

1/6 through 3 HP Adjustable Speed DC Motor Controllers

- 1/6-3 HP
- 115 or 230V, Single Phase (Reconnectable)
- Isolated Regulator
- Speed or Torque Control
- AC Line Starting
- Bi-Polar DC Tach Feedback
- Run Contact
- External Signal Follower
- Speed & Current Outputs (0-10VDC & 4-20mA)
- Stability Adjustment (Speed & Current)
- Zero Speed Output
- Configurations
 - Open Chassis
 - "Bookcase" Style
 - NEMA 4/12
- NEC & NEMA Compliance
- UL and cUL Listed as a Motor O/L



FIGURE 1. Series 2610 Controller

Series 2610MKII units are offered in a variety of standard models based on the four functional groups as shown in Tables 1-3. The flexible design of this series provides for many optional features making them suitable for a wide range of applications. The basic, open chassis 2611 and 2612 are the nucleus of all other series 2610 models. 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 2610 NEMA 4/12 ENCLOSED UNITS WITH INTEGRAL OPERATOR CONTROLS

HORSEPOWER RANGE (1)		MODEL NUMBER	FUNCTION
115V	230V		
1/6-1	1/2-2	2611P1	Run, Stop, Jog
1/6-1	1/2-2	2611BP1	Run, Stop, Jog, Armature Contactor Run and DB
1/6-1	1/2-2	2611P2	Run, Stop, Jog, Reverse
1/6-1	1/2-2	2611AP3	Run, Stop, Jog, Armature Contactor Reverse and DB

TABLE 2: SERIES 2610 NEMA 4/12 ENCLOSED UNITS WITHOUT OPERATOR CONTROLS

HORSEPOWER RANGE (1)		MODEL NUMBER	FUNCTION
115V	230V		
1/6-1	1/2-2	2611P0	Run-Stop
1/6-1	1/2-2	2611BP0	Run, Stop, Armature Contactor Run and DB
1/6-1	1/2-2	2611AP0	Run, Stop, Armature Contactor Reverse and DB

TABLE 3: SERIES 2610 BASIC CHASSIS UNITS WITHOUT OPERATOR CONTROLS

HORSEPOWER RANGE (1)		MODEL NUMBER	FUNCTION
115V	230V		
1/6-1	1/2-2	2611	Run-Stop
1/6-1	1/2-3	2612	
1/6-1	1/2-2	2611B	Run, Stop, Armature Contactor Run and DB
1/6-1	1/2-3	2612B	
1/6-1	1/2-2	2611A	Run, Stop, Armature Contactor Reverse and DB
1/6-1	1/2-3	2612A	

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. Standard ratings are:
 115V Controllers: 1/6, 1/4, 1/3, 1/2, 3/4, 1 HP
 230V Controllers: 1/2, 3/4, 1, 1-1/2 HP, 2 HP
 All 2612 models are also rated 3 HP 230V.
 Units are shipped connected for 230V.
 Units may be easily reconnected for 115V.

DESIGN FEATURES AND FUNCTIONS

- 1. Construction** — The die-cast aluminum alloy base assembly forms the basic Series 2610MKII open chassis (excluding Model 2615 units) 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.
Series 2610MKII unit covers are die-cast aluminum alloy. Various cover models are provided. Blank face models include no operator control elements, as they are intended for remote control operation. A number of local control models provide a motor speed potentiometer and toggle switches to match the function of the various models. (See Table 4.)
Model 2615 units are offered only in a special space saving chassis configuration, formed of aluminum into a "Book-Case" design, which requires only two mounting screws.
- 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.
- 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 megohms).
- 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 — Provided is impedance matching, voltage scaling and terminals for accepting a signal from a DC tachometer generator mechanically coupled to the drive motor armature. The tachometer feedback signal makes the controller directly sensitive to motor speed. 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 opened. Tachometers producing 7 VDC to 150 VDC (polarity insensitive) at maximum motor speed may be used.
- 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 2611AP3, etc. include 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 2611BP1, 2615B, etc. include 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 8.
- 13. Motor Overload** — UL approved as a motor O/L a nonadjustable electronic circuit continuously monitors motor armature current and shuts down the drive whenever the load exceeds 120% for 60 seconds.
- 14. Analog Outputs** — New to this series are outputs for both speed and current outputs are 0-10 VDC & 4-20 mA (4-20mA requires an external power supply - Option 1059A).

(continued)

DESIGN FEATURES AND FUNCTIONS (Continued)

15. 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 2610MKII 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 2610MKII units include isolation and impedance matching circuitry to interface an externally supplied grounded or ungrounded, isolated or non-isolated 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.

16. Horsepower and Voltage Calibration — Series 2610MKII 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.

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

18. 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.

19. 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.

20. 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.

