1/6 through 5 HP Adjustable Speed DC Motor Controllers

- 1/6–5 HP Ratings
- 115 or 230V, Single Phase
- Isolated Regulator
- Speed or Torque Control
- Overload Protection
- DC Tach Feedback
- AC Line Starting
- External Signal Follower
- Run Contact
- Configurations
  - Open Chassis
  - "Bookcase" Style
  - NEMA 4/12
- NEC enclosed and NEMA Compliance
- UL and cUL Listed

FIGURE 1.

Series 2601, 2602 units are offered in a variety of standard models based on the three functional groups as shown in Tables 1-3. These units differ from the 2330 series in that they expand horsepower range with capacities up to 5 HP while offering the on-board customization features of the 2610MKII series.
Model numbers that include a "P" suffix identify enclosed units assembled by adding a top cover assembly to a basic chassis unit. Top cover assemblies P1, P2 and P3 include integral operator controls. Top cover control P0 does not and is therefore intended for remote control operation. The top cover assemblies may be factory installed or, if desired, easily added to the basic chassis models as field-installed kits. All models are reconnectable for either a 115V or 230V AC power source.

TABLE 1: SERIES 2600 NEMA 4/12 ENCLOSED UNITS WITH INTEGRAL OPERATOR CONTROLS

HORSEPOWER RANGE (1)		MODEL NUMBER	FUNCTION
115V	230V		
1/6-1	1/2-3	2601P1	Run, Stop, Jog
1/6-1	1/2-5	2602P1 (2)	
1/6-1	1/2-3	2601BP1	Run, Stop, Jog, Armature Contactor Run and DB
1/6-1	1/2-5	2602BP1 (2)	
1/6-1	1/2-3	2601AP3	Run, Stop, Jog, Armature Contactor Reverse and DB
1/6-1	1/2-5	2602AP3 (2)	

TABLE 2: SERIES 2600 NEMA 4/12 ENCLOSED UNITS WITHOUT OPERATOR CONTROLS

HORSEPOWER RANGE (1)		MODEL NUMBER	FUNCTION
115V	230V		
1/6-1	1/2-3	2601P0	Run-Stop
1/6-1	1/2-5	2602P0 (2)	
1/6-1	1/2-3	2601BP0	Run, Stop, Armature Contactor Run and DB
1/6-1	1/2-5	2602BP0 (2)	
1/6-1	1/2-3	2601AP0	Run, Stop, Reverse and DB Armature Contactor
1/6-1	1/2-3	2602AP0 (2)	

TABLE 3: SERIES 2600 BASIC CHASSIS UNITS WITHOUT OPERATOR CONTROLS

HORSEPOWER RANGE (1)		MODEL NUMBER	FUNCTION
115V	230V		
1/6-1	1/2-3	2601	Run-Stop
1/6-1	1/2-5	2602	
1/6-1	1/2-3	2601B	Run, Stop, Armature Contactor Run and DB
1/6-1	1/2-5	2602B	
1/6-1	1/2-3	2601A	Run, Stop, Reverse and DB Armature Contactor
1/6-1	1/2-3	2602A	

NOTES: (1) Units are shipped calibrated for the maximum horsepower rating. Units may be calibrated for other standard ratings by changing the position of a jumper in accordance with instructions provided. Units are shipped connected for 230V. Units may be easily reconnected for 115V.
(2) Includes option 1170A cooling fan as standard.

DESIGN FEATURES AND FUNCTIONS

1. **Construction** — The die-cast aluminum alloy base assembly forms the basic Series 2600 open chassis which includes regulator electronics, AC line fuse, power conversion and protective circuitry as a totally functional, self contained unit.

   Enclosed models are TENV, NEMA 4 and 12.

   Model 2602, when rated five horsepower as an enclosed unit, requires the addition of Option 1170A cooling fan assembly, as shown in Figure 3.

