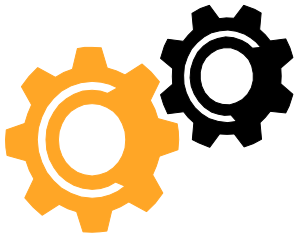

KASZOWSKI

GROUP LLC

657 White Pine Rd
Buffalo Grove IL 60089
Tel. 201-456-1216
Tel. 847-847-2987
www.kaszowskigroup.com
Email. sales@kaszowskigroup.com

For Technical Assistance, Service and Parts please contact

Kaszowski Group LLC at:

Kaszowski Group LLC
657 White Pine Rd
Buffalo Grove IL 60089

Artur: 201-456-1216
Greg: 847-847-2987

VERY IMPORTANT!!!!!!!!

Disconnect all power before removing any covers on the machine.

Disconnect all power before servicing and adjusting the machinery.

Do not operate the machine at any time with the covers removed.

W-24 RECOILER OPERATING MANUAL

1. Align the master coil so that it is in line with the left guide plate.

2. Insert the metal up to the robber rollers and turn the handle clockwise so the metal is at the face of the shear.

3. Important safety requirement, turn the speed control knob to zero.

4. Turn the recoiler on using the silver toggle switch.

5. Make sure that the drum is fully expanded to the 16" diameter.

6. Square of the metal using the manual shear.

7. Fold approximately ½ to 1 inch of material over the edge of the drum.

8. You are now ready to recoil the customer coil.

9. Slowly turn the speed control knob in clockwise direction until at least 1&1/2 turns are completed and then increase the speed to a comfortable speed.

10. Stop the recoiler at the desire length.

11. Important safety requirement; immediately return the speed control knob to zero.

12. Pull the shear handle down with firm quick action.

13. PUSH THE RESET BUTTON.

14. Tape the coil using the speed control knob slowly wraps the number of turns as needed.

15. When finish return the speed control knob to zero.

16. Reduce the drum diameter by turning the drum handle 6 to 8 turns in a counter clockwise direction.

17. Remove the coil. The process is complete.

18. Return to item #7 to repeat the process.

STANDARD EQUIPMENT WARRANTY

Kaszowski Group LLC warrants to the original purchaser that the equipment is free from defects in material and workmanship in normal use and service. Normal use and service does not extend to defects from mishandling, tampering or modifying the equipment.

The term of this warranty is for the period of three hundred and sixty five (365) days/one year for all Kaszowski Group LLC equipment from the date of the receipt of the equipment to the original purchaser. Kaszowski Group LLC shall repair or replace the defective parts at Kaszowski Group LLC place of business without charge to the original purchaser of the equipment.

The equipment subject to this warranty must first be returned to Kaszowski Group LLC with freight charges prepaid, which after examination by Kaszowski Group LLC shall disclose to its satisfaction to have been defective. Kaszowski Group LLC shall correct the defect and ship the prepaid equipment to the location of the purchaser's facility within the continental United States.

The foregoing warranties are in lieu of all other warranties expressed or implied, and of all obligations or liabilities on the part of Kaszowski Group LLC for breach of warranty.

Kaszowski Group LLC sole liability for any breach of warranty shall be limited to the repair or replacement of any defective parts in the accordance with the above.

Kaszowski Group LLC warranty does not extend to equipment that has been used under a lease or rental agreement from the original purchaser.

CUSTOM EQUIPMENT: WARRANTY AND LIABILITY

Kaszowski Group LLC liability for custom equipment prior to acceptance is the amount of deposit from the customer. Kaszowski Group LLC warrants, after acceptance all custom equipment for a period of three hundred and sixty five (365) days/one year (1) from the date of the receipt of the equipment to the original purchaser that the equipment is free from defects in material and workmanship in normal use and service.

The equipment subject to this warranty must first be returned to Kaszowski Group LLC with freight charges prepaid, which after examination by Kaszowski Group LLC shall disclose to its satisfaction to have been defective. Kaszowski Group LLC shall correct the defect and ship the prepaid equipment to the location of the purchaser's facility within the continental United States.

The foregoing warranties are in lieu of all other warranties expressed or implied, and of all obligation or liabilities on the part of Kaszowski Group LLC for breach of warranty.

Kaszowski Group LLC sole liability for any breach of warranty shall be limited to the repair or replacement of any defective parts in the accordance with the above.

Warranty will not be available if any of the following occurs:

1. Mishandling –tampering or modifying equipment
2. Leasing or renting equipment.

Contains

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Thank you for selecting our product!

This instruction will help you at correct service and accurate exploitation of described device.

Information included in this instruction were prepared with high attention by our specialists and is description of the product without any responsibilities within the meaning of the commercial law. Based on the information should not be inferred a certain features or suitability for a particular application. This information does not release the user from the obligation of own judgment and verification. P.P.H. WObit E.K.J. Ober S.C. reserves the right to make changes without prior notice.

- Please read instructions below carefully and adhere to its recommendation
- Please pay special attention to the following characters:

CAUTION!
Not adhere to instruction can cause damage or impede the use of hardware or software.

1. Safety and assembly rules

Safety rules

- Prior to first start-up of the device carefully read the manual.
- Prior to first start-up of the device make sure all cables are properly connected.
- Provide appropriate working conditions, in compliance with the device specifications (e.g.: power supply voltage, temperature, maximum current consumption).
- Prior to any modifications of cables connections, disconnect power supply voltage.
- Dismantling of the indicator housing during guarantee agreement period results in its invalidation.

Assembly recommendation

In the environments of unknown levels of interruptions it is recommended to use the following means preventing against possible interruptions of the device operation:

- Ground or zero the metal rails on which instruments are mounted.
- Do not power the device from the same lines as high power devices without appropriate network filters.
- Apply power supply, sensor and signal cables screening while screen grounding should be connected only on one side as close to the device as possible.
- Use communication cables (USB) equipped with filters in the form of ferrite beads.
- Avoid routing control (signal) cables in parallel with or in close vicinity of power and supply cables.
- Avoid close vicinity of devices generating high level of electromagnetic and/or pulse interference (high power loads, loads with phase or group power regulation).

2. Device description

2.1 Intended use and properties

MD150E is a multipurpose, programmable counter designed for counting pulses from incremental encoder or other sources of square wave signals. MD150E can define signal frequency and scale counted values into required unites (rpm, rps, mm, m, deg, etc.)

With two relay outputs the user is able to set thresholds as desired. MD150E is also equipped with additional input for resetting counter state.

MD150E counter is very intuitive. Only one parameter is needed to scale number of counted pulses to required unit.

MD150E is equipped in **USB** and **RS485 MODBUS** interfaces. USB enables direct connection between processing unit and PC (record to csv file). RS485 interface with MODBUS-RTU protocol enables communication with industrial devices like PLC or HMI.

Housing made of full aluminum profile guarantees excellent mechanical resistance to harsh external conditions.

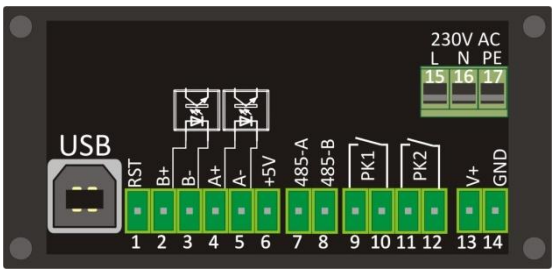
MD150E features:

- Counting external pulses with frequency up to **2Mhz**,
- Power supply 12…36V DC or 230V AC (depends on version)
- Can cooperate with any incremental enkoder, linear magnetic enkoder, other sources of Step/direction signals etc.,
- Scale of counting pulses to any unites,
- Defining frequency of counted pulses,
- Possibility of recording counted pulses – reconstructing counter state after turning on the device,
- Setting status of relay outputs based on set thresholds,
- 4 operation modes of relay outputs + additional **cycle counter -** it allows use in dose application without additional controller,
- Data transmission to PC (**USB**) or master device e.g. HMI panel, PLC (**RS485 MODBUS-RTU**).

2.2 Description of connectors and front panel

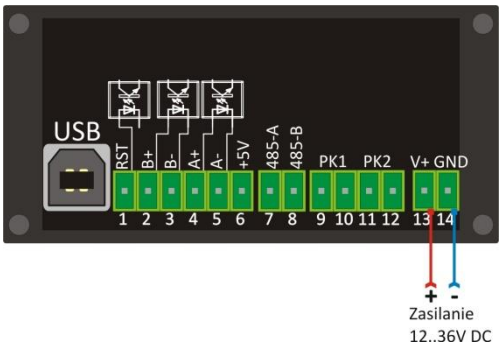
Front panel		
	**LED1**	- indicator of PK1 relay activation
	LED2	- indicator of PK2 relay activation
	ESC	- abortion, Reset (>3sec.)
	DOWN	- next menu position/next parameter digit/ change of displaying mode
	UP	- previous menu position / digit value increase / change of displaying mode

	ENTER	- menu entry/confirmation of entered changes

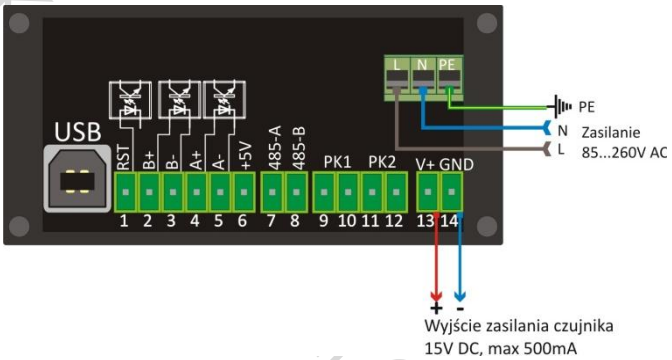
Back panel			
	1	RST	Resetting input
	2	B+	B+ counter input
	3	B-	B- counter input
	4	A+	A+ counter input
	5	A-	A- counter input
	6	+5V	Output +5V for sensor, max 500mA
	7	485A	A signal of RS485 interface
	8	485B	B signal of RS485 interface
	9,10	PK1	PK1 (NO) relay contacts
	11,12	PK2	PK2 (NO) relay contacts
	13	V+	12-36VDC power supply (or +15V output for ~230V power supply option)
	14	GND	Ground
	15,16	230V	Power supply 230V AC (230V version)
	17	PE	Protective signal (230V version)

2.3 Power supply

MD150E counter is available in two versions of power supply – low voltage (12…36 VDC) and high voltage (85…260V AC) supplied directly from mains electricity ~230V. For ~230V version on 13 (V+) clamp is available +15V voltage, which can be used for supplying sensor.



