



QUAD HALFBRIDGE DRIVER

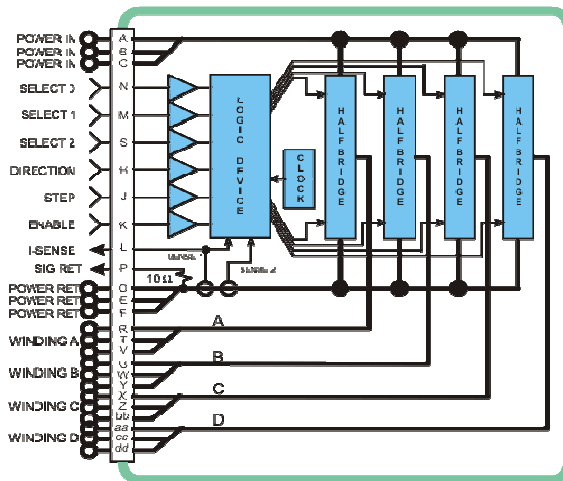
OUR SERIES 404 QUAD HALF BRIDGE DRIVERS PROVIDE SUPPORTABLE LOW COST MOTOR CONTROL ELECTRONICS FOR DIFFICULT ENVIRONMENTS. THE DRIVER EMPLOYS PROGRAMMABLE LOGIC ENABLING THE SELECT PINS TO BE ASSIGNABLE. THIS MEANS THAT THE DRIVE CAN BE USED IN MULTIPLE PLACES IN A SYSTEM FOR DIFFERENT APPLICATIONS WITHIN THE SYSTEM.



FOR EXAMPLE, THE DRIVE CAN BE SET UP SO THAT THREE OF THE SELECT PINS CAN BE USED TO ASSIGN UP TO EIGHT FUNCTIONS. USE STANDARD PROGRAM 101 SET UP TO DRIVE 3 PHASE STEPPERS, PROGRAM 010 SET UP TO DRIVE 2 PHASE STEPPERS, PROGRAM 110 CAN BE SET UP TO DRIVE TWO BRUSHED DC MOTORS. THIS EXAMPLE ALLOWS 1 PART NUMBER TO BE USED IN THREE SPOTS INTERCHANGEABLY RESULTING IN LOWER ACQUISITION COST AND LOWER LOGISTICS AND SUPPORTABILITY COST.

THE UNIT CAN BE USED TO CONTROL BRUSHLESS MOTORS IN CLOSED LOOP APPLICATIONS BY TAKING ADVANTAGE OF ITS PWM CAPABILITY EITHER DIRECTLY CONNECTED TO A MICRO CONTROLLER or BY ADDING A FRONT END ANALOG OR DEDICATED DIGITAL INTERFACE. SIMILARLY, THE DRIVER CAN PROVIDE THE POWER STAGE OF PWM VALVE CONTROL ELECTRONICS. AND AGAIN, BY TAKING ADVANTAGE OF THE SELECT PINS, ONE PART NUMBER CAN SOLVE MULTIPLE APPLICATIONS.

THE SERIES 404 DRIVER ALSO FEATURES A BUILT IN CURRENT SHUNT CONNECTED TO TWO COMPARATORS WITH DIFFERENT HARDWARE THRESHOLD SET POINTS. THIS FEATURE CAN BE USED TO INTERNALLY REGULATE CURRENT TO EITHER OF THE TWO SET POINTS.



- 4 POWERFUL HALF BRIDGES...** 10 Amps/Output, 15 Amps Total
- WIDE POWER INPUT RANGE...** MIL-STD-704E 28VDC
- 6 COMMAND SELECTION DISCRETES...** <.8v = Lo, > 2.0v = Hi
- PWM READY...** Fast Transition Power Stage
- 2 CURRENT LEVEL MONITORS...** Hardware Configured to 2A/10A
- 1 INTERNAL CURRENT SENSE...** 20 mV/Amp
- 1 INTERNAL OSCILLATOR...** ~200kHz
- TEMPERATURE RANGE...** -40C ♦ +85C
- CASE with ALUMINUM BASE...** 2.55" X 3.05" X .63"

CONNECTOR... 26 PIN 55302
DERATING GUIDELINE... Navmat P4855-1A



QUAD HALFBRIDGE DRIVER

All voltages with respect to Power Return

	Parameter	Typ @ 20C	Units	Min	Max	Condition/Notes
V_{sup}	Supply Voltage	+28	V	+16	+50	! Damage if max is exceeded MIL-STD-704D, E, & F 50 V Transients OK
V_{sig}	Signal Input Range	.2 to 4.8	V	-28	+28	! Damage if Max is Exceeded
V_{thr}	Signal Threshold	+1.7	V	+8	+2.0	
t_{on}	Power Stage Turn-on Time	180	nS			10% to 90% @ 28Vsup
t_{off}	Power Stage Turn-off Time	250	nS			90% to 10% @ 28Vsup
t_{delay}	Signal Debounce Delay	5	uS		8	TBD
t_{min}	Input Pulse Duration		uS	10		
I_q	Quiescent Current	+10	mA		+50	Enable Lo
I_{oc}	Bridge Output Current Trip	+10	A	+2	+15	Consult factory for others up to 15 A
I_{reg}	Current Regulation Set Point	+2	A			Consult factory for others up to 10 A
V_{sense}	Current Sense Scale Factor	+0.02	V/A			Pin L wrt Pin D
R_{pp}	Power Path $R_{DS(on)}$.066	Ohms			25C
η	Efficiency	.96				25C @ 10A
V_{SIGRET}	Maximum voltage difference between Signal Ret and Power Ret		V		+0.5/- .5	! Damage if Max is Exceeded Signal Ret and Power Ret must be connected via a total path of no more than .5 ohms.
f_c	Internal Clock Frequency	200	KHz			
I_{pin}	Connector Pin Current Rating	5	A			
C_o	Recommended External Power	100uF	uF			Low ESR. Make connection as close to unit
T_{oper}	Operational Temperature		Deg C	-40	+85	Base Plate Temperature