TABLE 4. COVER ASSEMBLIES WITH LOCAL OPERATOR CONTROLS

Cover Model Number	Control Elements		Use with Controller Models
	Toggle Switches	Potentiometer	
P0	None	None	2611AP0, 2611BP0, 2611P0
P1	Run-Stop-Jog (4), (5)	Motor Speed	2611BP1, 2611P1
P2	Run-Stop-Jog (4), (5) Fwd-Rev (2)	Motor Speed	2611P2
P3	Run-Stop-Jog (1), (4) Fwd-Rev (3)	Motor Speed	2611AP3

- NOTES: (1) Maintained in RUN position.
 (2) Maintained in FORWARD or REVERSE positions. Armature power switch includes a center position detent for anti-plug protection.
 (3) Momentary contact switch with spring return to center position.
 (4) JOG speed is set by the RUN speed potentiometer.
 (5) Maintained in RUN position. JOG position is momentary with a spring return to STOP.

TABLE 5. REMOTE CONTROL STATIONS

Model Number	Control Elements			Use With Controller Models
	Pushbuttons	Toggle Switch	Potentiometer	
SCS153	—	Run-Stop-Jog	Motor Speed	2611, 2611P0, 2612, 2615, 2615B
SCS161	Run, Stop	—	Motor Speed	
SCS154	—	Run, Stop-Jog Fwd-Rev	Motor Speed	2615A
SCS162	Run, Stop	Fwd-Rev	Motor Speed	
SCS153	—	Run-Stop-Jog	Motor Speed	2611, 2611P0, 2612, 2615, 2615B
SCS163	Run, Stop	Run-Jog	Motor Speed, Jog Speed	
SCS164	Run, Stop	Run-Jog Fwd-Rev	Motor Speed, Jog Speed	2615A
SCS157	—	Run-Stop-Jog Manual-Auto	Motor Speed	2611, 2611P0, 2612, 2615, 2615B

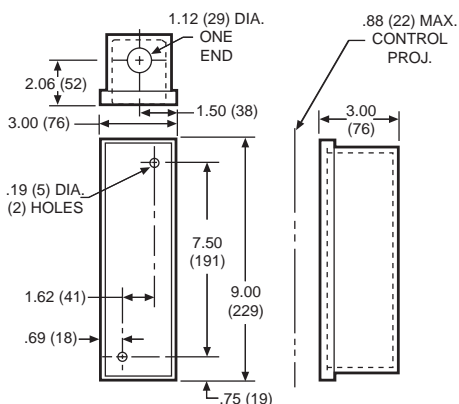


FIGURE 2. Remote Control Operator Station

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 2611 or 2612 open chassis units are mounted.

RATINGS

1. **Horsepower Range**.....1/6-3 HP
2. **Power Source**.....115V or 230V
Single-Phase, 50 or 60 Hz
3. **Operating Voltages**.....(See Table 7)
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.

PERFORMANCE CHARACTERISTICS

1. **Controlled Speed Range** — Zero to motor base speed. Speed range with respect to specified regulation is listed in Table 7. See Catalog Section E for continuous duty application limitations of DC motors.
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 regulator98%
 - (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
7. **Voltage Stability**0.1
8. **Current Stability**0.1

TABLE 7. 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 8. DB RESISTOR RATINGS

Model	Component	Unit	Rated Horsepower								
			1/6	1/4	1/3	1/2	3/4	1	1½	2	3
2611	Braking	115V	180	129	103	66	44	34	-	-	-
	Torque%	230V	-	-	-	278	190	130	88	62	-
2615	Stops Per Minute	115V	15	12	11	8	6	2	-	-	-
		230V	-	-	-	8	6	1	1	1	-
2612	Braking	115V	300	215	170	110	75	60	-	-	-
	Torque%	230V	-	-	-	400	320	220	145	105	85
	Stops Per Minute	115V	9	6	5	5	4	4	-	-	-
		230V	-	-	-	5	4	4	3	3	2



FIGURE 3 Chassis

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
Rated Kilowatts (kW)			0.124	0.187	0.249	0.373	0.560	0.746	1.120	1.492	2.238
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
KVA			0.48	0.58	0.71	1.00	1.40	2.00	3.00	4.00	5.00
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
	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
200V			-	-	-	1.0	1.0	1.0	1.0	1.0	1.5
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
Controller Weight lbs. (kgs)	2611, 2612		3.25 (1.48)								
	2611A, 2612A		3.8 (1.75)								
	2611P0, 2611P1, 2611P2		5.5 (2.5)								
	2611AP0, 2611AP3		6.05 (2.75)								
	2615		2.0 (0.91)								
	2615A, 2615B		2.25 (1.02)								