12..36V DC Power supply



85..260V AC Power supply

Caution!
For ~230V supply version, before any connections you should disconnect the device from main electricity.

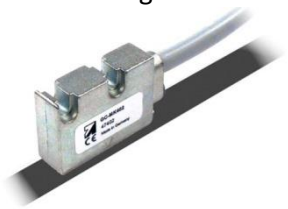
2.4 Compatible devices

MD150E counter is designed for integration with optical encoders with square wave output. That transducers are available in wide range of resolutions, versions of electronics, with connector or cable. MD150E can be also integrate with magnetic linear encoders to measure linear displacement; with motor drivers which generates Step/Direction signal or to count pulses from inductive sensors etc.

Encoders

Incremental encoders are designed for angle displacement measurement, which means measurement of angle, number of rotation and angle velocity. Using belt drive, cog wheel or friction wheel it is possible to measure linear displacement.

Encoder allow to define position by counting pulses. It can also recognize direction of movement due to phase shift of A and B channel (square wave signal).
Some encoders have C zero channel, which by each rotation indicates an absolute position. It can be used for designation of zero position.



Linear magnetic encoders

Linear encoders are designed for direct measurement of linear displacement. Incremental length measuring system consisting of read head and magnetic tape. An example of sensor is **GC-MK2** or **GC-MK5** from WObit's offer.

Proximity sensors, Area sensors

All sensors with output signal NPN or PNP can be connected directly to MD150E counter to count number of this signals. For example this sensors can be used for counting numbers of elements on a production line or for defining numbers of rotation/ velocity of measuring wheel.

CLOCK/DIRECTION signals for controlling servomotors and stepper motor drivers

For controlling servomotors and stepper motor drivers often are used CLOCK/DIR signals. This signal can be connected directly to MD150E counter, then it can be used for direct indication of motor position/velocity.

2.5 Input signals – way of connection

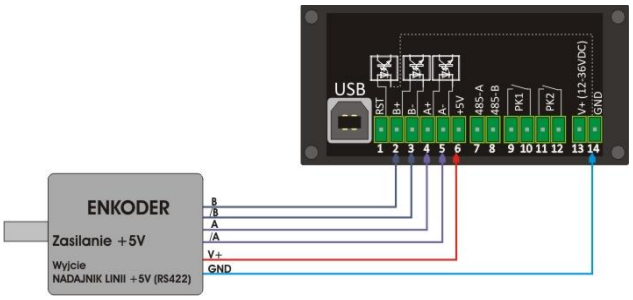
MD150E counts pulses from **two opt insulated A and B input channels** + zeroing signal (RST). This signals can be given asymmetrically (input + or – connected to sensor's ground) as well as symmetrically (straight signal and negation + and - inputs simultaneously). Most of rotary and linear encoders give asymmetrical signal (differential) due to greater transmission resistance for industrial noise. Simple proximity sensors usually give straight signal (without negation).

Level of transducers input signal depend on electronic standard. The most popular is O.C. (voltage supply +24 V, +12 or +5 V). This standard can't be used for long distances with high signal frequency. At distances up to 100 m and high rotational velocity of transducer usually is used Line Driver standard (RS422). At this standard at transducer are available also A and B signal negations. Then should be used proper cable with correct impedance (signal send in pairs, e.g. A+/A-).

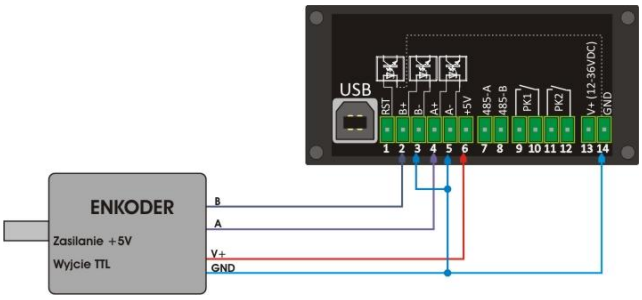
MD150E has fully opt insulated differential counter inputs, on which can be given signals in range 5..24V (between „+" and „-" clamp). It can be integrated directly with most of sensors (supplied from +5V as well as +24V).

Owing to input signal on opt-isolator is internally formed in square course with proper slope (for correct pulse identification). As pulse generator can be used almost any element with slow increasing pulse like optical sensor or proximity sensor. In case of electromechanical pulse sources, **the**

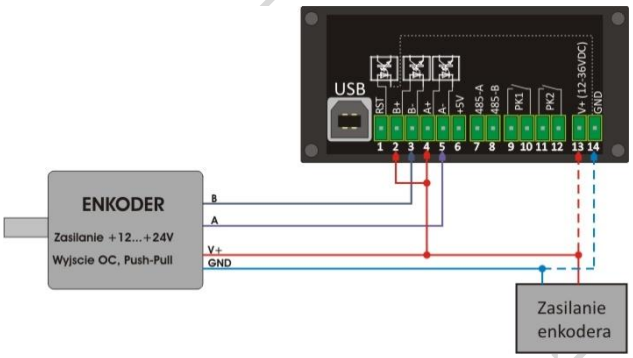
condition of correct operation is the elimination of joint vibration effect, causing pulse multiplication.
Way of connection external signals to MD150E counter depends on used sensor output type. Below are shown exemplary ways of connection.



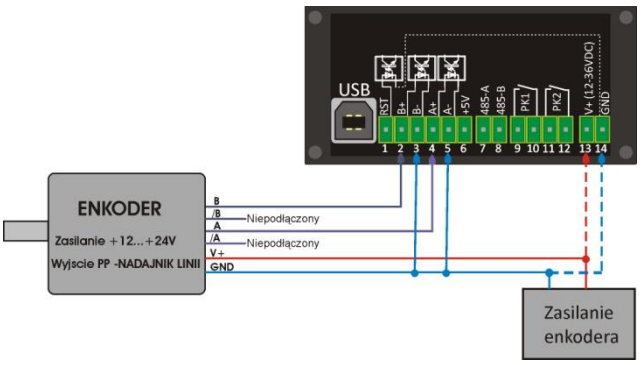
Picture. 1 Connection of +5V encoder with output RS422 type (Line driver).



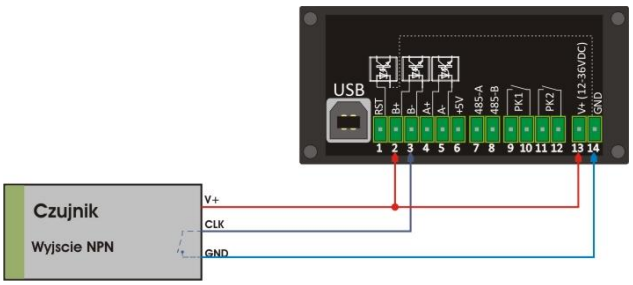
Picture. 2 Connection of +5V encoder with output TTL type.



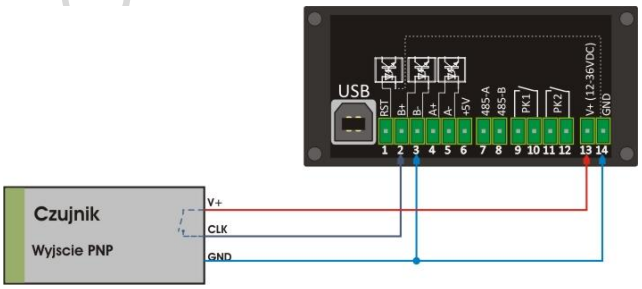
Picture. 3 Connection of +12V..+24V encoder with output Open Collector (OC) or Push-Pull (PP) type.



Picture. 4 Connection of +12V..+24V encoder with output Push-Pull and Line Driver type.



Picture. 5 Connection of sensor with NPN output.



Picture. 5 Connection of sensor with PNP output.

2.6 Counter indications – pulses / cycles / velocity

MD150E can display one of three measuring values:

- **Value of pulses counter**
- **Value of cycle counter**– value is preceded by **L**
- **Pulses frequency** (velocity) – value is preceded by **U**

You can switch between next values apart from the MENU, using UP/DOWN buttons.
There is an additional option to set default counter indications after its activation (MENU-> **11. DISP**).