STANDARD TRUTH TABLES for v.601
Consult Factory for Custom Truth-table Options

Notes:

- 1) Binary Program Number refers to the required states of Select 0, Select 1, and Select 2 inputs respectively.
- 2) Hi indicates connection to > 2.0 Volts
- 3) Lo indicates connection to < 0.8 Volts
- 4) Each transition of the STEP input from Lo to Hi results in incrementing to the next STATE.

BINARY PROGRAM NUMBER: 101					
3 Phase, 2 Leads Tied					
			PHASES		
STATE	ENA	DIR	A	B	C
X	0	X	Lo	Lo	Lo
0	1	1	Hi	Lo	Lo
1	1	1	Hi	Hi	Lo
2	1	1	Lo	Hi	Lo
3	1	1	Lo	Hi	Hi
4	1	1	Lo	Lo	Hi
5	1	1	Hi	Lo	Hi
4	1	0	Lo	Lo	Hi
3	1	0	Lo	Hi	Hi
2	1	0	Lo	Hi	Lo
1	1	0	Hi	Hi	Lo
0	1	0	Hi	Lo	Lo
5	1	0	Hi	Lo	Hi

BINARY PROGRAM NUMBER: 100					
3 Phase Six Step Line to Line					
			PHASES		
STATE	ENA	DIR	A	B	C
0	0	1	Off	Lo	Lo
1	0	1	Lo	Lo	Off
2	0	1	Lo	Off	Lo
3	0	1	Off	Lo	Lo
4	0	1	Lo	Lo	Off
5	0	1	Lo	Off	Lo
0	1	1	Off	Lo	Hi
1	1	1	Hi	Lo	Off
2	1	1	Hi	Off	Lo
3	1	1	Off	Hi	Lo
4	1	1	Lo	Hi	Off
5	1	1	Lo	Off	Hi
4	1	0	Lo	Hi	Off
3	1	0	Off	Hi	Lo
2	1	0	Hi	Off	Lo
1	1	0	Hi	Lo	Off
0	1	0	Off	Lo	Hi
5	1	0	Lo	Off	Hi
4	0	0	Lo	Lo	Off
3	0	0	Off	Lo	Lo
2	0	0	Lo	Off	Lo
1	0	0	Lo	Lo	Off
0	0	0	Off	Lo	Lo
5	0	0	Lo	Off	Lo

BINARY PROGRAM NUMBER: 111						
2 Phase Unipolar Low-Tap 4 Phase						
Wavedrive(STD)			PHASES			
STATE	ENA	DIR	A	B	C	D
X	0	X	Off	Off	Off	Off
0	1	1	Hi	Off	Off	Off
1	1	1	Off	Hi	Off	Off
2	1	1	Off	Off	Hi	Off
3	1	1	Off	Off	Off	Hi
2	1	0	Off	Off	Hi	Off
1	1	0	Off	Hi	Off	Off
0	1	0	Hi	Off	Off	Off
3	1	0	Off	Off	Off	Hi

BINARY PROGRAM NUMBER: 001 - Bipolar						
2 Phase Continuous						
Normal			PHASES			
STATE	ENA	DIR	A	B	C	D
X	0	X	Lo	Lo	Lo	Lo
0	1	1	Hi	Hi	Lo	Lo
1	1	1	Lo	Hi	Hi	Lo
2	1	1	Lo	Lo	Hi	Hi
3	1	1	Hi	Lo	Lo	Hi
2	1	0	Lo	Lo	Hi	Hi
1	1	0	Lo	Hi	Hi	Lo
0	1	0	Hi	Hi	Lo	Lo
3	1	0	Hi	Lo	Lo	Hi

BINARY PROGRAM NUMBER: 010						
2 Phase Unipolar Hi-Tap						
Normal			PHASES			
STATE	ENA	DIR	A	B	C	D
X	0	X	Off	Off	Off	Off
0	1	1	Lo	Lo	Off	Off
1	1	1	Off	Lo	Lo	Off
2	1	1	Off	Off	Lo	Lo
3	1	1	Lo	Off	Off	Lo
2	1	0	Off	Off	Lo	Lo
1	1	0	Off	Lo	Lo	Off
0	1	0	Lo	Lo	Off	Off
3	1	0	Lo	Off	Off	Lo