DIMENSIONS

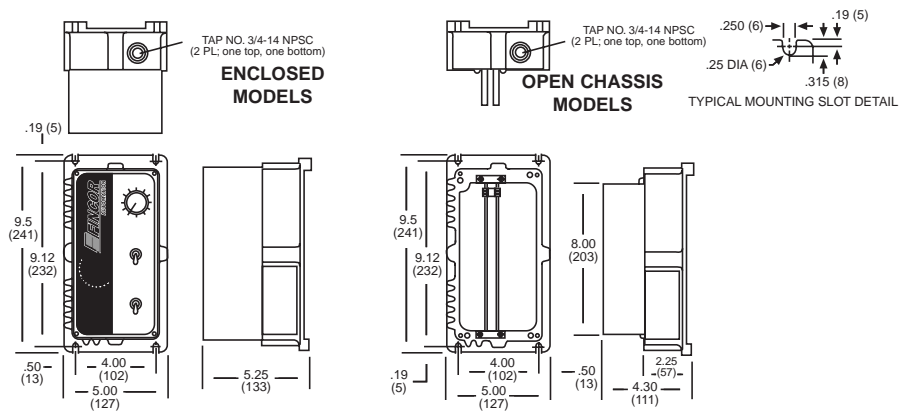


FIGURE 4. Series 2610MKII Dimensions

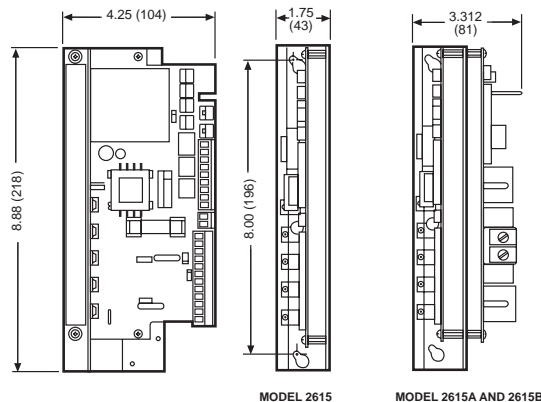


FIGURE 5. Series 2615MKII Dimensions

OPTIONS

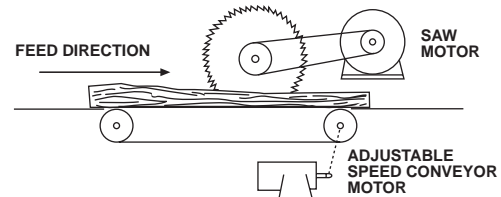
TABLE 10. ALLOWABLE OPTION COMBINATIONS

Remarks	Option Group	Option Number	Option	Type
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 Option — Option 1004 may be combined with all other options within this group.	C	1004	Armature Contactor, Reversing with DB	XK
Signal Options — Choice of one within this group. Can be combined with options selected from all groups except Group F. Option 1775 is a prerequisite for all options in this group. Option 1055 is not compatible with "P7" covers.	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	1059A	External DC Power Supply (for 4-20mA Signal Output)	XK
Feedback Options — Choice of one within this group. Can be combined with options from all groups except Group F. Option 1775 is a prerequisite for all options in this group.	E	1062A	Feedback, Digital Pulse Generator	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	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
Miscellaneous Options — Choice of one or all when mounted external to any Series 2610MKII unit. Can be combined with options from all other groups.	H	1015	Magnetic Control Interface 115V	XK
	H	1081B	Current (Torque) Monitor	XK