Value of pulses counter = counted pulses/calculator (**DIV** parameter) + offset (**OFFS** parameter)
Value of cycle counter = pulses counter / P1 setting (only at 0 and 3 operation modes)

3. Menu description

3.1 MENU map

000000 -> displaying of current measurement value				
Menu entry		Change of displayed value: ▪ No sign: Pulses ▪ **U** sign: velocity ▪ **L** sign: cycles		(>3 sec.) Reset of pulses and cycles counter
1. P1 -> Menu				
Next/previous parameter		parameter selection		Digit selection Change value Parameter edition
1.	P1	Settings control relays	Relays	± 999999
2.	P2	Settings control relays		± 999999
3.	PTIM	Time of relays activation (depends on PMOD)		0…999999 ms
4.	PMOD	Relays operations mode		mode 0 / 1 / 2 / 3 / 4
5.	DIV	Pulses calculator (divider) into required unit	Measurement	± 9999.99
6.	OFFS	Offset of initial counter value		± 999999
7.	IN	Signal input mode of counter		A-b / U-d / d-C
8.	FILT	Filtration of input signals		on / oFF
9.	DP	Number of decimals of the result		0…5
10.	SPD	Unit of velocity counter		1.Sek / 2. Min /3. Hour
11.	DISP	Default indications of the counter after its activation		PoS / SPEEd / CYCLE
12.	MEM	Record of counter position		on / oFF
13.	CLR	Counter zeroing mode		oFF / riS / FAL
14.	RS1	MODBUS address	RS485	0-99
15.	RS2	MODBUS baudrate		96000 / 19200 / 38400 57600 / 115200
16.	BEP	Sound signal of buttons	Other	On / oFF
17.	LED	Brightness level of display		0-9
18.	FAC	Restoring factory default settings		
19.	PAS	Password		X-0000 - non active
Menu exit/abortion		Parameter confirmation/abortion		

CAUTION: Appearing of blinking measured value on display preceded by C means overfilling of result value (the result don't fit in 6 position display). To display older part of the result press button.

3.2 Example of parameter change

After correct connection of external elements and switching power supply on MD150E counter is ready for operation with previously used settings, and in case of first operation – with factory settings.

In order to enter programming mode, press ENT. The display shows ***1. P1***, if the password is switched off or ***0000*** if it is active. In such case, in order to enter programming mode (at active password) enter the password and confirm it with the key ENT;

- With subsequent pressing of ▼ key you switch to next parameters and with pressing of ▲ key you return to previous parameters.
- At the selected parameter you want to change, press ENT;
- With ▼ key select display digit position you want to change and change its value with ▲ key. Confirm the entered value with ENT key;
- Value of single digit parameters is selected with ▲ and ▼ keys;
- If you want to enter a negative value select the first digit (from the left) then press and hold ▲ key until the symbol "-" is displayed.
- With ENT key you confirm the introduced change and with ESC key you abort the change or exit the menu.

Prolonged pressing of ▲ or ▼ keys results in automatic increase/decrease of a given position/value.

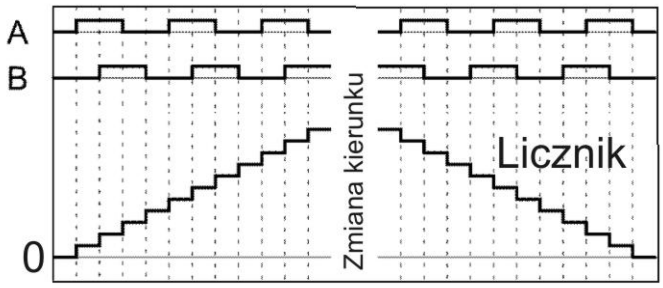
4. Counter configuration

4.1 Inputs modes – Encoder / Up-Down / Step-Direction

Selection of input signal sources depends on application. User can use two differential input channels: A+/A- and B+/B- used for counting and RST signal for counter zeroing. One of three ways of signals interpretation is specified as **Input mode** parameter – **7. In**, which enables setting modes presented below:

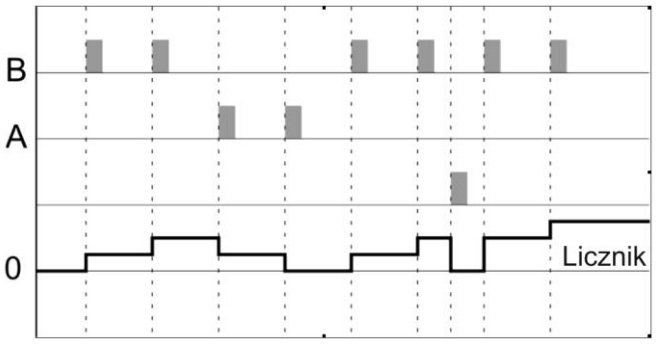
A-B – encoder

A-B mode is designed for use with encoders, which generate signals on two channels shifted in phase. It enables to define direction of movement, and counting of all 4 slopes (square wave) allows to increase four times the real encoder resolution.



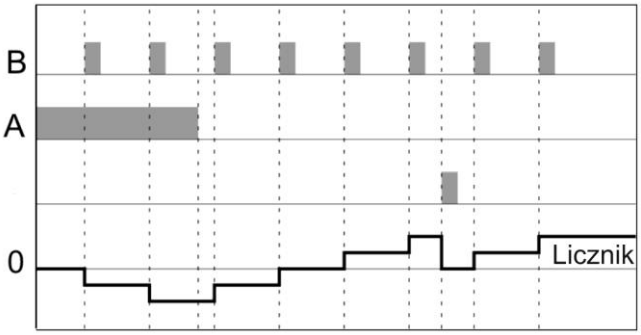
U-D – up/down

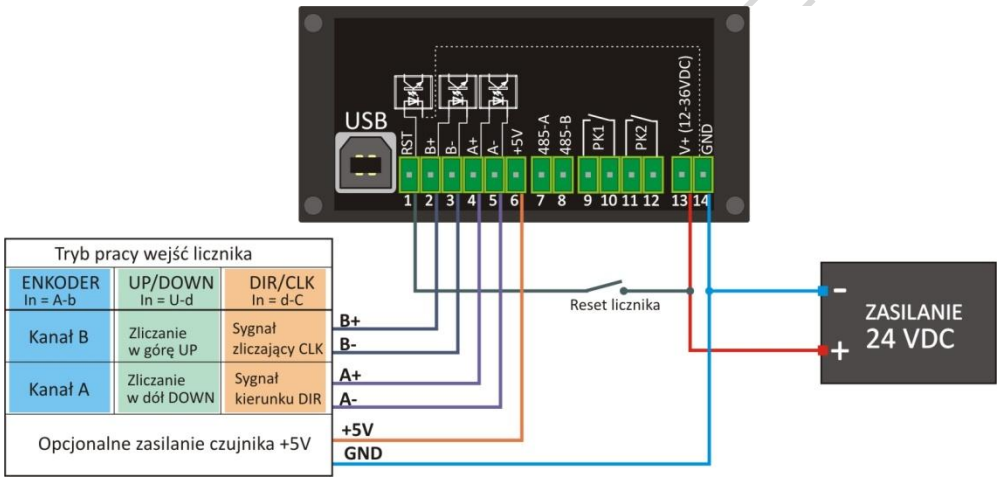
At this mode pulses given on B channel increase counter value and given on A channel decrease counter value. **You can't use this mode for encoders**. This mode requires signals from two independent sources.



D-C – Direction/Clock

d-C mode is specific to control of stepper motors and servo motors. B channel counts pulses, A channel switch counting direction. This mode is designed mostly for use with external devices or with sensors with mentioned above signals.





*Picture. 6 Meaning of A/B external signals in dependence on input mode (**7. In** parameter).*

4.2 Calibration of counted pulses

5. DIV parameter allows conversion of received pulses into selected unit e.g. distance or rpm.

Other parameters which influence on displayed value

6. OFFS – value offset causing adding for indication constant number value,
9. DP – allows to define number of decimals of displayed result. DP parameter also influence on range of **1. P1**, **2. P2** and **6. OFFS** parameters. If **DP** = 0, then **P1**, **P2**, ***OFFS*** settings can be changed only in an integer part in range from -99999 up to 999999. When **DP**=4 parameters above could be changed in range from -99.9999 up to 99.9999.

4.3 Measurement of pulses frequency (velocity)

MD150E counter provides readout of counted pulses frequency, which allows e.g. to define rotational or linear speed of measured object with build-in sensor generating pulses. To provide correct velocity indication in set units (e.g.. in mm/sec., rpm./sec.) you should properly calibrate pulses according to **4.2** paragraph.

Furthermore **10. SPD** parameter allows to define unit of displayed velocity in:

1. SEH –pulses / second (gate time 0,1 sec.)
2. nIn – pulses / minute (gate time 1 sec.)
3. HoUr – pulses / hour (gate time 60 sec.)

CAUTION!
During external zeroing of the counter (or counter operation mode with automatic zeroing), when zeroing occur more often than gate time of velocity measurement, the velocity won't be updated.

4.4 Filtration of input signals

8. FILT parameter provides activation of filtration for **A**, **B** counting signals and reset signal **RST**. Filtration prevents accidental counting of pulses (or counter reset by RST input) during operation in noise environment or while counting of pulses from irregular slopes.

	Filtration deactivated -> FILT = OFF	**Filtration activated -> FILT= ON**
A/B Inputs	Inputs frequency. max. 2Mhz	Inputs frequency. max. 125Khz
RST Input	Resetting pulse > 1mS	Resetting pulse > 10ms

Table 1.Inputs parameters in dependence on set filtration.

4.5 Resetting of pulses and cycles counter

Reset by keyboard : Press and hold (ESC) button by 3 sec. On display appears **Reset** inscription.