   Series 2600 unit covers are molded of high strength Noryl® engineering plastic. An aperture in the cover permits mounting a blank panel for remote control models or various standard or optional local operator control panels. (See Table 4.) *Where a hinged cover is desired, Option 1638 provides a kit permitting easy field installation.*

2. **Full-Wave Power Conversion** — Full-wave converter configuration consisting of four SCR's and a freewheeling diode provide benefits for optimum motor performance and long service. Power bridge is composed of 600PIV, discrete, encapsulated and electrically isolated devices. The alloy base forms an integral heatsink with the power control devices electrically isolated from the base.

3. **Voltage Transient Protection** — Metal oxide suppressor across the AC line is combined with RC snubbers across the power bridge to limit potentially damaging high voltage spikes from the AC power source.

4. **AC Line Protection** — A high (100K amp) interrupting capacity AC line fuse provides instantaneous protection from peak loads and fault currents. Optionally offered for Model 2601 is (Option 1010), a two-pole, molded case, magnetic trip circuit breaker which provides a means of manually disconnecting the AC power to the controller and motor and automatic, instantaneous trip protection from a peak load.

5. **Isolated Regulator** – Internal DC circuits are isolated from the AC power source for operator and equipment safety and for simplified application. The control reference input common may be grounded or connected without additional isolation to other drive units or grounded external signal sources. Isolation eliminates the common condition of line voltage to ground potentials being present on the speed control potentiometer.

6. **Feedback Isolation** –

   (a) Current Feedback – Isolation by optical coupler.

   (b) Voltage Feedback – High impedance circuit (two megaohms).

7. **Feedback** – Two selectable modes of analog feedback are provided. See Table 7 for speed regulation characteristics.

   (a) Armature Feedback – Counter EMF voltage feedback with IR compensation. IR compensation is adjustable to suit individual motor characteristics and optimize speed regulation in this mode.

   (b) DC Tachometer Feedback – Provides impedance matching, voltage scaling and terminals for accepting a signal from a DC tachometer generator mechanically coupled to the drive motor armature. This results in expanded speed range, improved speed regulation with load changes and reduced sensitivity to operating conditions such as line voltage variations, ambient temperature changes, motor field heating and other operating variables. The controller will automatically transfer to counter EMF voltage feedback to prevent run away if the tachometer circuit is open. Tachometers producing 7 VDC to 150 VDC at maximum motor speed may be used.

   This feature is suitable for use with unidirectional units using DC tachometers. See Options 1061C or 1061F for other conditions.

8. **Control Voltage** – A transformer coupled 24 VDC power supply isolates all magnetic pushbutton control and logic from the AC power source for operator protection.

9. **Field Supply** – Transient protected, half-wave or full-wave. See Table 6 for output voltages.

10. **Contactorless Design** – Unit is designed for reliable solid state, run-stop operation without an armature contactor. Logic includes a provision to prevent an involuntary restart after a power failure. This feature may be defeated when an external customer furnished AC line contactor is used to control the unit.

11. **Motor Contactor** –

    (a) Bidirectional Models — Model numbers which have an "A" suffix such as 2601A, includes DC magnetic armature reversing contactors. This provides a positive, two-pole disconnection of the motor armature from the rectified power source. Action of the contactor is sequenced with the SCR regulator to ensure that the DC power circuit is "phased-off" before the contactor is opened. This results in "dry switching" for improved contactor longevity. The standard contactor circuit board permits both unidirectional and selectable bidirectional operation when desired. To facilitate this, anti-plug protection is also provided to prevent armature reversal until a safe minimum speed is reached.

    (b) Unidirectional Models — Model numbers which include a "B" suffix such as 2602BP1, includes a DC magnetic armature contactor. This provides a positive, two-pole disconnection of the motor armature from the rectified power source. Action of the contactor is sequenced with the SCR regulator to ensure that the DC power circuit is "phased-off" before the contactor is opened. This results in "dry-switching" for improved contactor longevity. The contactor circuit board permits unidirectional operation only.

12. **Dynamic Braking** — Standard feature of model numbers with an "A" or "B" suffix. Dynamic braking provides exponential rate braking of the DC motor armature. Included is a DB resistor with an anti-plug circuit to prevent restarting the controller until the braking cycle is complete, thereby preventing a potentially damaging electrical surge and mechanical stress. The DB resistor is rated for stopping a typical load, when the external machine inertia does not exceed that of the motor armature, as shown in Table 9.