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

OPTION DESCRIPTIONS

Option Number	Description
1022	<p>Jog, Toggle Switch Selection Option includes a RUN-JOG selector switch and a JOG SPEED potentiometer for installation in the operator control panel.</p> <p>The RUN-JOG toggle switch (maintained) contacts in the operator station open the contactor seal-in circuit. Controller then jogs when the RUN pushbutton is pressed and held at the JOG SPEED potentiometer setting.</p> <p>Jog action is momentary, causing motor rotation only when the RUN pushbutton is depressed. This option is also suitable for reversing units where identical forward and reverse jog speeds are acceptable.</p>
1050	<p>Follower, External AC Signal Provides necessary impedance matching, isolation, signal conversion and filtering as required to adjust the speed of the drive (or drives) from an external AC signal source. Option 1050 permits full range speed control from an external 0 to 115 VAC adjustable signal source manually controlled by a potentiometer, variable autotransformer or some other suitable means.</p> <p>This option is required for each controller which is to be controlled by the external AC signal.</p> <p>Included in this option are minimum and maximum speed adjustments, with the normal drive run speed potentiometer functioning as a ratio setting when following the external AC signal. This option is useful for multiple section machines where a definite speed relationship must be maintained between sections, while the entire machine is varied over a specified speed range by a common manual speed control device.</p> <p>This option consists of a small plug-in circuit board which inserts into the input connector of the control board.</p> <p><i>The option does not include the external AC signal source.</i></p>
1050A	<p>Follower, AC Current Transducer Intended for automatic control systems where it is necessary for the drive to follow an AC signal proportional to the load current of an AC constant speed, induction motor. Typical examples are conveying systems where the material feed rate has a direct influence over the loading of the AC motor, i.e: the carriage or conveyor feeding logs to a saw powered by an AC motor. Since the thickness and density of the wood is not uniform this option permits automatic adjustment of conveyor speed to the highest feed rate which will not overload the saw motor.</p> <p>In order that a proper current transformer may be supplied it is necessary that nameplate data such as horsepower, voltage, load current, etc. be provided from the AC motor.</p> <p>This illustration shows an application which requires an inverse relationship between AC motor load current and the follower drive motor speed. This option may also be programmed for a direct relationship where the follower drive would increase in speed with increasing AC motor load current. Included are independent controls and adjustments for:</p> <p>AUTO/MANUAL SELECTOR SWITCH (1) — Selects the operation function. When the switch is in AUTO position, the drive functions as an AC current follower unit. When the switch is in MANUAL position the drive functions as an adjustable speed unit. When the AUTO function is selected, the separately furnished Motor Speed potentiometer provides speed adjustment of the DC motor at a ratio from 0 to 100% of the AC input signal. When the MANUAL function is selected, the Motor Speed potentiometer provides normal manual speed adjustment of the DC motor.</p> <p>DIRECT/INVERT SLIDE SWITCH (2) — Selects the operation mode. When the switch is in DIR position, the speed of the DC drive motor varies directly proportional to the load current drawn by the AC motor. When the switch is in INVT position the speed of the DC drive motor varies inversely proportional to the AC motor load current, i.e., when the load of the AC motor increases causing it to draw more current, the DC motor speed decreases.</p> <p>BIAS (2) — Set the maximum DC motor speed for the INVERT mode of operation.</p> <p>CURRENT SCALING (2) — Matches the range of the AC input signal to the input signal range requirements of the controller.</p> <p>INTEGRATION RATE (2) — Sets the response rate of the system when the AUTO function is selected.</p> <p>MINIMUM SPEED (2) — Sets minimum speed independently of the input control signal.</p> <p>PROPORTIONAL GAIN (2) — Sets the gain of Circuit Board when the AUTO function is selected.</p> <p><i>This option consists of:</i></p> <ol style="list-style-type: none"> <i>Toroidal current transformer for separated mounting by the user for sensing AC motor load current</i> <i>A small plug-in circuit board which inserts into the input connector of the control circuit board.</i> <i>AUTO/MANUAL selector switch for mounting remotely.</i> <p>Notes: (1) Mounted in operator control station. (2) Located on circuit board</p>