BINARY PROGRAM NUMBER: 011						
4 Phase Unipolar Hi-Tap						
Wavedrive(STD)			PHASES			
STATE	ENA	DIR	A	B	C	D
X	0	X	Off	Off	Off	Off
0	1	1	Lo	Off	Off	Off
1	1	1	Off	Lo	Off	Off
2	1	1	Off	Off	Lo	Off
3	1	1	Off	Off	Off	Lo
2	1	0	Off	Off	Lo	Off
1	1	0	Off	Lo	Off	Off
0	1	0	Lo	Off	Off	Off
3	1	0	Off	Off	Off	Lo

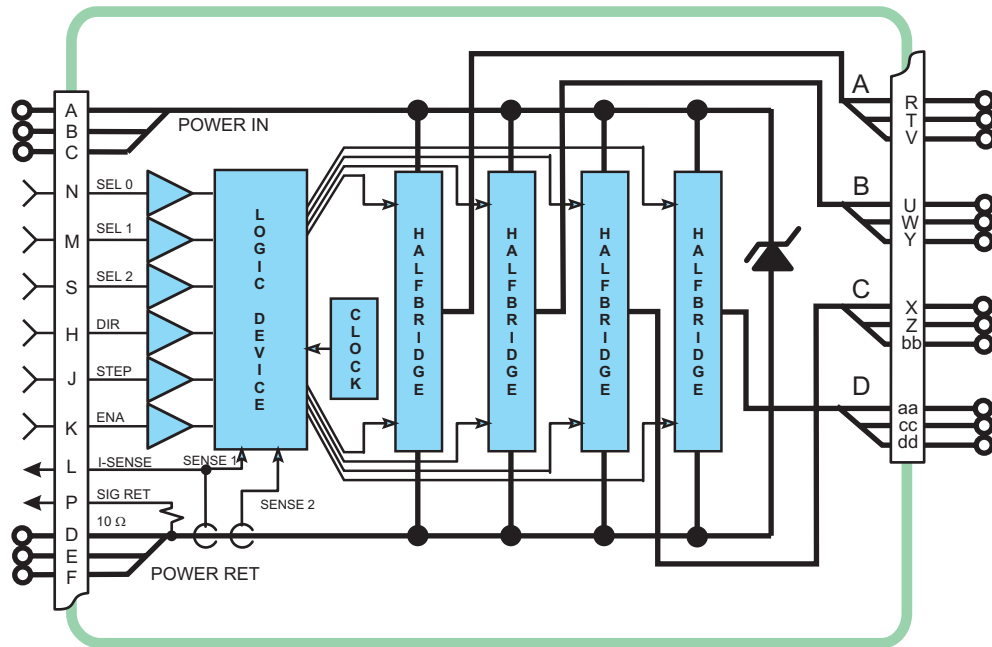


Figure A Electrical Interface

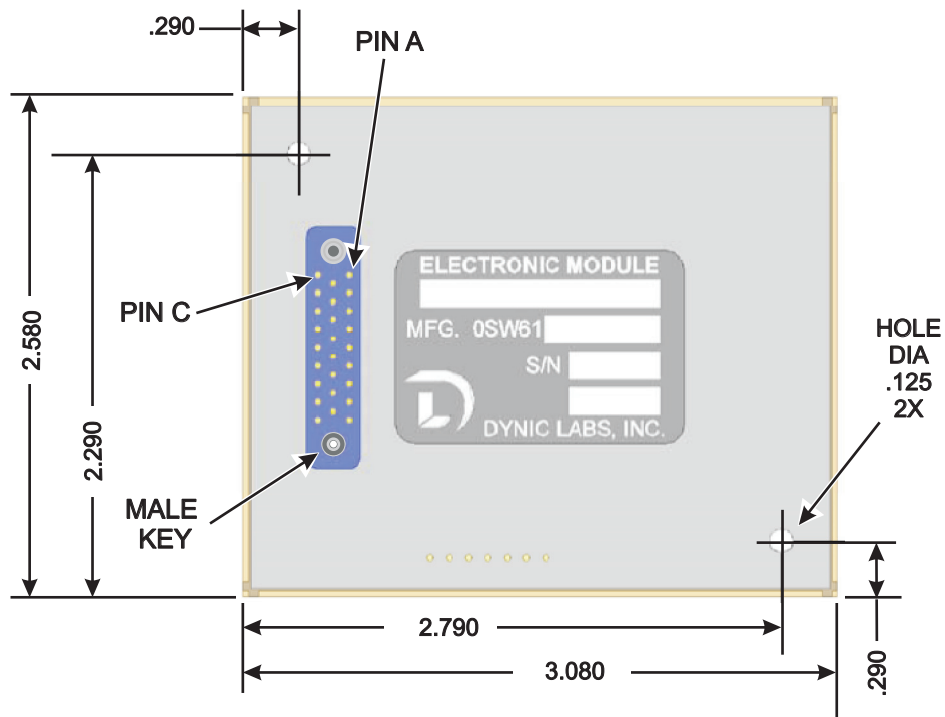
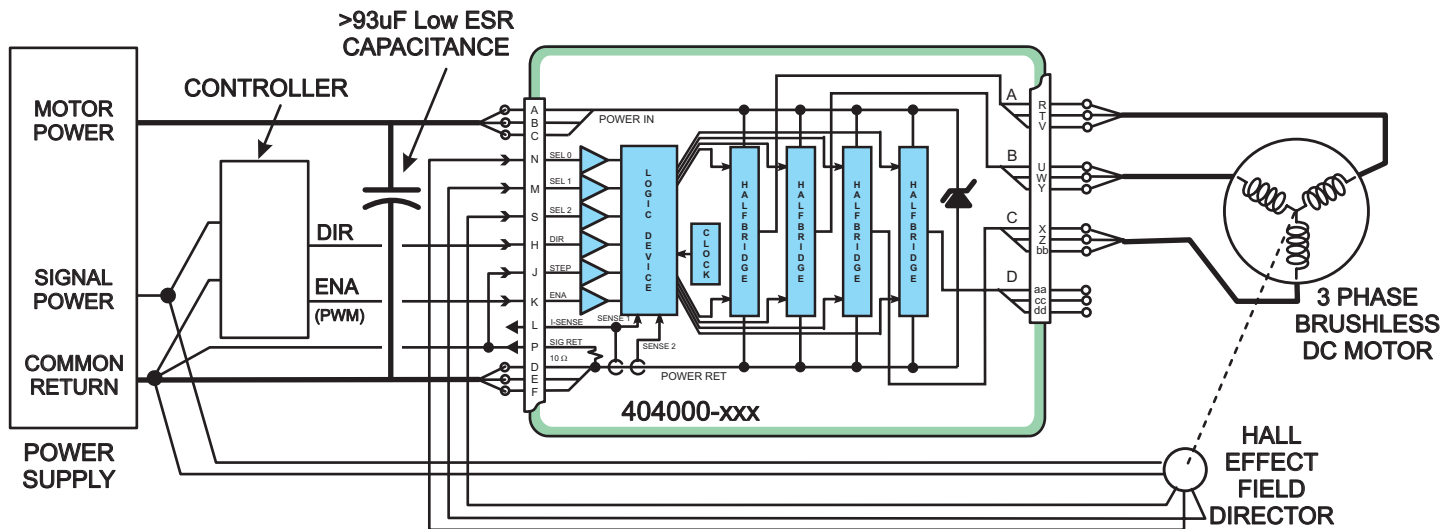