13. **Motor Overload** — A nonadjustable electronic circuit continuously monitors motor armature current and shuts down the drive whenever the load exceeds 120% for 80 seconds.

(continued)

DESIGN FEATURES AND FUNCTIONS (Continued)

14. Selectable Capabilities —

(a) DC Tachometer Feedback — See Description under item 7 Feedback.

(b) AC Line Starting — Provision is included to defeat the no-restart-after-power-failure feature to permit run-stop control of unidirectional models by an external AC line contactor. Included is circuitry to assure smooth starting.

(c) Torque Regulator — Series 2600 units may be easily reconfigured to function as a torque regulator. In this mode the speed setting potentiometer is used to set and regulate the motor maximum armature current over a range of 0-150% of rated. Accordingly, motor speed is unregulated and will go to a level of 0–100% of rated, depending upon the application load torque.

(d) External DC Signal Follower — Series 2600 units include isolation and impedance matching circuitry to interface an externally supplied grounded or ungrounded, isolated or nonisolated 0–5 VDC, 0–10 VDC or 4–20 mA DC signal source with the motor controller reference input. The option provides a linear transfer of the external signal to motor speed.

15. Horsepower and Voltage Calibration — Series 2600 units are shipped calibrated for the maximum horsepower rating and 230V operation. They may be easily recalibrated for any standard horsepower rating within the design range and 115V operation by reconfigurable jumpers.

16. Customer Use Run Contact — Form A normally open contact rated five amps at 115 VAC or 30 VDC coordinated with run command may be used for external control and indicating devices.

17. Visual Status Indicator — Bicolor LED glows green to show normal operation with the armature current at 100% of rated or less, glows red to show current limit operation.

18. Control Relay — Enables remote control of all contactorless models and provides an interlock to prevent a restart after a power outage. Table 5 is a listing of Standard Remote Control stations offered for these units.

19. Safety Features — UL and cUL Listed. Low Voltage Operator Control. Requires reset for restart after power interruption. High visibility paint finish. TENV enclosure. Isolated regulator. High Interrupting Capacity AC Line Fuse.

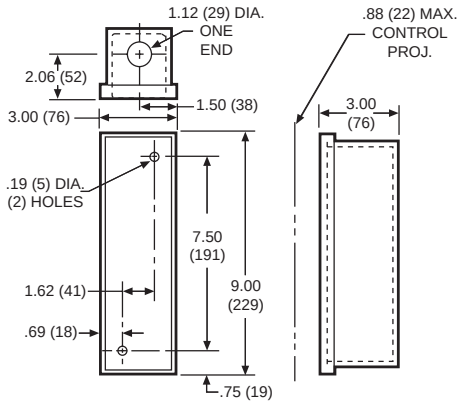

FIGURE 2. Remote Control Operator Station

TABLE 4. COVER ASSEMBLIES WITH LOCAL OPERATOR CONTROLS

Cover Model Number	Control Elements		Use with Controller Models
	Toggle Switches	Potentiometer	
P0	None	None	2601AP0, 2601BP0, 2601P0, 2602AP0, 2602P0
P1	Run-Stop-Jog (1), (2)	Motor Speed	2601BP1, 2601P1, 2602BP1
P3	Run-Stop-Jog (1) Fwd-Rev	Motor Speed	2601AP3, 2602AP3

NOTES: (1) Maintained in RUN position. JOG position is momentary with a spring return to STOP.

(2) Maintained in FORWARD or REVERSE positions. Armature power switch includes a center position detent for anti-plug protection.