Option Number	Description
<p>1055</p>	<p>Follower, AC or DC Tachometer Generator Intended for automatic control systems where it is necessary for the drive to follow the speed of a preceding drive unit or rotating machine coupled to an AC or DC tachometer generator. The tachometer voltage signal provides the speed reference for the “follower” drive.</p> <p>Option 1055 is not recommended for use where multiple drive controllers are required to operate from a common signal source, unless the controllers are isolated. A more economical approach if the controllers are not isolated would be the use of the MIRC101 master isolated reference controller which is intended for use with multiple drive controllers. See Option 1051.</p> <p>Adjustments are provided to adapt the unit to a wide range of system requirements. Included are independent adjustments for:</p> <p>TACH SCALING — Adjustable to interface the tachometer generated voltage with the required controller reference voltage when the FOLLOWER RATIO potentiometer is set on maximum. If a plus ratio is required (i.e.: the follower drive is at full speed when the master drive is at half speed) set the FOLLOWER RATIO potentiometer at its midpoint and adjust TACH SCALING for the required controller reference voltage and then adjust the FOLLOWER RATIO potentiometer toward 100.</p> <p>FOLLOWER RATIO — Adjustable to permit tracking the tachometer signal voltage at a plus or minus ratio. See Figure 1. The FOLLOWER RATIO potentiometer is mounted in the operator control panel.</p> <p>MINIMUM SPEED (additive) — Adjustable to permit tracking the tachometer signal at a fixed offset voltage. See Figure 2. MINIMUM SPEED ADDITIVE potentiometer is mounted on the Option 1055 circuit board.</p> <p>MINIMUM SPEED (Override) — Adjustable by the MOTOR SPEED potentiometer to establish a minimum drive speed independent of tachometer signal voltage. The MOTOR SPEED potentiometer is also used as a manual speed setting control when no tachometer signal is present. See Figure 3. The MOTOR SPEED potentiometer is mounted in the operator control station.</p> <p>A MANUAL/FOLLOWER selector switch is therefore unnecessary for most applications and is not included with this option. See Option 1058A when a switch is required. The MOTOR SPEED potentiometer is mounted in the operator control station.</p> <p><i>Option 1055 consists of a small plug-in circuit board which inserts into the INPUT connector of the Control Circuit Board and a FOLLOWER RATIO potentiometer for separate mounting.</i></p> <p><i>This option does not include the tachometer generator which must provide 30 volts at base speed and not to exceed 180 volts at maximum speed.</i></p>
<p>1057A</p>	<p>Follower, Digital Pulse Generator This option provides signal conditioning and isolation for accepting a signal from a magnetic pulse pick-up mechanically coupled to a preceding drive motor, rotating machinery or various static pulse generators permitting the drive to follow at an adjustable ratio.</p> <p><i>This option consists of:</i></p> <ol style="list-style-type: none"> <i>Digital to analog conversion circuit board which inserts into the INPUT connector of the control circuit board.</i> <i>A signal conditioning circuit board which is mounted in the base of the controller or remotely mounted.</i> <i>MANUAL/FOLLOWER selector switch for separate mounting.</i> <i>Interconnection wire harness.</i> <p>Two modes of operation are provided: Manual and Follower, as selected by the MANUAL/FOLLOWER switch. In the Manual mode, the MOTOR SPEED potentiometer controls motor speed. In the Follower mode, the motor follows the digital pulse signal, and the MOTOR SPEED potentiometer functions as the follower ratio adjust potentiometer.</p> <p>The signal conditioner circuit board accepts the output of any one of the following devices:</p> <ol style="list-style-type: none"> Magnetic pulse pick-up capable of providing 450 pulses/second at motor base speed and not exceeding a maximum of 2500 pulses/second at motor base speed. Recommended input: <ul style="list-style-type: none"> 100 tooth gear on a 1150 RPM motor. 60 tooth gear on a 1750 RPM motor. 30 tooth gear on a 2400 RPM motor. Pulse generator (TTL) with a 0 to +5V output, capable of providing a minimum of 450 pulses/second at motor base speed and not exceeding a maximum of 2500 pulses/second at motor base speed. Pulse generator with an open collector output, capable of conducting 2 milliamperes at 24VDC. <p><i>This option does not include the magnetic pick-up assembly, pulse gear or other signal source, or the MOTOR SPEED potentiometer.</i></p>
<p>1058A</p>	<p>Manual/Follower Mode Select (Toggle Switch) This option is intended as a companion to Option 1055, Option 1049 and Option 1052.</p> <p>Options 1055, 1049 and 1052 do not include a selector switch and rely upon a zero speed setting of the MOTOR SPEED potentiometer to transfer to full automatic control by the external signal. Option 1058A, when used with these options, allows manual switch selection of either the MOTOR SPEED potentiometer or automatic control by the external signal.</p> <p><i>Option 1058A includes a switch with a MANUAL/FOLLOWER legend plate for installation in the operator control panel.</i></p>

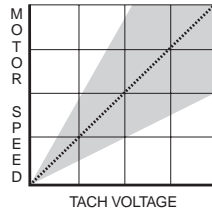


FIGURE 1. Tach Scaling and Follower Ratio

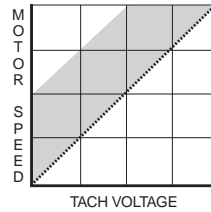


FIGURE 2. Minimum Speed Additive

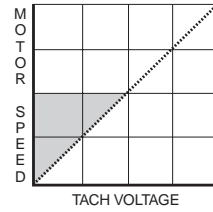
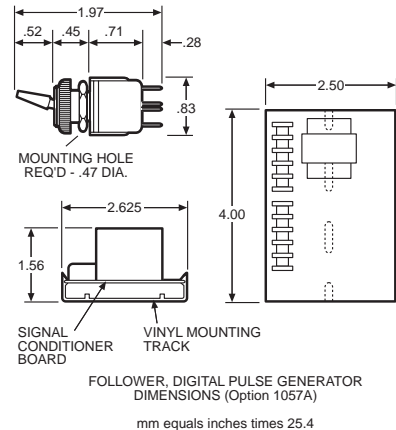
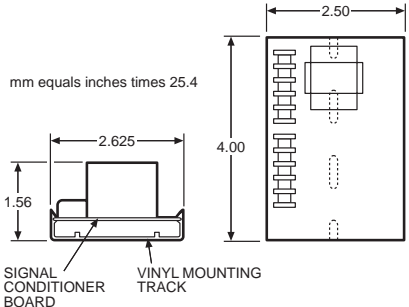