Reset by external signal RST: State of pulses and cycles counter can be reset by signal given on resetting input RST. There is an additional possibility to set signal slope, on which should occur counter reset or blocking of external reset function. For this aim is designed **13. CLR** parameter, which can take values listed below:

1. **oFF** - external reset turned off

2. **rIS** - reset on rising slope (signal change from 0 to +5..+24V)
3. **FAL** - reset on falling slope (signal change from +5..+24V to 0V)

4.6 Record of counter state

MD150E provides saving of current pulse counter state which is accessible after next counter activation. For this purpose use **12. MEM** parameter**.** When that parameter is set on „**On**" the current value of the counter will be saved before its turning off and will appear on display after next turning on.

CAUTION!
Cycle counter state (L) is not saved.

4.7 Relay outputs and operation modes

MD150E counter has two relay outputs PK1 and PK2, which can be turned on/off in dependence on counter state and operation mode. For configuration relay outputs you can use parameters listed below:

1. P1 - P1 setting
2. P2 - P2 setting
3. PTIM - relay turn-on duration (in milliseconds)
4. PMOD – operation mode

CAUTION!
P1 and P2 settings can take negative values, but it is useful only in some cases (see -> operation modes)

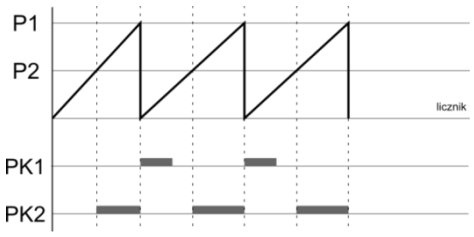
PMOD operation mode defines way of turning on/off of relay outputs, automatic counter reset at specified value and increasing of cycle counter. There are available operation modes listed below:

- ***Mode 0*** (***nodE 0***) – Cyclic mode with automatic reset

At this mode reset of the counter occur after reaching **P1** setting. Each zeroing of the counter also causes increasing cycle counter (**L**). At the same time **PK1** follows into active state for time specified by **PTIM** parameter, or for non defined time when **PTIM** = 0.

If **P1** > **P2** condition is fulfilled, **PK2** output will be active in range of **P1** ÷ **P2** indications. In other condition **PK2** stayed off-line.

P1 > P2
PTIM > 0



PK1 output activates **PTIM** time, while counter will exceed value of **P1** setting. At the same time pulses counter is reset and cycle counter increases (**L**).
PK2 output will be activated when counter value will be located between **P1** and **P2** settings.

➢ ***Mode 1*** (***nodE 1***) – Absolute with two thresholds

Activation of **PK1** and **PK2** outputs occurs after reaching **P1** and **P2** values**,** which can be positive or negative.

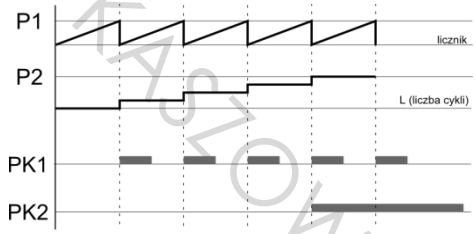
➢ ***Mode 2*** (***nodE 2***) – Absolute with thresholds and margin

At this mode **PK1** output is active when counter value is in range (**P2** – **P1**) ÷ (**P2** + **P1**). If **P2** <0, **PK2** output will be active after reaching P1 setting (positive or negative).

➢ ***Mode 3*** (***nodE 3***) – Cyclic with cycle counting

At this mode counter reset occur after reaching **P1** setting. At the same time **PK1** output follows into active state for time specified by **PTIM** parameter for non defined time when **PTIM** = 0. Each zeroing is counted by cycle counter (**L**). If cycle counter (number of zeroing of pulses counter) reach value set by **P2** parameter, **PK2** output will be activated.

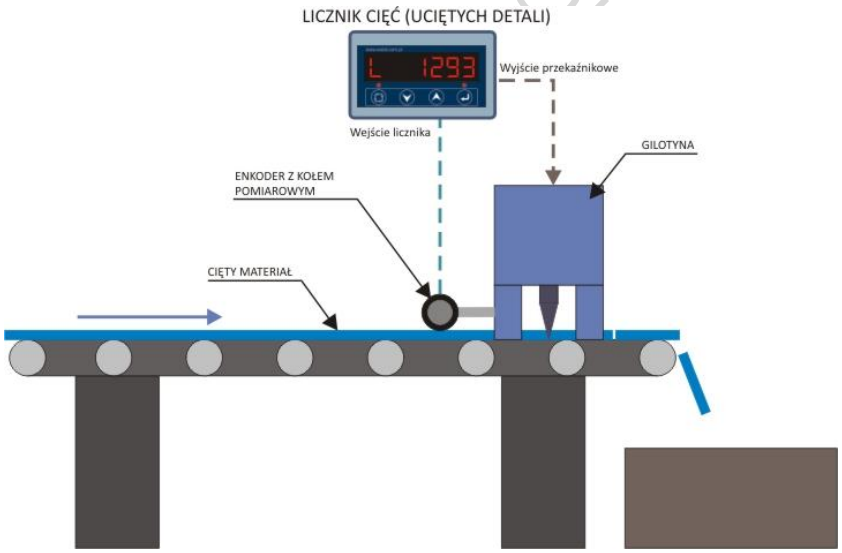
P1> 0
P2> 0



PK1 output is activated for **PTIM** time when counter will reach **P1** value. At the same time pulses counter is reset and cycles counter increases (**L**).

PK2 output is activated when cycles counter reach **P2** value and it is turned off when counter is reset by external signal or by keyboard.

This mode is dedicated for application in cutting machines for counting length and number of cut elements.



Picture. 7 Example of length measurement application with MD150E used for counting material cut offs in a production line.

➢ ***Mode 4*** (***nodE 4***) – Absolute controlled by velocity

Activation of **PK1** and **PK2** outputs follows when velocity counter exceed (pulses frequency) values of **P1** and **P2** settings.

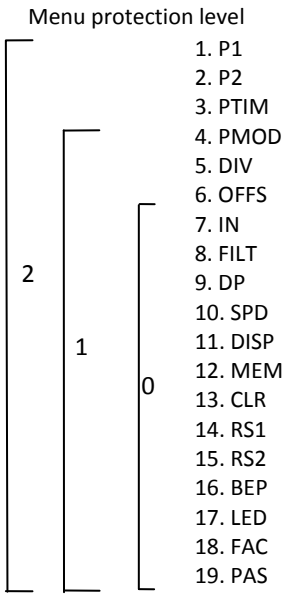
5. Password protection

Access to the process display settings can be password protected (parameter ***19. PAS***). There are 3 protection levels available. Protection level is set with the first digit, and the last 4 digits are used for password entry.

0-0000

4-digit password (0-9999)

Protection level:
0- Settings protection above ***6. OFFS*** parameter
1- Settings protection above ***3. PTIM*** parameter
2- Protection of all settings



If the digital processing unit is password protected, then after switching to protected settings the display shows ***0000*** value – enter previously set password. The password can be deactivated by switching the parameter ***19. PAS*** and setting 0000 value.

6. USB and RS485 Modbus interfaces

6.1 USB interface

USB interface is used for connection of MD150E counter with MD150E-PC software (device configuration, recording of measurements) and for updating of internal software. MD150E process display must be powered in order to facilitate connection via USB.

CAUTION

USB interface is prone to interference in the power supply grid and to electromagnetic interference occurring in industrial environments. In case of connection problems during communication of the digital processing unit with MD150E-PC software, apply additional protective elements in the form of:

- Powering of MD150E digital processing unit from an independent power supply source,
- Application of network filters upstream of the indicator supply feeder.
- Use of USB cable of length <1,5m equipped with ferrite beads at the cable beginning and its end.
- Use of optically insulated USB hubs at PC side.

In the conditions of severe interference (e.g. high interference of power grid) the communication may not be possible.

6.2 RS485 (MODBUS-RTU) interface

MD150E counter is equipped with **RS485** interface. It can be used for connection with PLC controller, HMI panel or other device supporting MODBUS-RTU protocol.

Default transmission parameters:

- Speed: **38400bps**, Bits: 8, Stop Bits: 1, parity: none
- Address **Modbus: 1**

Transmission speed and MD150E counter address in MODBUS-RTU network can be set with the following parameters:

12. RS1 - baudrate setting MODBUS (9600, 19200, 38400, 57600, 115200)

13. RS2 - address setting MODBUS (1…99)

6.2.1 Description of MODBUS protocol

Implemented MODBUS functions

Function no (hex)	Description
1 (0x01)	Reading of outputs status (relays)
3 (0x03)	Reading X registers
5 (0x05)	Recording of single Bit

Type of used variables

Variable name	Description	Size (Bytes)	Number of occupied registers	Range
INT	2 Bytes number with sign	2	1	-32768 - +32767
DINT	4 Bytes number with sign	4	2	-2^{31}…$(2^{31}-1$
REAL	Floating point number	4	2	$1.18*10^{-38}$…$3.40*10^{38}$, 0, $-3.40*10^{38}$ … $-1.18*10^{-38}$

Map of MD150E records

Address	Name	Mode	Variable type (MODBUS function)	Description
0 -1 (*1-2)	COUNTER_VAL	R	DWORD (0x03)	Readout of pulses counter value (non calibrated value)
2 (*3)	CYCLE_VAL	R	INT (0x03)	Readout of cycles counter value – L
4-5 (*5-6)	COUNTER _DISP	R	REAL (0x03)	Readout of pulses counter value indicated by display (floating point number)
6-7 (*7-8)	SPEED _DISP	R	REAL (0x03)	Velocity readout indicated by display– U (floating point number)
5000 (*5001)	COUNTER_RESET	W	BYTE (0x05)	Reset of cycles and pulses counter
5002 (*5003)	PK_OUT	R	BYTE (0x01)	Readout of relay outputs status (bit 0:PK1, bit 1:PK2)
5004 (*5005)	INPUTS	R	BYTE (0x01)	Readout of inputs state (bit 0: INA. bit 1: INB, bit 2:RST)

* for devices with address starting with 1 value (offset address +1)

CAUTION: 4-Byte number of type **REAL** or **DINT** is contained in two registries. The first registry contains younger part of the number, the second - its older part. In order to read **REAL** or **DINT** number value correctly, read two registries (X, X+1) then conduct appropriate conversion.