Figure B Mechanical Interface

Notes:

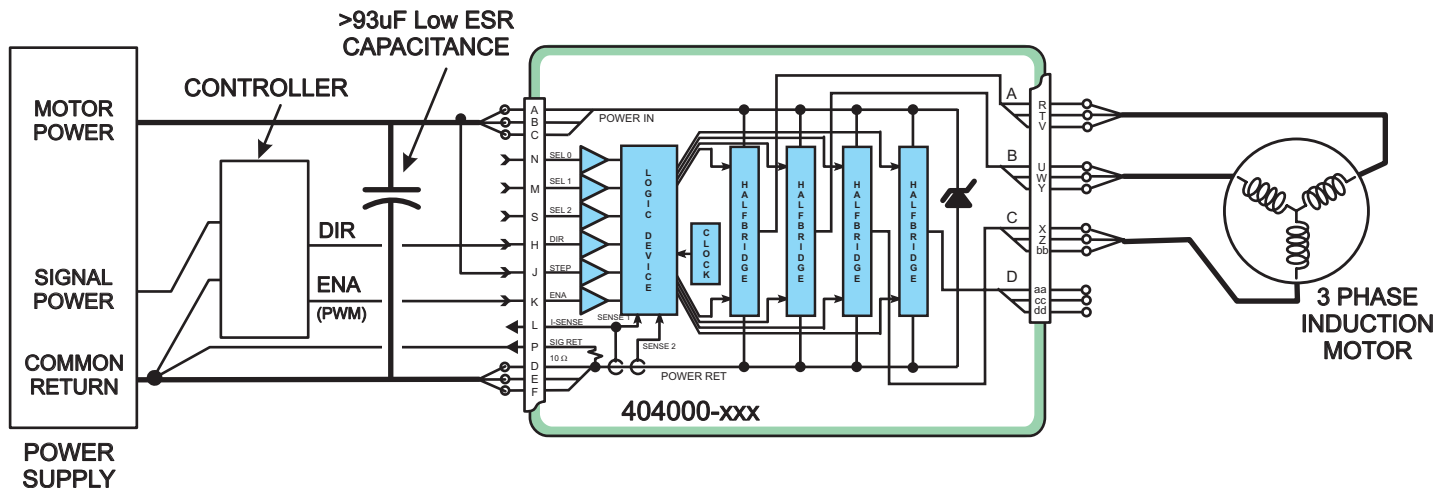
- 1) The 404 employs several internal low ESR capacitors, but external low ESR capacitors located within 3 inches of wiring to the connector are required when load currents are greater than 5 Amps.
- 2) When dynamic breaking of the load is necessary, the power supply must be capable of absorbing some of the energy removed from the inertia. Energy dissipation provisions can be added externally when advisable. Dynamics that result in or cause the voltage between Power In and Power Return to be greater than 50V will damage the unit.