FIGURE 3. Minimum Speed Override



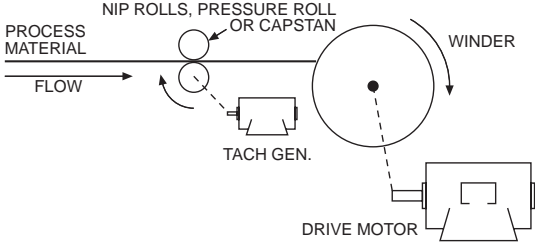
Option Number	Description
1059A	This option provides a $\pm 24/12$ VDC power supply source to provide power to operate a remote transmitter requiring an external power source. It has a power output capability of 100mA total for all the power outputs inclusively. This option requires external mounting by the customer and requires a .5amp fused 115/230V power source supplied by the customer.
1062A	<p>Feedback, Digital Pulse Generator</p> <p>Provides signal conditioning and isolation for accepting a signal from a magnetic pulse pick-up mechanically coupled to the drive motor armature. The magnetic pulse pick-up must provide a minimum of 450 pulses per second at motor speed (60 tooth gear on a 1750 RPM motor). The pulse pick-up signal defeats the IR compensation circuitry in the drive controller, making the unit directly sensitive to motor speed. Speed range is limited to 35:1.</p> <p>The option results in improved speed regulation with load changes (equal to DC tachometer feedback) and reduced sensitivity to operating conditions such as line voltage variations, ambient temperature changes, motor field heating and other variables.</p> <p><i>Option 1062A consists of:</i></p> <ol style="list-style-type: none"> Digital to analog conversion circuit board which inserts into the FEEDBACK connector of the control circuit board. A signal conditioner circuit board which is mounted on the base of the controller or remotely mounted. This option does not include the pulse pick-up assembly.
1064A	<p>Follower, Current Regulator</p> <p>Provides a means of controlling motor armature current and torque by a manually adjusted potentiometer or an external DC voltage reference signal. The circuit includes internal isolation permitting direct connection to a grounded signal source or the armature circuit shunt of another DC drive controller. Since torque is directly controlled independent of motor speed, provision is included for limiting maximum motor speed.</p>
	<p>Multiple motor applications typically involve a master speed regulated drive which establishes the speed of the system and one or more current regulated follower drive units. The follower units obtain their current reference signal from the master controller. Typical applications include:</p> <ol style="list-style-type: none"> Load sharing between two or more drive units with their motors mechanically coupled. Load sharing between two or more drive units coupled by the process material itself such as steel bar stock being pulled by multiple drive units through separately powered sections of a machine. Tension control of a web of process material being transferred between sections of a multiple section machine. <p>APPLICATION INFORMATION</p> <ol style="list-style-type: none"> Current Response time Zero to full-load current 150 Milliseconds Output Current Control Range 10:1 Signal input required for maximum current output Range 1. 3.35 to 36.5 VDC Range 2. 0.34 to 3.7 VDC Range 3. 0.04 to 0.44 VDC Transfer linearity Input signal to output current 1% <p><i>This option consists of a plug-in circuit board which inserts into both input and feedback connectors of the control board. Included are separate adjustments for:</i></p> <p>Maximum Speed 0-Motor Base Speed Maximum Current 0-150% of rated (1) Input Scaling Adjustable to match the input signal (0.04 to 36.5 VDC) for maximum current output Current offset Adjustable for zero current output with minimum signal output.</p> <p>(1) 0-75% of rated achieved by adjustment of the unit current limit.</p> <div style="text-align: right;">  </div>