Conversion of 2 registries (4 Byte) into 32 Bit number (REAL, DINT)

Register HI <-> Byte1
Register LO <-> Byte0
Register_X+1 HI <-> Byte3
Register_X+1 LO <-> Byte2

Number_32_bit = **Byte3**<<24 + **Byte2**<<16 + **Byte1**<<8 + **Byte0**
or **Number_32_bit** = Register_2 + Register_3<<16

Example of MODBUS communication table

Readout of counter state (non calibrated) - COUNTER_VAL (Function: 03, Register address: 0)

Request (MODBUS MASTER -> MD150E)		Response (MD150E -> MODBUS MASTER)	
Device address	0x01	Device address	0x01
Function	**0x03**	Function	**0x03**
Hi registry address	**0x00**	Number of Bytes	0x04
Lo registry address	**0x00**	Register 0x02 Hi	REAL (Byte 1)
Number of Hi registries	0x00	Register 0x02 Lo	REAL (Byte 0)
Number of Lo registries	0x02	Register 0x03 Hi	REAL (Byte 3)
CRC Hi	0xC4	Register r 0x03 Lo	REAL (Byte 2)
CRC Lo	0x0B	CRC Hi	8 bit
		CRC Lo	8 bit

Readout of cycle counter - CYCLE_VAL (Function: 03, Register address: 2)

Request (MODBUS MASTER -> MD150E)		Response (MD150E -> MODBUS MASTER)	
Device address	0x01	Device address	0x01
Function	**0x03**	Function	**0x03**
Hi registry address	**0x00**	Number of Bytes	0x02
Lo registry address	**0x02**	Register 0x00 Hi	INT (Byte 1)
Number of Hi registries	0x00	Register 0x00 Lo	INT (Byte0)
Number of Lo registries	**0x01**	CRC Hi	8 bit
CRC Hi	8 bit	CRC Lo	8 bit
CRC Lo	8 bit		

Counter reset- COUNTER_RESET (Function: 05, Register address: 5000)

Request (MODBUS MASTER -> MD150E)		Response (MD150E) -> MODBUS MASTER)	
Device address	0x01	Device address	0x01
Function	**0x05**	Function	**0x05**
Hi registry address	**0x13**	Address of Hi registries	**0x13**
Lo registry address	**0x88**	Address of Lo registries	**0x88**
Register 0x00 Hi	0xFF	Register 0x00 Hi	0xFF
Register 0x00 Lo	0x00	Register 0x00 Lo	0x00
CRC	16 bits	CRC	16 Bits

7. Technical parameters

Description	Parameter
Power supply	Standard version **12 … 36V DC**, recommended 24 VDC, min. 250mA + current consumption MD150E-230 version: **85 … 260V AC**, 10W, 47-440Hz
Sensor power supply output	5V DC, max. 500mA 15V DC, max. 500mA (only for 230V version, please contact with WObit technical support)
Counter inputs A/B	Differential, opt insulated Low level: 0V (max. 2V), High level: +24V (5…24V)
Reset input RST	Low level: 0V (max. 2V), High level: +24V (5…24V)
Max. frequency for counter inputs A,B	2Mhz (off-line filtration) 125Khz (filtration activated)
Min. length of reset signal RST	1ms (off-line filtration) 10ms (filtration activated)
Relay outputs PK1, PK2	2 x 1A/125VAC, 2A/30VDC
Interfaces	RS485 MODBUS-RTU**,** default parameters 38400bps, 8:n:1, **USB: 1.1, 2.0**
Operation temperature range	0..50^{o} C

Display	6 digits, height13.5 mm
Housing	Height: 45 mm Width: 92 mm Length: 81 mm
Weight	200g (300g for 230V version)
IP class	IP40, for front panel– IP65
Universal password	3145

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SAFETY NOTICES

WARNING - STATEMENT INDICATES A POTENTIALLY HAZARDOUS SITUATION WHICH, IF NOT AVOIDED, COULD RESULT IN INJURY OR DEATH.

CAUTION - Statement indicates a potentially hazardous situation which, if not avaoided, could result in damage to property..

Note - Additional information that is not critical to the installation or operation.

WARNING! READ ALL SAFETY NOTICES BEFORE ATTEMPTING TO USE THIS CONTROL. WIRE CONTROL IN ACCORDANCE WITH THE NATIONAL ELECTRICAL CODE REQUIREMENTS AND OTHER LOCAL CODES THAT MAY APPLY. BE SURE TO FUSE EACH CONDUCTOR WHICH IS NOT AT GROUND POTENTIAL. DO NOT FUSE NEUTRAL OR GROUNDED CONDUCTORS.

WARNING! DO NOT CONNECT SWITCHES OR RELAYS IN SERIES WITH THE ARMATURE. ARMATURE SWITCHING CAN CAUSE CATASTROPHIC FAILURE OF MOTOR AND/OR CONTROL.

WARNING! TO AVOID ERRATIC OPERATION DO NOT BUNDLE AC LINE AND MOTOR WIRES WITH POTENTIOMETER, VOLTAGE FOLLOWING, ENABLE, INHIBIT OR OTHER SIGNAL WIRING. USE SHIELDED CABLES ON ALL SIGNAL WIRING OVER 12” (30 CM) – THE SHIELD SHOULD BE GROUNDED ON THE DRIVE SIDE ONLY.

WARNING! DO NOT USE START/STOP, INHIBIT OR ENABLE FUNCTIONS AS A SAFETY DISCONNECT SINCE THEY ARE NOT FAIL-SAFE. USE ONLY AN AC LINE DISCONNECT FOR THAT PURPOSE.

WARNING! DO NOT USE THIS DRIVE IN AN EXPLOSIVE ENVIRONMENT. AN EXPLOSION CAN CAUSE SERIOUS OR FATAL INJURY. THIS DRIVE IS NOT EXPLOSION PROOF.

WARNING! DO NOT ADJUST TRIMPOTS WITH MAIN POWER ON IF POSSIBLE. IF ADJUSTMENTS ARE MADE WITH POWER ON, INSULATED ADJUSTMENT TOOLS MUST BE USED AND SAFETY GLASSES MUST BE WORN. HIGH VOLTAGE EXISTS IN THIS CONTROL. ELECTROCUTION AND/OR FIRE CAN RESULT IF CAUTION IS NOT EXERCISED.

WARNING! READ ALL SAFETY NOTICES BEFORE ATTEMPTING TO OPERATE THE CONTROL OR SEVERE INJURY OR DEATH CAN RESULT. FAILURE TO OBSERVE THIS WARNING, MAY RESULT IN ELECTRIC SHOCK, FIRE OR EXPLOSION.

WARNING! HIGH VOLTAGE IS PRESENT IN THIS DRIVE. DISCONNECT MAIN POWER BEFORE MAKING CONNECTIONS TO THE DRIVE. FAILURE TO OBSERVE THIS WARNING COULD RESULT IN ELECTRICAL SHOCK OR ELECTROCUTION.

WARNING! DO NOT DEPEND ON PANEL MOUNTED LED’S, AS A GUARANTEED POWER OFF CONDITION. BE SURE THE MAIN POWER SWITCH OR CIRCUIT BREAKER IS IN THE “OFF” POSITION BEFORE SERVICING THE DRIVE.

WARNING! BE SURE TO FOLLOW ALL INSTRUCTIONS CAREFULLY. FIRE OR ELECTROCUTION CAN RESULT DUE TO IMPROPER USE OF THIS PRODUCT.

CAUTION!

1. **Adjusting the CL above 150% of motor rating can cause overheating and possibly demagnetization of some PM motors. Consult motor manufacturer.**

2. **Do not leave the motor in a locked condition for more than a few seconds since armature damage may occur.**

CAUTION! Do not use in explosive atmosphere. Be sure the BC160 is used within its maximum ratings. Follow all installation instructions carefully (Refer to Sections 3 and 4).

CAUTION! Shunt-Wound motors may be damaged if field windings remain energized for an extended period of time without armature rotation.

1. INTRODUCTION

Thank you for purchasing the BC160 Series NEMA 4X (IP65) DC drive. Baldor is committed to providing total customer satisfaction by providing quality products that are easy to install and operate.

The Baldor SCR DC Motor, Variable Speed and Torque Control is designed for applications requiring washdown watertight integrity. Its housing is ruggedly constructed of die cast aluminum which is protected with an acrylic coating for the ultimate in corrosion resistance. All switches are sealed with rubber boots and the main speed potentiometer contains a shaft seal. The BC160 state-of-the-art electronics include short circuit and transient protection to provide the ultimate in reliability. Electronic overload protection is also provided, which prevents motor burnout and demagnetization of PM motors. The control can be operated in either the speed or torque mode via a jumper selection. The BC160 contains jumper selections for feedback type (armature/tachometer).