TABLE 5. REMOTE CONTROL STATIONS

Model Number	Control Elements			Use With Controller Models
	Pushbuttons	Toggle Switch	Potentiometer	
SCS153	–	Run-Stop-Jog	Motor Speed	2601, 2601B, 2601BP0, 2601P0, 2602, 2602B, 2602BP0, 2602P0, 2611,
SCS161	Run, Stop	–	Motor Speed	
SCS154	–	Run, Stop-Jog Fwd-Rev	Motor Speed	2601A, 2601AP0, 2602A, 2602AP0
SCS162	Run, Stop	Fwd-Rev	Motor Speed	
SCS153	–	Run-Stop-Jog	Motor Speed	2601, 2601B, 2601BP0, 2601P0, 2602, 2602B, 2602BP0, 2602P0,
SCS163	Run, Stop	Run-Jog	Motor Speed, Jog Speed	
SCS164	Run, Stop	Run-Jog Fwd-Rev	Motor Speed, Jog Speed	2601A, 2601AP0, 2602A, 2602AP0
SCS157	–	Run-Stop-Jog Manual-Auto	Motor Speed	2601, 2601B, 2601BP0, 2601P0, 2602, 2602B, 2602BP0, 2602P0

RATINGS AND CHARACTERISTICS

OPERATING CONDITIONS

1. **Line Voltage Variation** ..... ±10% of rated (1)
2. **Line Frequency Variation** ..... ±2 Hz
3. **Ambient Temperature (2)** ..... 0°C to 40°C (32°F to 104°F)
4. **Altitude (standard)** ..... 3300 feet (1000 meters) maximum
5. **Relative Humidity** .....95% noncondensing

NOTES: (1) Unit will operate down to –15% of rated voltage although this may prevent rated speed with rated load.

(2) 55°C (131°F) maximum in enclosed areas where 2601 & 2602, open chassis units are mounted.

RATINGS

1. **Horsepower Range**.....1/6-5 HP
2. **Power Source**.....115V or 230V Single-Phase, 50 or 60 Hz
3. **Operating Voltages**.....(See Table 6)
4. **Service Factor**.....1.0
5. **Duty**.....Continuous
6. **Overload Capacity (armature circuit)**.....150% for 1 minute
7. **Line Fuse Interrupting Capacity** .....100,000 amps
8. **Reference Power Supply**.....10 VDC (See Table 6)
9. **Run Speed Potentiometer**.....5K ohms, 1/2W
10. **Current/Torque Reference Potentiometer**.....5K ohms, 1/2W

TABLE 6. OPERATING VOLTAGES

Power Source (Single-Phase)	Output VDC		Control Reference Voltage (1)	Magnetic Control Voltage
	Armature	Field		
115V, 50 or 60 Hz	0-90	50/100	0-5 VDC, 0-10 VDC, 4-20 mA	24 VDC
230V, 50 or 60 Hz	0-180	100/200		

NOTE: (1) Grounded or ungrounded. Choice of one.

PERFORMANCE CHARACTERISTICS

1. **Controlled Speed Range** — Zero to motor base speed. Speed range with respect to specified regulation is listed in Table 7.
2. **Speed Regulation** — Regulation percentages shown in Table 7 are of motor base speed under steady-state conditions.
3. **Efficiency** — (rated speed/rated load)
   (a) Controller SCR regulator 98%
   (b) Complete drive with motor (typical) 85%

ADJUSTMENTS

Potentiometer adjustments are provided for:

1. **Torque (current) Limit**.....0-150% full-load torque
2. **Minimum Speed**.....0-40% of motor base speed
3. **Maximum Speed**.....50-100% of motor base speed
4. **IR (load) Compensation**.....0-100% of rated load
5. **Acceleration (linear)**.....0.2 –30 seconds
6. **Deceleration (linear)**.....0.2 –30 seconds

TABLE 8. SPEED REGULATION CHARACTERISTICS

Regulation Method	Variable				Speed Range
	Load Change 95%	Field Line Voltage ±10% (1)	Heating Cold/ Normal	Temperature ±10°C	
Standard Voltage Feedback with IR Compensation	2%	±1%	5-12%	±2%	50:1
Optional Speed (Tach) Feedback (1061C) with Sigmation or 5 PY DC Tach	0.5%	±1%	0.2%	±2%	200:1

NOTE: (1) With Precision Reference regulation (Option 1059) due to ±10% Line Voltage Change is ±0.1%.