APPLICATION 1: 3 PHASE BLDC WITH HALL FIELD DIRECTOR



In the above application, the 404 Driver has been set up to drive a 3ph BLDC motor using a hall effect field director. The unused input has been connected to signal return so that it is in a known state. The user supplied controller is configured to command DIR and ENA. These two inputs can be used to control direction and speed of the motor by using the ENA input to pulse width modulate the voltage to the motor while the DIR input selects the phase sequence of the outputs. A similar set up can be used to control speed and direction of a two phase BLDC if desired. Consult Dync Labs, Inc. for specific application programming configurations.

APPLICATION 2: 3 PHASE INDUCTION MOTOR

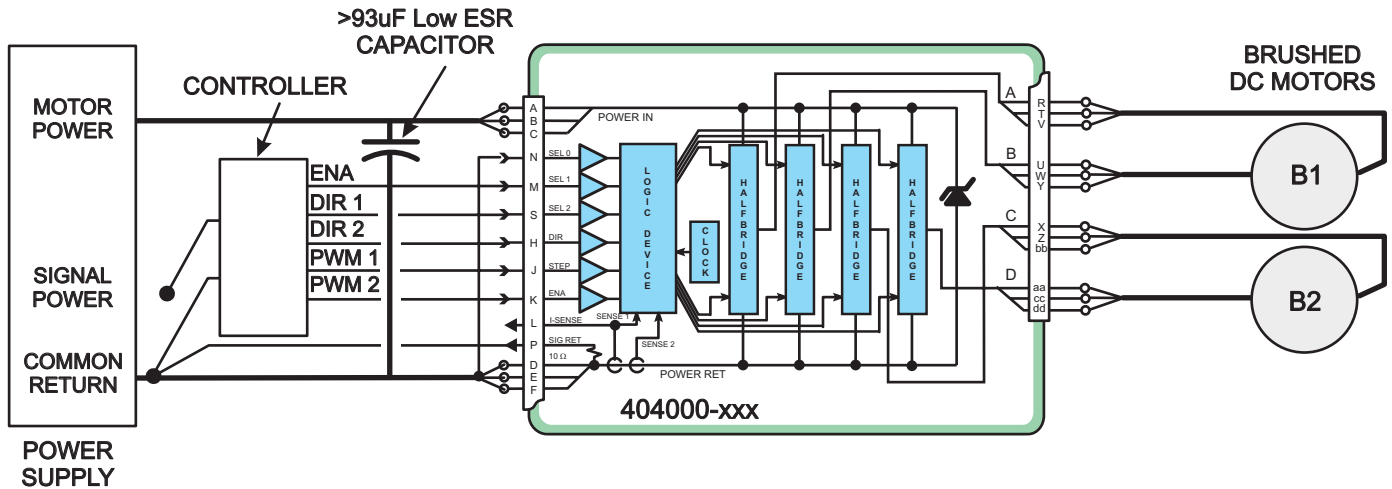


In APPLICATION 2, the 404 Driver has been set up to drive a 3ph induction motor. The STEP input has been connected to positive power so that it is at an asserted state. The user supplied controller is configured to command DIR and ENA. These two inputs can be used to control direction and speed of the motor by using the ENA input to pulse width modulate the voltage to the motor while the DIR input selects the phase sequence of the outputs. A similar set up can be used to control speed and direction of a two phase BLDC if desired. Consult Dync Labs, Inc. for specific application programming configurations. If desired, APPLICATION 1 and APPLICATION 2 can be set up on the same device so that when "STEP" is high, APPLICATION 2 will be executed and SEL 0, SEL 1, and SEL 2 will be ignored and the internal clock will generate the frequency for the induction motor excitation.

Notes:

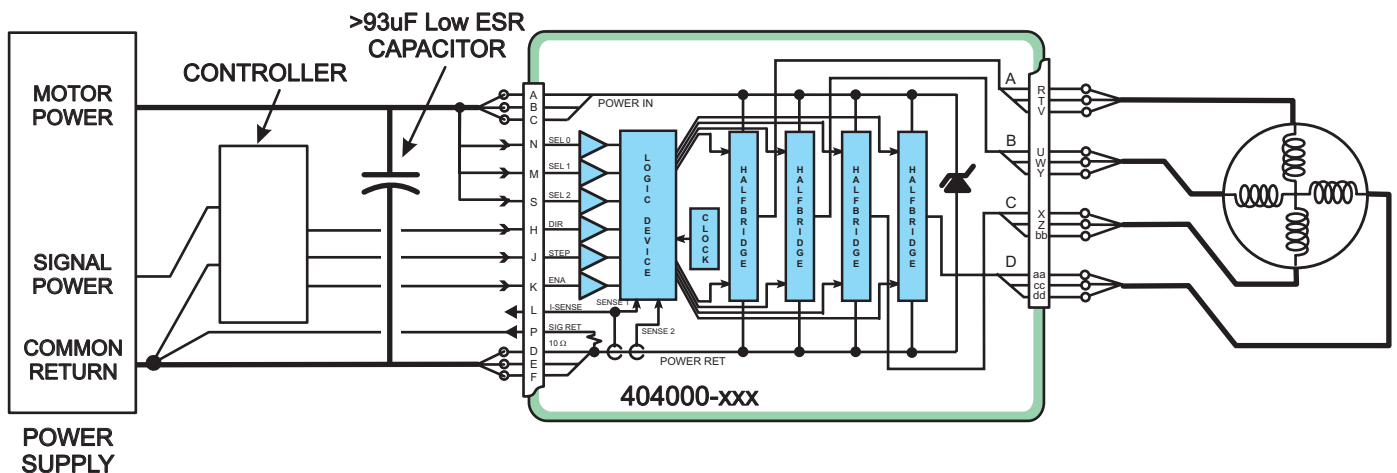
- 1) The 404 employs several internal low ESR capacitors, but external low ESR capacitors located within 3 inches of wiring to the connector are required when load currents are greater than 5 Amps.
- 2) When dynamic breaking of the load is necessary, the power supply must be capable of absorbing some of the energy removed from the inertia. Energy dissipation provisions can be added externally when advisable. Dynamics that result in or cause the voltage between Power In and Power Return to be greater than 50V will damage the unit.