Standard features include Electronic Start/Stop Switch and LED Indicator Array for “Power On,” “Stop” and “Overload.” Although the BC160 is factory set for most applications, a variety of trimpots allow adjustment of the following parameters: MIN and MAX speed, Acceleration, Deceleration, Current Limit, IR Compensation, and Timed Current Limit. The drive offers the ultimate in flexibility with the availability of several customer installed options. These include: Run-Stop-Jog Switch and Input Signal Isolation. Refer to Figure 1-1, Figure 1-2, Figure 2-1, and Tables 1–1 through 1-6.

WARNING: BE SURE TO FOLLOW ALL INSTRUCTIONS CAREFULLY. FIRE OR ELECTROCUTION CAN RESULT DUE TO IMPROPER USE OF THIS PRODUCT.

CE This product complies with all CE directives pertinent at the time of manufacture. Contact your local Baldor District Office for Declaration of Conformity. Installation of a CE approved RFI filter is required. Additional shielded cable and/or AC line cables may be required along with a signal isolator.

Table 1-1 Standard Features

Feature	Description
Simple to Operate	Does not require programming. Uses trimpots and jumpers which are factory set for most applications.
AC Line Voltage - 115/230 Volts Operation	Jumper selectable for 115 or 230 VAC input for 90 or 180 VDC output.
Electronic Overload Protection	Prevention of Motor Burnout.
Diagnostic LED’s	Panel mounted LEDs for Power on (ON), Overload (OL) and Stop (STOP).
Start/Stop Switch	Panel mounted. Used to START or STOP the drive.
Main Speed Potentiometer	Panel mounted. Provides adjustment of motor speed.
Jumper Selections	Speed/Torque mode, Timed Current Limit, (TCL) or Non Timed Current Limit, (NTCL), Armature Voltage Feedback or Tachometer Feedback, (AFB. TFB), Tachometer Voltage level, (50V 20V/30V 7V), if Tach used.
Adjustable Trimpots	For adjusting settings for Minimum Speed (MIN), Maximum Speed (MAX), Current Limit (CL), IR Compensation (IR), Acceleration (ACCEL), Deceleration (DECEL), Timed Current Limit (TCL) and Jog Speed (JOG).

Table 1-2 Selectable Jumpers (See Section 6)

Feature	Description
J1 Speed / Torque Mode Jumper. Refer to Section 6.1.	In SPD position, (Factory Setting), the motor speed is adjustable according to the main speed potentiometer setting, In TRQ position, the motor torque is adjustable according to the main speed potentiometer setting.
J2A, J2B, Input AC Line Voltage. Refer to Section 6.	Selectable for 115VAC or 230VAC. Factory set for 230VAC.
J3, Armature Voltage or Tachometer feedback. Refer to section 6.2.	Factory set to Armature Voltage Feedback.
J5, Current limit Mode. Refer to Section 6.3.	In the TCL position, (Factory Setting Timed Current Limit), motor overload protection is active. In the NTCL position, (Non Timed Current limit), drive will run in Current Limit mode. If in an Overload condition, drive will trip on OL. Armature fuse may clear.
J6, Tachometer Voltage. Refer to Section 6.4.	Selection for tachometer voltage in Volts/1000 RPM Based on maximum motor speed.
J7, Analog Speed Reference Signal Input Voltage. Refer to Section 6.5.	Factory set to 10V for maximum speed. May be set to 5V for maximum speed. Speed range adjustable with MIN and MAX speed trimpots.

Note: Jumper J4 not installed.

Table 1-3 Trimpot Adjustments (See Section 7)

Trimpot	Description
Minimum Speed (MIN), Refer to Section 7.2.1.	Sets the minimum speed of the motor. Range of adjustment 0 to 30% of Base Speed.
Maximum Speed (MAX), Refer to Section 7.2.2.	Sets the maximum speed of the motor. Range of adjustment 60% to 120% of Base Speed.
Acceleration (ACCEL), Refer to Section 7.2.3.	Sets the amount of time for the motor to accelerate from zero speed to full speed.
Deceleration (DECEL), Refer to Section 7.2.4.	Sets the amount of time for the decelerate from full speed to zero speed.
Current Limit (CL), Refer to Section 7.2.5.	Sets the maximum amount of DC current that the motor can draw. This determines the amount of maximum motor torque in both the Speed Control Mode and Torque Mode.
IR Compensation (IR), Refer to Section 7.2.6.	Set to provide improved load regulation. The adjustment is factory set for 3% regulation.
Timed Current Limit (TCL), Refer to Section 7.2.7.	Sets the approximate amount of time the drive will stay in Current Limit before trip out.
JOG Speed, Refer to Section 7.2.8.	The JOG potentiometer (with the panel switch in the JOG position; can be adjusted to set a JOG speed. The trimpot is only operational when the optional RUN-STOP-JOG Switch is installed.

Table 1-4 Optional Accessories

Description	Catalog No.
Signal Isolator Board: Provides analog input isolation from non-isolated sources. Input signals can be 0-25VDC or 0-250VDC, 1-5mA. 4-20mA. or 10-50mA. (Jumper selectable). Also contains an isolated enable Input.	BC145
RUN-STOP-JOG Switch: This switch provides a momentary jog mode that can be used to index a machine Into position.	BC157
Auto Manual Switch Kit: Allows for switching between Auto / Manual mode when the BC145 Signal Isolator Board is installed (BC145 sold separately).	BC158
RFI Filter: This Module is a Radio Frequency Interference (RFI) filter designed to meet “CE” compliance.	BC24LF
Note: All optional accessories are supplied with complete installation instructions.	

Table 1-5 Electrical Ratings

Model Number	Input Line Voltage (VAC-50/60Hz)	Maximum AC Line Current (Amperes)	Output Voltage (VDC)	Maximum DC Output Current (ADC)	Maximum Field Current (ADC)	Maximum Horsepower HP, (kW)
BC160	115	22	0 - 90	15	1.5	1.5, (1.12)
	230	22	0 - 180	15	1.5	3.0, (2.25)

Table 1-6 General Performance Specifications

Description	Specification	Factory Setting
AC Line Input Voltage (VAC ±15%, 50/60 Hz)	115/230	230
Horsepower Rating (HP)	1.5/3	3
Armature Voltage Range (VDC)	0 – 200 (1)	180VDC
Field Voltage (VDC)	200/100 (2)	—
Ambient Temperature Range (ºC)	0 - 45	—
Speed Range (Ratio)	50:1 (3)	—
Load Regulation (Armature Feedback, % Base Speed)	±1	—
Load Regulation (Tachometer Feedback, % Set Speed)	±1	—
ACCEL and DECEL Range (Seconds)	0.1 - 15	1
IR COMP (VDC)	0 - 30	8
Current Limit Range, %	0 - 180	150
Timed Current Limit Range (Seconds)	0.5 - 15	7
Voltage Following Linearity (% Base Speed)	±0.5	—

Notes:

(1) Maximum recommended output voltage is 180VDC at 230VAC. Exceeding this output Voltage will cause a reduction in load regulation performance.

(2) For shunt wound motor with lower field voltage, use F+ and L1 connection.

(3) Consult motor manufacturers for constant torque speed range of motor. (Typical speed range for most 3HP DC motors is 20:1).