TABLE 9. DB RESISTOR RATINGS

Model	Component	Unit	Rated Horsepower									
			1/6	1/4	1/3	1/2	3/4	1	1½	2	3	5
2601	Braking	115V	300	215	170	110	75	60	–	–	–	–
	Torque%	230V	–	–	–	400	320	220	145	105	85	–
	Stops Per	115V	9	6	5	5	4	4	–	–	–	–
	Minute	230V	–	–	–	5	4	4	3	3	2	–
2602	Braking	115V	1000	960	660	460	320	220	150	100	–	–
	Torque%	230V	–	–	–	920	640	440	300	200	160	100
	Stops Per	115V	15	12	11	8	6	4	3	3	–	–
	Minute	230V	–	–	–	8	6	4	3	3	2	2

FIGURE 3. Cooling Fan Assembly Option 1170A

TABLE 9. TYPICAL APPLICATION DATA

Component			Ratings									
Rated Horsepower (HP)			1/6	1/4	1/3	1/2	3/4	1	1-1/2	2	3	5
Rated Kilowatts (kW)			0.124	0.187	0.249	0.373	0.560	0.746	1.120	1.492	2.238	3.730
1-Phase AC Input (Full-Load)	Line Amps	115V Unit	3.9	5.0	6.0	8.7	12.4	15.8	–	–	–	–
		230V Unit	–	–	–	4.2	5.9	8.8	12.6	15.8	22.0	32.0
	KVA		0.48	0.58	0.71	1.00	1.40	2.00	3.00	4.00	5.00	8.0
DC Output (Full-Load)	Motor Armature Amps	90V	2.0	2.8	3.5	5.4	8.1	10.5	–	–	–	–
		180V	–	–	–	2.6	3.8	5.5	8.2	11.6	15.1	25.0
	Motor Field Amps	50V	1.0	1.0	1.0	1.0	1.0	1.0	–	–	–	–
		100V	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.5	2.0
		200V	–	–	–	1.0	1.0	1.0	1.0	1.0	1.5	2.0
Full Load Torque (lb-ft) with 1750 RPM base Speed Motors			0.5	0.75	1.0	1.5	2.2	3.0	4.5	6.0	9.0	15.0
Controller Weight lbs. (kgs)	2601		7.7 (3.50)									NA
	2602		8.2 (3.7)									8.6 (3.9)
	2601A		8.5 (3.85)									NA
	2602A		8.9 (4.0)									9.3 (4.20)
	2601P0, P1, P3		11.6 (5.27)									NA
	2602P0, P1, P3		12.1 (5.5)									12.5 (5.68)
	2601AP0, P1, P3		12.4 (5.64)									NA
	2602AP0, P1. P3		12.8 (5.8)									13.2 (6.00)

