and motor to the six pin terminal strip as shown.
2. Program the dip switch as follows:
   Positions 1 thru 5: "On" or "Off" per paragraph 4.
   Position 6: "ON"
3. Put a jumper between pins 1 & 2 on terminal block.
4. Put a jumper between Slow, pin 9, and OV, pin 10.
5. Connect the transformer to a power source. Green LED will light. Adjust to desired speed. Red LEDs will light or flash.
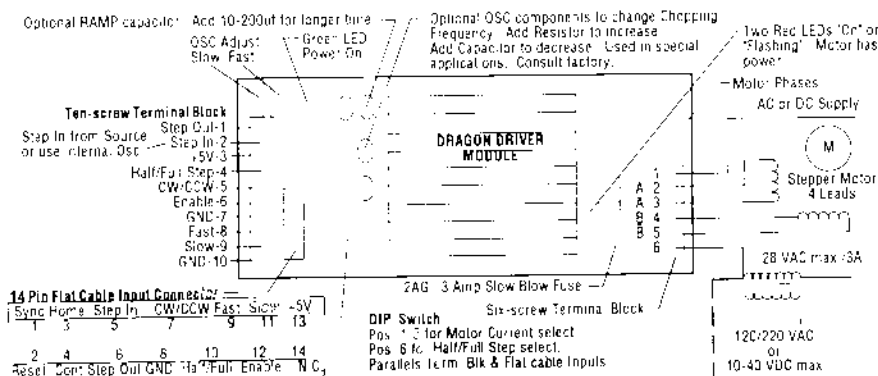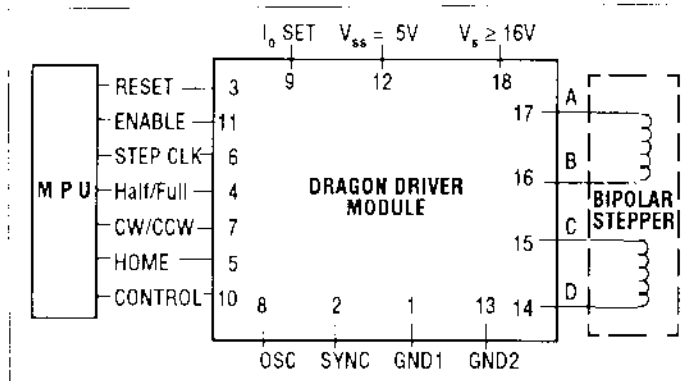
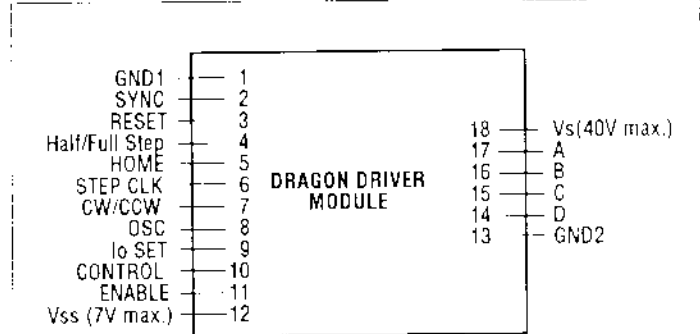Fig. 9. Typical Application - Module Models 29A65 & 29A70.

Fig. 10. Connection Diagram- Module Models 29A65 & 29A70.

Operation

Dragon Drivers ™ Module and Module assemblies are complete bipolar stepper motor drivers that incorporate all the small signal and power functions to directly interface a microprocessor or other pulse source with a two phase permanent magnet motor (see the typical application). Only two connections have to be made between the micro-processor and the module. They are:

- Step Clock
- Direction (clockwise or counterclockwise)
  Other available options:
  - Mode (half of full step)
  - Reset and Enable
  - Current Decay (slow or fast)
  - Motor Current Select
  - Sync
  - Zero State
  - Oscillating Frequency

Based on this information, the module generates the proper phased sequence to directly drive the motor, greatly simplifing the task of the microporcessor and the system programmer.

No external components are needed to operate Dragon Drivers. How ever, to add flexibility in use, some internally set functions can be modified externally, such as the maximum current flowing through the motor windings and the switching frequency of the chopper, by adding a few inexpensive passive components (resistors and capacitors).

If any logic input is left open, the module forces them to high level.

The heart of the Dragon Driver is a module housed in a metal case that provides a heat sink and shielding against radiated EMI. The thermal resistance case to ambient is about 5°C/W. This means that for each watt of internal power dissipation the case temperature is +5°C above ambient temperature below 85°C in operating conditions.

Dragon Driver outputs are fully protected against short circuits to ground, to Vs and each other by a latching circuit. This means that the normal operation can be restored, after the problem has been corrected by a low level applied to the ENABLE input, or by switching the power supply off and on.

Dragon Drivers incorporate thermal protection that switches off the power stages when the junction temperature of active components reach 150°C.

Programming External Options

The Dragon Driver ™ module is set at these conditions when no external component is used:

$$I_{out} = 2 \text{ Ampere}$$
$$f_o = 17 \text{ kHz}$$

By addition of inexpensive passive components the operating parameters can be modified.