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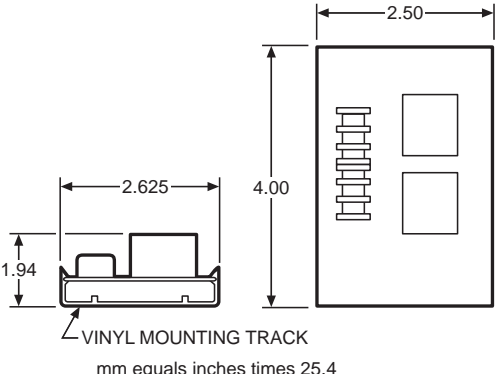
Option Number	Description
1081B	<p>Torque (Current) Monitor Provides an adjustable, static circuit that monitors motor armature current and provides a programmed shutdown of the drive under sustained overload conditions to prevent motor damage. The circuit provides greater versatility than the standard, nonadjustable overload circuit calibrated to trip whenever armature current exceeds 120% for 80 seconds.</p> <p>The static overload circuit supplements the protective benefits of the controller current limit and motor thermostat. It is especially effective in preventing motor damage when:</p> <ol style="list-style-type: none"> The motor is subjected to high torque loads at low speeds. The current limit allows adjustments to 150% of rated armature current. Standard 1.0 service factor motors are rated for 1 minute of operation at this load. Damage or reduced motor life may result if sustained for longer periods since the current limit functions independent of time. The motor is forced cooled and must run at speeds below 50% base speed for any sustained period of time. <p>Circuit includes one set of Form C, 2 amp, 120 VAC or 28 VDC rated relay contacts that may be used to signal audible or visual alarms or auxiliary control devices such as lubrication pumps, fans or valves.</p> <p>Circuit includes two adjustments:</p> <ol style="list-style-type: none"> “THRESHOLD” (trip current level) 10-180% Rated Armature Amps “DELAY” (time at trip current level) 1-90 seconds <p>The threshold adjustment establishes the amount of armature current necessary to initiate the timing period set by the delay circuit. When the current remains above the threshold level for a period equal to the delay time setting, the relay energizes.</p> <p>The accuracy of the current monitor is not affected by ambient temperature changes within the design operating limits of the drive controller.</p>
1120	<p>Control Station Provides a standard model numbered remote control station for separate mounting by the user. Control elements are provided mounted within the station and wired to a terminal board.</p>
1120A	<p>Potentiometer, Ten-Turn Motor Speed (Analog Dial) Provides a ten-turn, 2W potentiometer, knob and analog counting dial for separate mounting by user. See Specification 7100; Table 2 for selection by product series, Figure 2 for dimensions.</p>
1120B	<p>Potentiometer, Single-Turn Motor Speed Assembly Provides a single-turn, 2W potentiometer, knob and dial wired to a terminal board for separate mounting by user. See Specification 7100; Table 5 for selection by product series, Figure 4 for dimensions.</p>
1120C	<p>Potentiometer, Ten-Turn Motor Speed (Digital Dial) Provides a ten-turn, 2W potentiometer, knob and digital counting indicator dial assembly for separate mounting by user. See Specification 7100; Table 5 for selection by product series, Figure 6 for dimensions.</p>
1190	<p>Torque Taper Center driven winders ideally require a reciprocal speed torque relationship (constant horsepower) to maintain constant tension throughout the range of material buildup as illustrated by Figure 1. Acceptable performance can be economically achieved for many applications with an inverse-linear speed-torque relationship provided by this option. Tension control accuracy of approximately 20% can normally be maintained from empty to full roll at a given production machine speed.</p> <p><i>This option consists of a plug-in circuit board which inserts into the FEEDBACK connector of the control circuit board, and a TORQUE ADJUST potentiometer wired for installation in the operator control panel. Independent potentiometers are provided for:</i></p> <p>TORQUE ADJUST — Establishes maximum low speed torque as illustrated by Figure 2. The TORQUE ADJUST in combination with the SLOPE ADJUST establishes the torque available at any point throughout the operating speed range. The TORQUE ADJUST potentiometer is mounted in the operator control panel.</p> <p>SLOPE ADJUST — Establishes the slope or rate of linear torque increase with decreasing speed, throughout the operating range. Adjustable from 0 to 100% torque at maximum motor speed with minimum effect on low speed torque. See Figure 3. The SLOPE ADJUST potentiometer is mounted within the controller on the option circuit board.</p> <p>Use caution in the selection of motors for center driven windup applications where torque loads increase in inverse proportions to motor speed. Web break or other process material detectors are recommended to prevent a dangerous overspeed should the process material break.</p> <p><i>Option 1190 normally provides acceptable performance in applications where the material being wound travels a constant speed during winder roll buildup. If the process is such that the speed of the material being wound varies during winder roll buildup or if more accurate tension control is desired, see Option 1191.</i></p> <p><i>Option 1190 can also be used for constant torque applications where conventional operation of the current limit is required and remote mounting of the torque (current) potentiometer is desired. When used in this manner, the Slope adjustment is set for a vertical cut-off of motor (maximum setting) torque (current).</i></p> <div style="display: flex; justify-content: space-around;"> <div data-bbox="792 1623 976 1822"> </div> <div data-bbox="1027 1623 1227 1833"> </div> <div data-bbox="1263 1623 1458 1833"> </div> </div> <p style="text-align: center;"> FIGURE 1. “Ideal” Constant HP Curve for a Winder Application. </p> <p style="text-align: center;"> FIGURE 2. Torque Adjust with Taper Adjust at Maximum. </p> <p style="text-align: center;"> FIGURE 3. Taper Adjust with Torque Adjust at 100% Torque Setting. </p>