Figure 1-1 Cover Layout

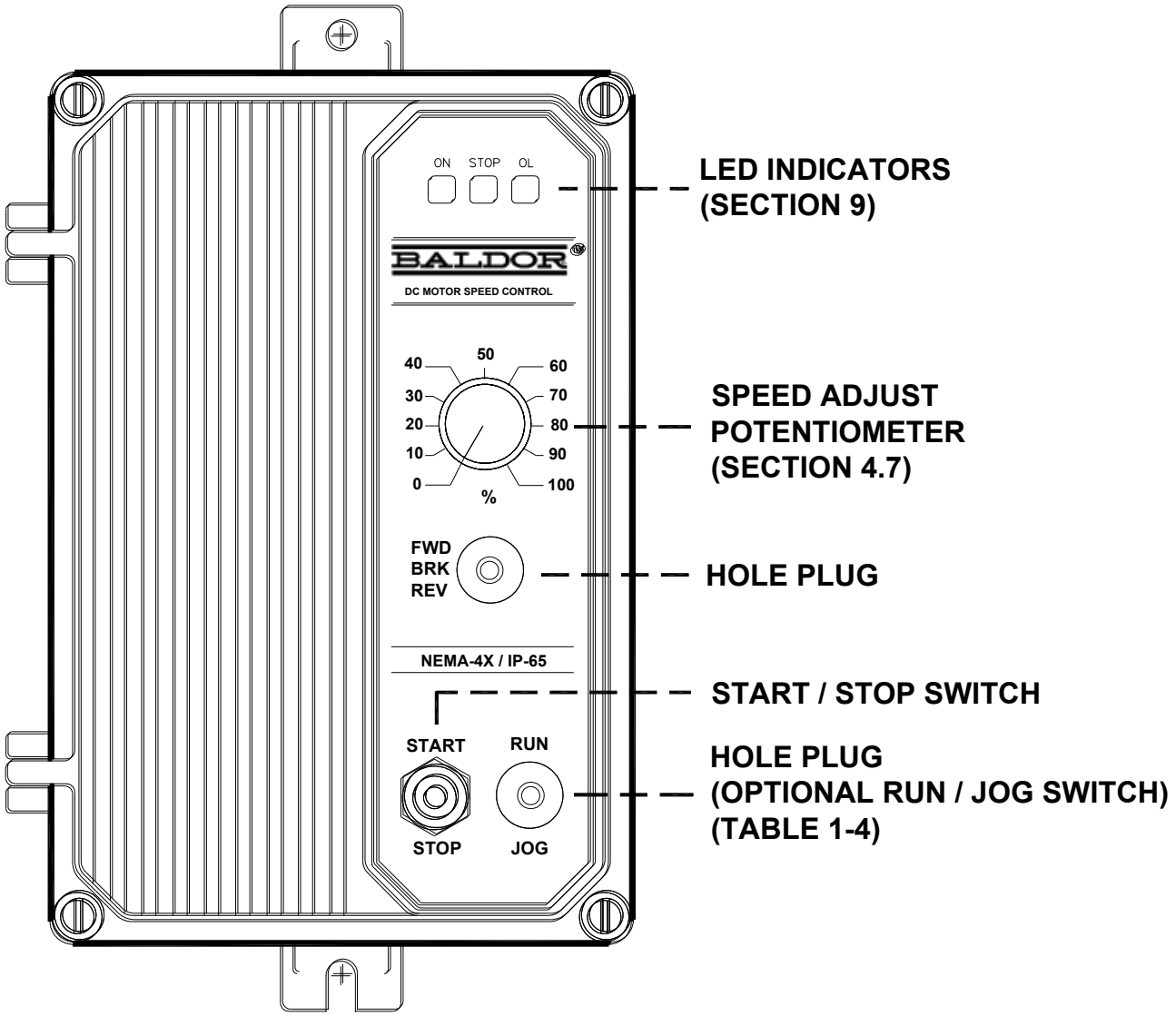
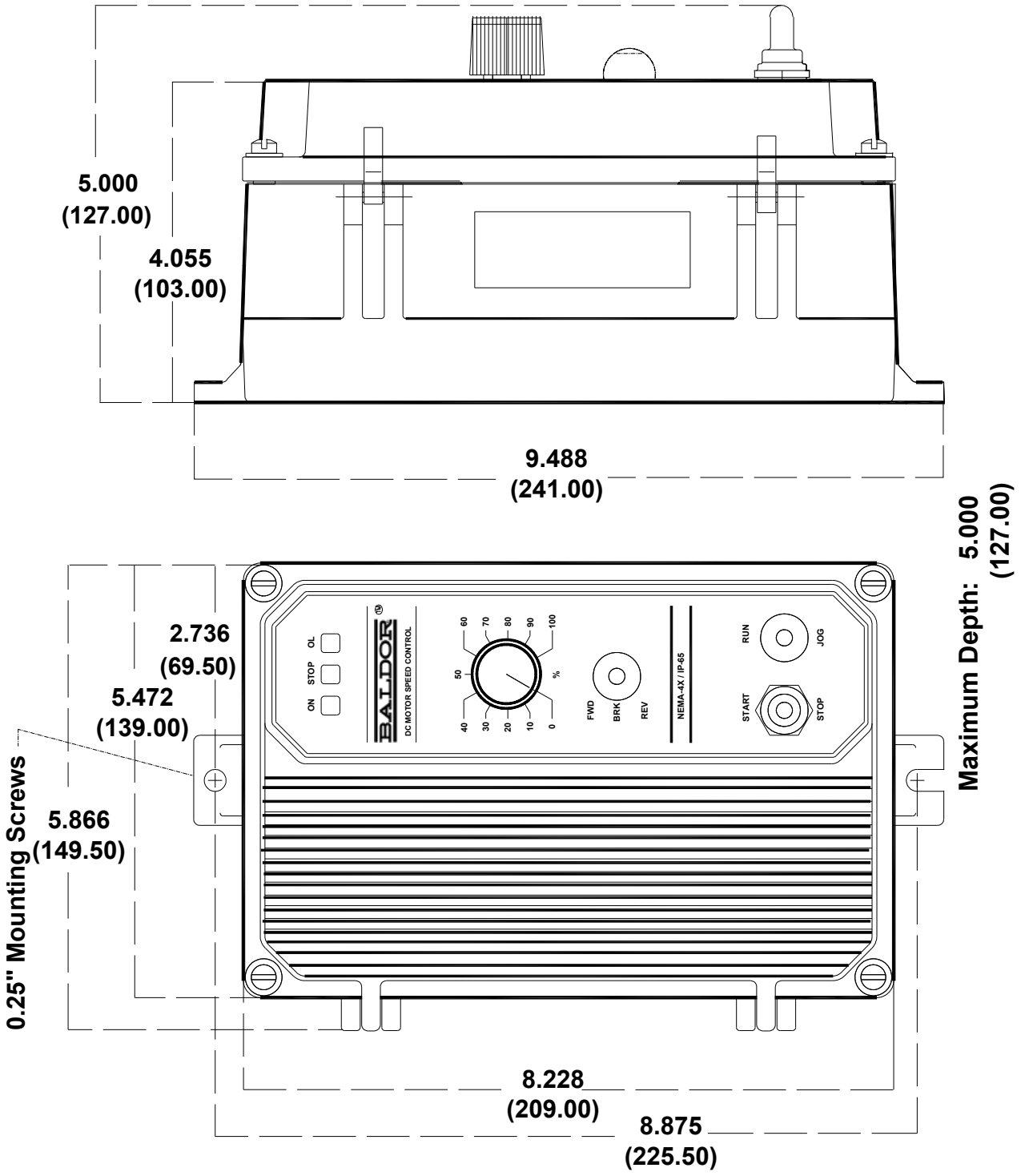


Figure 1-2 Mechanical Specifications



2. QUICK-START INSTRUCTIONS

Important: You must read these simplified instructions before proceeding. These instructions are to be used as a reference only and are not intended to replace the details provided herein. You must read the SAFETY NOTICES before proceeding.

2.1 CONNECTIONS (See Figure 2-1)

2.1.1 AC Line

Connect AC line voltage to terminals L1 and L2. Verify jumpers J2A and J2B are both set to the correct input line voltage, 115 or 230VAC. Connect ground wire (earth) to green ground screw terminal.

2.1.2 Motor (See Figure 2-1)

2.1.2.1 Permanent Magnet (PM) Type

Connect motor armature leads to A(+) and A(-). Be sure jumper J3 is set to the proper position “90V” for 90 volt DC motors and “180V” for 180 volt DC motors.

Note: 180 volt DC motors must be used with 230VAC line, 90 volt motors can be used with a 230VAC or 115VAC line. See Section 6.

2.1.2.2 Shunt Wound Motors

Connect motor armature as above. Connect full voltage shunt field wires (90 volt motors with 100 volt fields and 180 volt motors with 200 volt fields) to F(+) and F(-). Connect half voltage field wires (90 volt motors with 50 volt fields and 180 volt motors with 100 volt fields) to F(+) and L1. See Section 4.

2.2 SPEED OR TORQUE MODE

Jumper J1 is factory set for speed control operation (SPD). For torque control, set J1 to TRQ position.

2.3 TRIMPOT SETTINGS

All trimpots have been factory set in accordance with Figure 2-1. See Table 1-3 for descriptions.

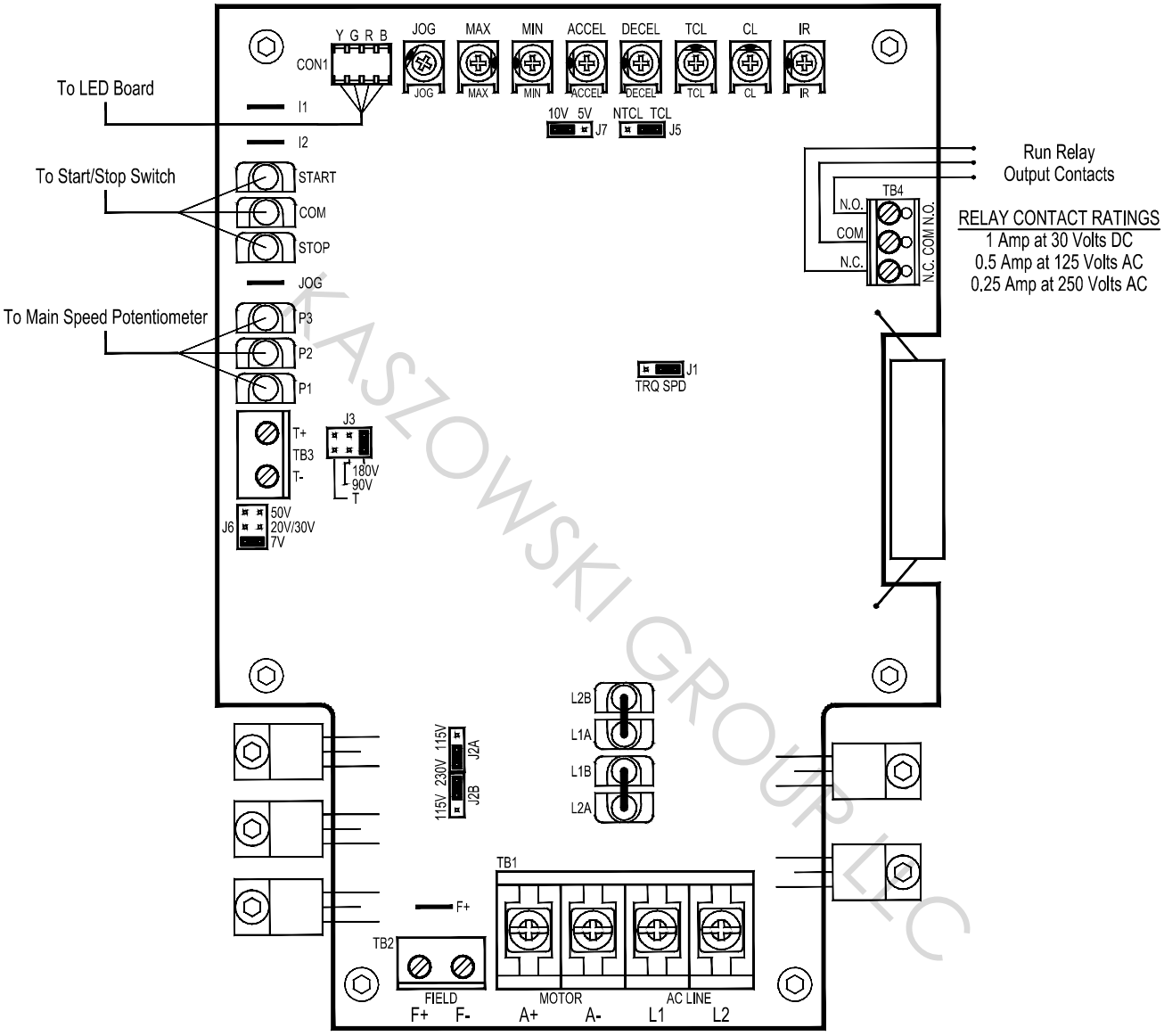
2.4 DIAGNOSTIC LED’s

After AC input power is applied, observe the LED’s on the Control Board, to verify proper control function. See Section 8.