APPLICATION 3: DUAL BRUSHED MOTOR DRIVE



Application 3 shows the 404 Driver has been set up to drive two brushed motors in either direction. The unused input has been connected to signal return so that it is in a known state. The user supplied controller is configured to command DIR, PWM, and ENA. These inputs can be used to control direction and speed of the motor by using PWM1 and PWM2 signals to pulse width modulate the voltage to the motors independently while the DIR1 and DIR2 inputs determine the direction. Here the ENA signal is connected to Driver SEL 1 and is used to open circuit the outputs to either let the motors free wheel or dynamic brake. Consult Dync Labs, Inc. for specific application programming configurations.

APPLICATION 4: 2 PHASE STEPPER DRIVE (Std. Program 001)

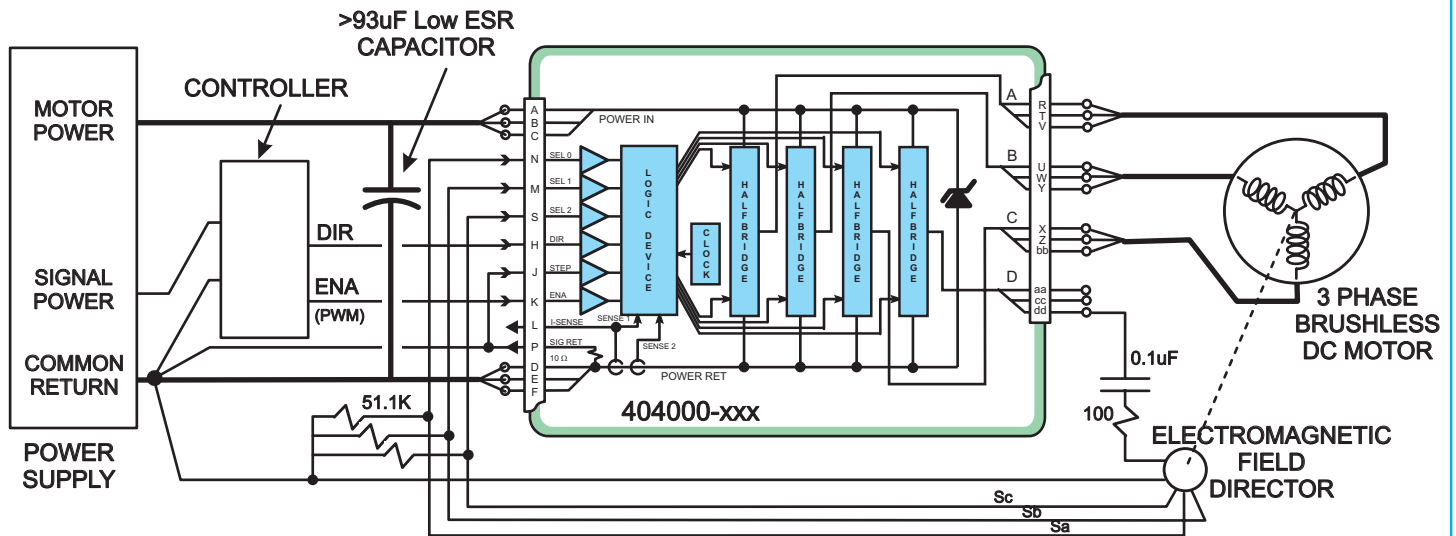


In APPLICATION 4, the 404 Driver has been set up to drive a 2ph stepper motor. The STEP, DIR, and ENA are connected to the user supplied controller. The ENA input can be used to pulse width modulate the voltage to the motor so that a low holding current can be applied when the motor is stopped and needs to hold against a disturbance larger than the detent torque. The drive incorporates a current sense capability so that stepping current and holding current can be two different values automatically controlled by the 404 driver if there is a desire to off-load this function from the controller. A similar set up can be used to control a three phase stepper motor if desired. A variety of modes are available for Stepper Motor Control. Consult Dync Labs, Inc. for specific application programming configurations.