DIMENSIONS

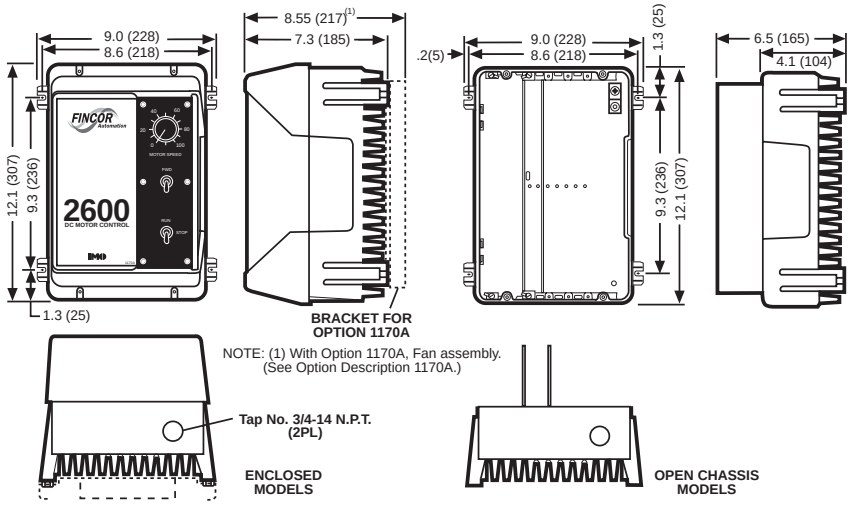

FIGURE 4. Series 2600 Dimensions

OPTIONS

TABLE 11. ALLOWABLE OPTION COMBINATIONS

Remarks	Option Group	Option Number	Option	Type
Enclosure Options — Choice of any or all within this group. May be combined with options selected from any other group. Option 1170A is required whenever Model 2602 is operated at a five horsepower rating as an enclosed unit.	A	1170A	Fan Assembly (5 HP only)	XK
	A	1638	Hinge, Enclosure Cover	XK
Options Used to Convert Open Chassis Units Into Enclosed Package Controllers — Choice of one within this group. Combine with all other groups.	B	1639	Cover Assembly, Blank Type P0	XK
	B	1639C	Cover Assembly, Type P1	XK
	B	1639E	Cover Assembly, Type P2	XK
	B	1639G	Cover Assembly, Type P3	XK
Power Options — Option 1004 may be combined with all other options within this group. Option 1010 applies to Model 2601 only.	C	1004	Armature Contactor, Reversing with DB	XK
	C	1010	Circuit Breaker – Two-Pole	XK
Signal Options — Choice of one within this group unless Option 1037 is selected. Can be combined with options selected from all groups except Group F. Option 1775 is a prerequisite for all options in this group.	D	1037	Input, External Interface	XK, P
	D	1049	Follower, External DC Signal	XK, P
	D	1050	Follower, External AC Signal	XK, P
	D	1050A	Follower, AC Current Transducer	XK, P
	D	1055	Follower, Tachometer AC or DC Generator	XK, P
	D	1057A	Follower, Digital Pulse Generator	XK, P
	D	1059	Reference Precision	XK, P
	D	1775	Interface, Signal Options	XK
Feedback Options — Choice of one within this group unless Option 1037 is selected. Can be combined with options from all groups except Group F. Option 1775 is a prerequisite for all options in this group.	E	1037	Feedback, External Interface	XK, P
	E	1061C	Feedback, Tachometer, AC or DC	XK, P
	E	1061F	Feedback, Tachometer, AC or DC with Tach Loss	XK, P
	E	1062A	Feedback, Digital Pulse Generator	XK, P
	E	1064	Torque (Current) Limit Control	XK, P
	E	1190	Torque Taper	XK, P
	E	1775	Interface, Signal Options	XK
Input and Feedback Options — Can be combined with options from all groups except Groups D and E.	F	1064A	Follower, Current Regulator	XK
	F	1191	Centerwind Torque Control	XK
	F	1220	Constant Velocity Winder	XK
External Options — Choice of one or all options within this group.	G	1022	Jog, Toggle Switch Selection	K
	G	1037A	Input-Feedback Adapter (External) One Position	K
	G	1058A	Follower/Manual Mode Select Switch	K
	G	1120	Operator Control Station, Remote	K
	G	1120A	Potentiometer, Ten-Turn, Motor Speed (Analog Dial)	K
	G	1120B	Potentiometer, Single-Turn, Motor Speed	K
	G	1120C	Potentiometer, Ten-Turn Motor Speed (Digital Dial)	K
	G	1166	Manual, Instruction	K
Miscellaneous Options — Choice of one when mounted within a Model 2601 or 2602. Choice of one or all when mounted external to any Series 2600/2610 unit. Can be combined with options from all other groups.	H	1015	Magnetic Control Interface 115V	XK
	H	1047E	Controlled (Ramp) Step	XK
	H	1081B	Current (Torque) Monitor	XK
	H	1072A	Aux. Contacs (2 Form C)	XK

Codes: X—Factory Installed or Field Kit K—Field Kit P—Plug-in option

OPTION DESCRIPTIONS

The 2600 series controllers share many of the same options as the 2610MKII series. Please refer to the "OPTION DESCRIPTIONS" section in the 2610MKII product literature.