The output current (already set at 2 Amperes) can be re-programmed by addition of an external resistor. If a lower current is desired, a resistor R1 must be connected between $I_o$set and GND1 pins.

The value of the output current, for Vss − 5V, is related to the value of R1 by:

$$I_{out} = \frac{22.72}{11 + 8.25/R1}$$ where R1 is in kohm

If a higher current is needed, a resistor R2 must be connected between $I_o$set and Vss.

The output current, for Vss = 5V, is related to the value of R2 by

$$I_{out} = 2.11 \frac{R2 + 10}{R2 + 0.697}$$ where R2 is in kohm

Minimum value of R2 is 47 kohm.

To increase the chopper frequency, a resistor R3 must be connected between OSC and Vss pins. The new chopper frequency is given by:

$$f_o = 19 \frac{1 + 33}{R3}$$ where R3 is in kohm

To decrease the chopper frequency, a capacitor C must be connected between OSC and GND1 pins. The new chopper frequency is given by:

$$f_o = \frac{43.9}{2.19 + C}$$ where C is in nF

Note: For electrical characteristics of Dragon Driver Module refer to page 5 of this brochure.

Module Assembly

The System model 29A55 is ready to run.

Ordering Information

Pin /Function Description for Dragon Driver Module & Module Assembly

PIN	FUNCTION
1-GND1	Common ground for low current path.
2-SYNC	Output of the module chopper oscillator. Several Dragon Driver modules can be synchronized by connecting together all SYNC pins. An external chopper clock source, if used, must be injected at this pin.
3-RESET	Reset asynchronous input. An active low pulse on this input restores the module to the Home position. (ABCD-0101).
4-HALF/FULL	Half/Full step select input. When high or not connected, it selects half step operations, when low it selects full step operation.
5-HOME	Output that indicates when the module is in its initial state (Active low: ABCD = 0101 = state 1). This signal should be ANDed with the output of a mechanical home position sensor.
6-STEPCLK	A pulse on this input moves the motor by one step. The step occurs on the rising edge of this signal.
7-CW/CCW	Clockwise/counterclockwise direction control input. When high or not connected, clockwise rotation is selected. Physical direction of the motor rotation depends also on the connection of the windings. Direction can be changed anytime.
8-OSC	The chopper frequency of the module is internally fixed at 17kHz. This frequency can be increased by connecting a resistor between this pin and Vss, or decreased by connecting a capacitor between this pin and GND1. When multi-module configurations must be synchronized, this pin is connected to ground on all but one module.
9-IoSET	The motor phase current is set at 2.0A. This current can be decreased by connecting a resistor between this pin and GND1, or increased by connecting a resistor between this pin and Vss.
10-CONTROL	Control input that defines the motor current decay inherent to chop mode control. When low, a fast decay is obtained; when high or not connected, slow current decay is imposed to the motor current.
11-ENABLE	Module enable input. When low the module is inhibited. When high or not connected the module is active. This input must be driven by an open collector output.
12-Vss	5V supply input. Maximum voltage must not exceed 7V.
13-GND2	Common ground for high current path.
14-D	Phase D output.
15-C	Phase C output.
16-B	Phase B output.
17-A	Phase A output.
18-Vs	Module supply voltage (<40V).

Dragon Drivers™ Modules & Systems

DESCRIPTION	CATALOG NUMBER
Module with Heat Sink, ready for PCB.	29A65
Module with terminal block, on PCB.	29A70
System Assembly, ready to run.	29A55

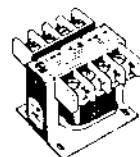## Options & Available Acessories

MOUNTING TRACK:
Three foot long.   Catalog #ST1
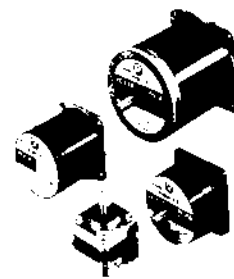For mounting multiple drivers

POWER TRANSFORMER:
Heavy Duty.   Catalog #HDT1
Allows up to 3 Drivers to be connected to one power source.
Standard Duty.   Catalog #SDT1
120/220 VAC, 50/60 Hz.
for single drive connection.

MOTORS
1.7" 25 in-oz Step Motor
        1.8° or 0.9° (Full Step)
2"   75 in-oz Step Motor
        1.8° or 0.9° (Half Step)
3" x 2" long 150 in-oz Step Motor
        1.8° or 0.9° (Half Step)
3" x 5" long 275 in-oz Step Motor
        1.8° or 0.9° (Half Step)
2" 75 in-oz Step Motor
        0.9° or .45° (Half Step). *
3" x 2" long 150 in-oz Step Motor
        0.9° or .45° (Half Step). *
* For mini step and very smooth operation.

Gear Boxes:
We carry 2" x 3" motors with a complete range of gear boxes available with easy 4 bolt mounting. Great for low cost micro stepping or high torque low speed applications. Call us for recommendations.
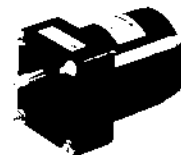
Other Available Products:
Custom versions of standard Dragon Drivers and other motion control devices are available. Examples:
- Drivers with on-board indexers for precise motion control..
- Accessory Buffer card that allows input step pulse frequency of any rate to be applied to the Dragon Driver. Call us for more information.