Notes:

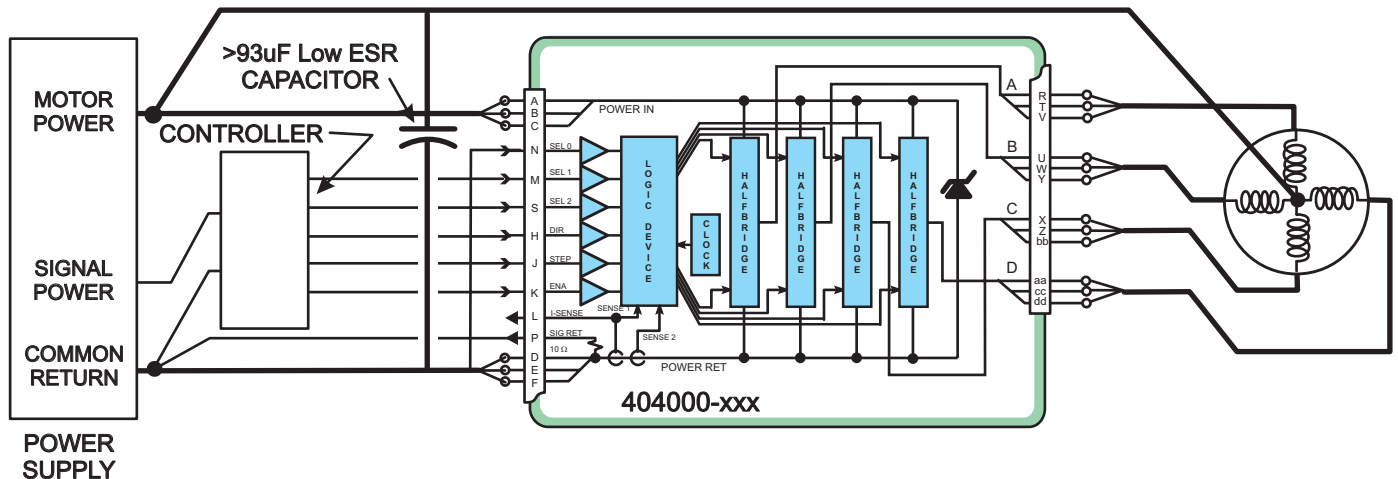
- 1) The 404 employs several internal low ESR capacitors, but external low ESR capacitors located within 3 inches of wiring to the connector are required when load currents are greater than 5 Amps.
- 2) When dynamic breaking of the load is necessary, the power supply must be capable of absorbing some of the energy removed from the inertia. Energy dissipation provisions can be added externally when advisable. Dynamics that result in or cause the voltage between Power In and Power Return to be greater than 50V will damage the unit.

APPLICATION 5: 3 PHASE BLDC WITH ELECTROMAGNETIC FIELD DIRECTOR



In this application, the 404 Driver has been set up to drive a 3ph BLDC motor using an electromagnetic field director. The unused input has been connected to signal return so that it is in a known state. The user supplied controller is configured to command DIR and ENA. These two inputs can be used to control direction and speed of the motor by using the ENA input to pulse width modulate the voltage to the motor while the DIR input selects the phase sequence of the outputs. The D output is programmed to drive the field director reference winding (R1 and R2) at 24KHz nominal and the SEL inputs are configured to demodulate the Field Director Outputs. Consult Dynic Labs, Inc. for specific application programming configurations.

APPLICATION 6: UNIPOLAR STEPPER WITH HIGH TAP (Std. Programs 010 or 011)

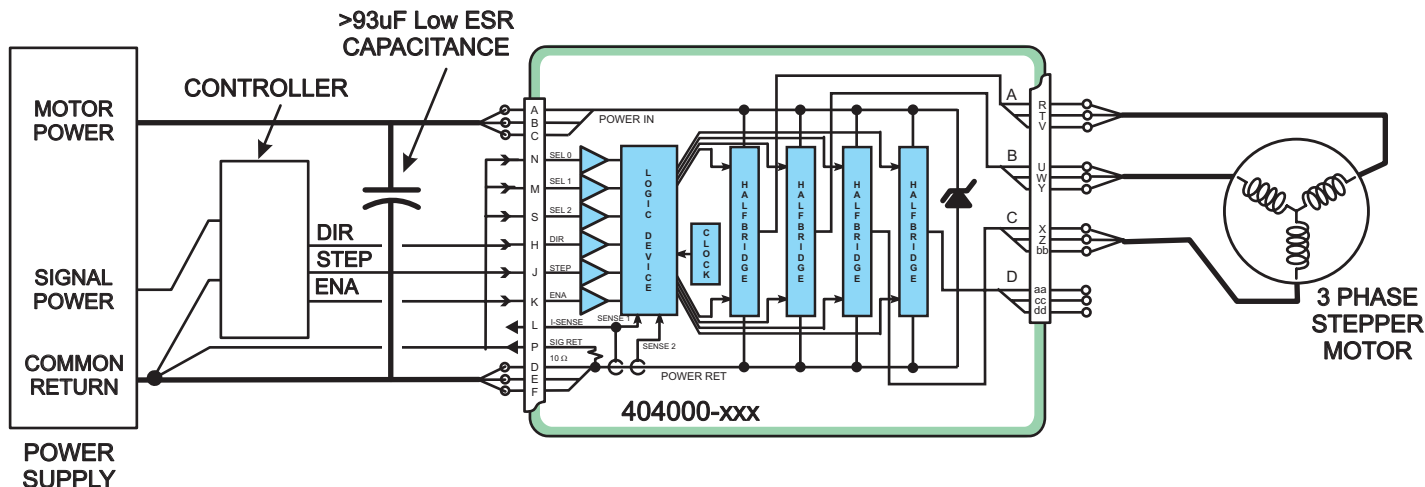


In APPLICATION 6, the 404 Driver has been configured to drive a 2phase stepper motor in a unipolar set up. The STEP, DIR, and ENA are connected to the user supplied controller. The ENA input can be used to pulse width modulate the voltage to the motor so that a low holding current can be applied when the motor is stopped and needs to hold against a disturbance larger than the detent torque. The drive incorporates a current sense capability so that stepping current and holding current can be two different values and can be automatically controlled by the 404 driver if there is a desire to off-load this function from the controller. A similar set up can be used to control a three phase stepper motor if desired. A variety of modes are available for Motor Control. Consult Dynic Labs, Inc. for specific application programming configurations.