Option Number	Description
1191	<p>Centerwind Torque Control</p> <p>This option offers a more sophisticated solution to controlling the tension of center driven winders than Torque Taper Option 1190. Tension control is more accurate since this option produces a reciprocal speed-torque relationship which closely matches the ideal constant horsepower curve required to maintain constant tension.</p> <p>Option 1191 has provisions to accept a signal proportional to web speed from either a tachometer generator driven from the production machine feeding the winder or a potentiometer ganged to the production machine speed control. Tension control accuracy of better than 20% can normally be maintained from empty to full roll; and the control automatically compensates for changes in production machine speed.</p> <p><i>This option consists of a plug-in circuit board which inserts into both the INPUT and the FEEDBACK connectors of the control board, and a TORQUE ADJUST potentiometer pre-wired for installation in the operator control panel. Included are independent potentiometer adjustments for:</i></p> <p>TORQUE ADJUST — Sets the desired tension in the material being wound. This potentiometer is mounted in the operator control panel.</p> <p>TACH SCALING (1) — Scales the production machine tachometer signal voltage to the control requirements.</p> <p>MAX TORQUE EMPTY ROLL (1) — Establishes the torque required to maintain proper tension at high winder speed.</p> <p>MAX TORQUE FULL ROLL (1) — Establishes the torque required to maintain proper tension at low winder speed.</p> <p>TORQUE BOOST TIME (1) — Establishes the time that additional torque is supplied to accelerate the winder when the production machine speed is increased.</p> <p>Use caution in the selection of motors for center driven windup applications where torque loads increase in inverse proportion to motor speed. Also, web break or other process material detectors are recommended to prevent a dangerous overspeed should the process material break.</p> <p>An AC or DC tachometer generator with a minimum output of 30 volts at base speed and not exceeding 180 volts at maximum production machine speed or a 5K ohm potentiometer ganged to the production machine speed control is required, but not furnished as part of this option.</p> <p>(1) These potentiometers are mounted on the option circuit board.</p>
1220	<p>Constant Velocity Winder</p> <p>This option provides an economical but accurate method of automatically controlling the tension of process material in strip, web, wire or cable form as wound by a center driven winder.</p> <p>As shown by the figure below, the option requires the use of a DC tachometer generator coupled to the process material by nip rolls, a pressure roller or capstan in a manner that will provide a continuous feedback of the velocity of the process material.</p> <p>A manually set MOTOR SPEED potentiometer establishes the desired line speed of the process material. As material builds up on the winder core, the diameter increases which would tend to increase the line speed of the material. This will produce a higher voltage output from the tachometer generator which will cause the drive motor and winder to slow down to maintain a constant velocity and uniform winder tension.</p> <p>Should a break occur in the process material, this option will automatically transfer to an adjustable minimum take up speed to minimize damage to the product and winder machinery.</p> <p>RATINGS</p> <p>1. Regulation Accuracy 2% of motor base speed</p> <p>2. Maximum Line Speed Range 30 Build Ratio</p> <p>Example: a 3:1 build ratio (3 ft. dia. full roll, 1 ft. dia. empty roll) = 10:1 line speed range.</p> <p>3. MOTOR SPEED potentiometer 5,000 ohms</p> <p><i>The option consists of a plug-in circuit board which inserts into both the INPUT and the FEEDBACK connectors of the control board. Included are independent potentiometer adjustments for :</i></p> <p>ADJUSTMENTS</p> <p>1. Take-Up Speed 0 to 50% of maximum speed</p> <p>2. Maximum Speed Set maximum range of MOTOR SPEED potentiometer</p> <p>3. Acceleration (Response Time) 1-60 sec.</p> <p>Use caution in the selection of motors for center driven windup applications where torque loads increase in inverse proportion to motor speed.</p> <p>A DC Tachometer Generator with a minimum output of 1.0 volt at base speed and not to exceed 120 volts at maximum production machine speed and a 5K MOTOR SPEED potentiometer are required but not furnished as part of this option.</p> <div data-bbox="906 1486 1437 1726" style="text-align: center;">  </div>

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Option Number	Description
<p>1015</p>	<p>Magnetic Control Interface (115V) The standard magnetic control run logic excitation is 24 VDC, obtained from a self-contained power supply in the 2600 controllers. This option provides a means of interfacing a 2600 controller with pushbuttons or external logic powered by a 115 or 230 VAC excitation source. The interface circuit includes three control relays with 115 VAC coils for use in both unidirectional and reversing applications.</p>  <p style="text-align: center;">mm equals inches times 25.4</p>
<p>1072A</p>	<p>Auxiliary Contacts Provides two form C Relays each with one normally-open and one normally-closed contact rated 1 amp, 120 VAC or 28 VDC. One relay is energized with the Forward contactor and the other relay is energized with the Reverse contactor. Contacts may be used to signal external circuits. <i>Option 1072A consists of a circuit board and a wire harness.</i></p>
<p>1166</p>	<p>Manual, Instruction Additional instruction manuals with dimension drawings, schematic and connection diagrams will be packaged separately in addition to the manual packaged with the controller.</p>