Notes:

- 1) The 404 employs several internal low ESR capacitors, but external low ESR capacitors located within 3 inches of wiring to the connector are required when load currents are greater than 5 Amps.
- 2) When dynamic breaking of the load is necessary, the power supply must be capable of absorbing some of the energy removed from the inertia. Energy dissipation provisions can be added externally when advisable. Dynamics that result in or cause the voltage between Power In and Power Return to be greater than 50V will damage the unit.

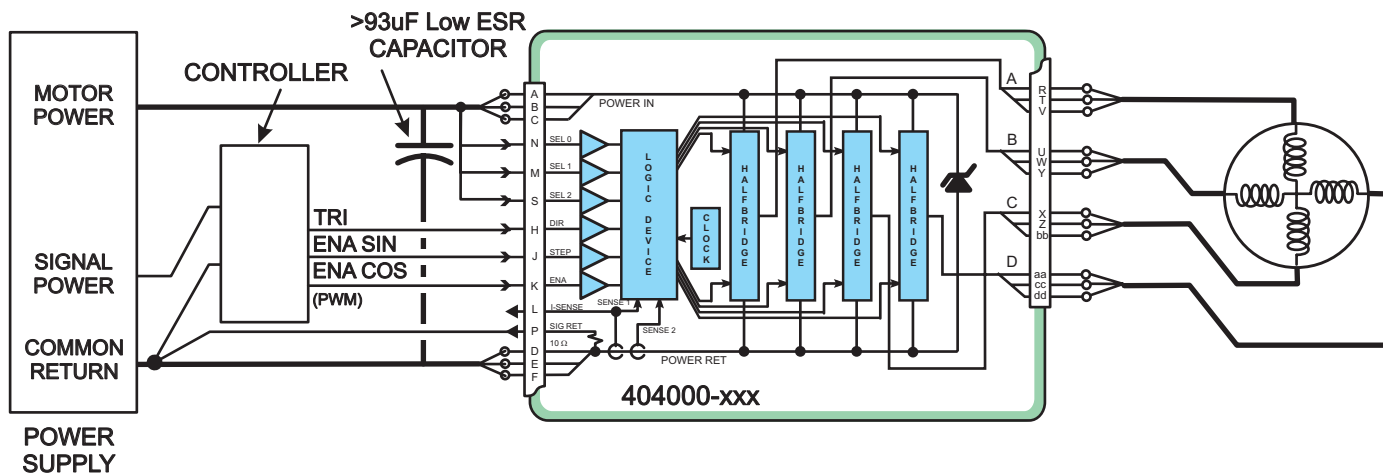
APPLICATION 7: 3 PHASE STEPPER WITH BILEVEL CURRENT REGULATION



Here the 404 Driver has been set up to drive a 3 Phase Stepper motor using the current regulating feature of the Driver. The unused inputs have been connected to signal return to assure a known state for these. The user supplied controller is configured to command DIR, ENA, and STEP. The 404 Driver monitors the current level appearing at SENSE 1 and SENSE 2. When the current reaches the Set Point, the active Half Bridge switches to RETURN and the current circulates in the motor winding inductance. When the next internal clock cycle begins, the active Half Bridge switches to the power input and the current builds in the winding until the set point is reached.

Having two internal sense inputs permits the unit to regulate current at two different levels. For example the unit can be set to regulate current at a 5 Amp level as long as step commands are present and then after a short period to drop to a 1 Amp level to circulate a holding current in the motor winding. The current levels are factory set by hardware per customer instructions. In addition there is a current sense connection to facilitate external current monitoring. Consult Dync Labs, Inc. for specific application programming configurations.

APPLICATION 8: 2 PHASE INDUCTION MOTOR



In APPLICATION 8, the 404 Driver has been configured to drive a 2ph induction motor with sinusoidal voltage. The STEP input is set up to be useable as a PWM input for the Sine winding, The ENA input will be used to control the Cosine winding. The user supplied controller is configured to command TRIstate, Enable Sin, and Enable Cos. These inputs can be used to control direction and speed of the motor by using the ENA SIN input to pulse width modulate the voltage to the motor Sine winding while the ENA COS input pulse width modulates the voltage to the Cosine winding. This setup would be suitable to accomplish the equivalent of microstepping if the two phase induction motor were replaced by a stepper motor. Consult Dync Labs, Inc. for specific application programming configurations. If desired, APPLICATION 8 and an additional APPLICATION can often be set up on the same device so that when "SEL 0" is asserted, the other APPLICATION will be executed.