2.5 FUSING

Install 25 amp - 250VAC fuses in both the AC Line and armature leads. See Section 4.

Figure 2-1 Control Layout



3. MOUNTING INSTRUCTIONS

WARNING! DO NOT USE THIS DRIVE IN AN EXPLOSIVE ENVIRONMENT. AN EXPLOSION CAN CAUSE SERIOUS OR FATAL INJURY. THIS DRIVE IS NOT EXPLOSION PROOF.

Mount the control in a vertical position on a flat surface. Be sure to leave enough room below the bottom of the control to allow for the AC line and motor connections. Although the control is designed for outdoor and washdown use, care should be taken to avoid extremely hazardous locations where physical damage can occur.

Mount the control in such a manner that there is unrestricted air flow through the heatsink cooling fins.

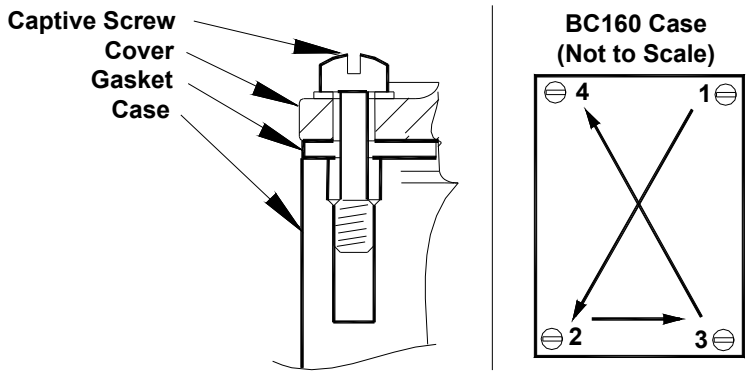
If the control is mounted in a closed, unventilated cabinet, remember to allow for proper heat dissipation. If full rating is required, a minimum enclosure size of 12” W x 24” H x 12” D should be used. See Figure 1-2, for dimensional specifications.

Front Cover - The BC160 is designed with a hinge so that when the front cover is open, all wiring stays intact. To open the cover, the four cover screws must be loosened, so they no longer are engaged in the case bottom.

Note: Front cover screws are captive type.

After mounting and wiring, close the front cover, making sure all connections are contained within the enclosure and the gasket is in place around the cover lip. Tighten all four over screws, in sequence, so that the gasket is slightly compressed. **Do not overtighten.** See Figure 3-1.

Figure 3-1 Captive Screw and Case



Tighten the four case captive screws in the 1- 4 sequence.
Torque Specification: 12 lb-in (14 kg-cm)

4. ELECTRICAL CONNECTIONS

WARNING! READ SAFETY NOTICE BEFORE ATTEMPTING TO USE THIS CONTROL. CONNECT THE CONTROL IN ACCORDANCE WITH THE NATIONAL ELECTRIC CODE REQUIREMENTS. BE SURE TO FUSE EACH CONDUCTOR WHICH IS NOT AT GROUND POTENTIAL. DO NOT FUSE NEUTRAL OR GROUNDED CONDUCTORS.

Note: A separate AC line switch, or contactor, must be connected as a disconnect switch, so that the contacts open each ungrounded conductor. (See Figure 4-1, for AC Line and Armature connection.)

To maintain the watertight integrity of the control, be sure to use suitable watertight connectors and wiring, which are appropriate for the application. Two .875" (22.2 mm) knockout holes are provided for a standard 1/2" knockout connector (not supplied) for wiring. A watertight plug is provided if only one knockout is used.

4.1 FUSING

4.1.1 AC Line Fusing

Most electrical codes require that each ungrounded conductor contain fusing. Separate branch circuit fusing, or circuit breaker may be required. Check all electrical codes that may apply to the installation. This control does not contain AC line fuses. 25 amp rated fuses or circuit breaker can be used.

4.1.2 Armature Fusing

It is suggested that an armature fuse be installed in series with an armature lead. Use a 25 amp 250V rated fuse or circuit breaker.

4.2 AC LINE

Connect AC Line to terminals L1 and L2. Verify jumpers J2A and J2B are both set to the correct input line voltage, 115 or 230VAC.

Notes:

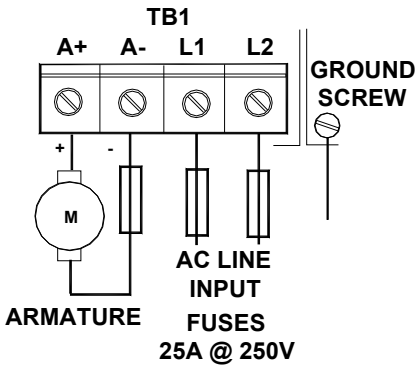
1. External 25A fuse must be added. See Figure 4-1.
2. Connect ground wire (earth) to Green Screw terminal on case.

4.3 MOTOR ARMATURE

Connect motor armature to terminals A(+) and A(–). See Figure 4-1. Be sure jumper J3 is set to the proper position "90V" for 90 volt DC motors and "180V" for 180 volt DC motors.

Note: 180 volt DC motors must be used with 230VAC line, 90 volt motors can be used with a 230VAC or 115VAC line. See Section 6.

Figure 4-1 Connection Diagram



Torque Specification:
12 lb-in (14kg – cm)

WARNING! DO NOT CONNECT SWITCHES OR RELAYS IN SERIES WITH THE ARMATURE. ARMATURE SWITCHING CAN CAUSE CATASTROPHIC FAILURE OF MOTOR AND/ OR CONTROL. DO NOT BUNDLE AC AND MOTOR WIRING WITH OTHER WIRES (e.g., POTENTIOMETER, ANALOG INPUT, ETC.)

4.4 FIELD (For Shunt Wound Motors Only)

Do not use terminals F+ and F- for any other purpose than to power the field on a shunt wound motor. Connect motor shunt field to terminals F+ and F- for full voltage fields, (90VDC motors with 100VDC fields or 180VDC motors with 200VDC fields). For motors with half voltage fields (90VDC motors with 50VDC fields or 180VDC motors with 100VDC fields), connect motor shunt field to terminals F+ and L1. See Table 4-1 for summary of field connections and Figures 4-2A and 4-2B for field connection diagrams.

CAUTION! Shunt-Wound motors may be damaged if field remains connected without motor rotating for an extended period of time.

Table 4-1 Field Connections (Shunt Wound Motors Only)

AC LINE VOLTAGE (VAC)	MOTOR VOLTAGE	FIELD VOLTAGE (VDC)	FIELD CONNECTION
115	90	100	F+, F-
115	90	50	F+, L1
230	180	200	F+, F-
230	180	100	F+, L1
230	90*	100	F+, L1

* Step Down Operation

Figure 4-2A Full Voltage Field

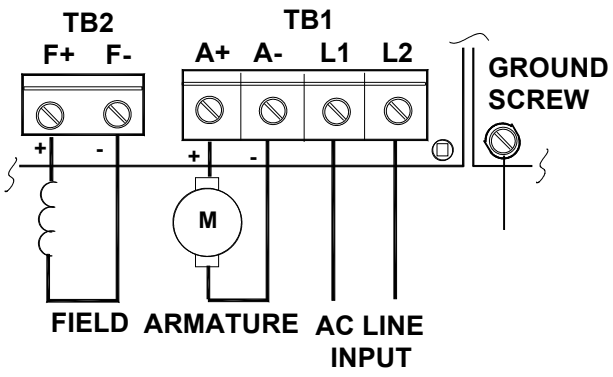
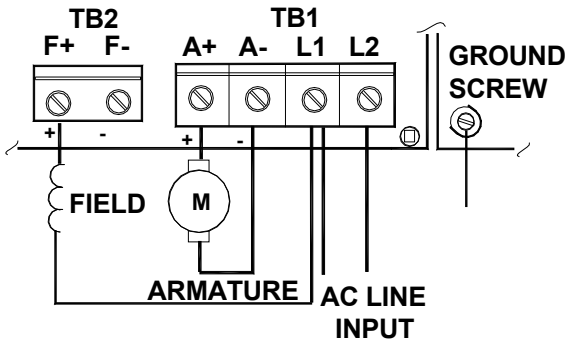


Figure 4-2B Half Voltage Field



Torque Specification: 12 lb-in (14 kg-cm)

4.5 GROUND

Be sure to ground (earth) the control by connecting a ground connection to the Green Ground Screw located to the right of the terminal block. See Figure 4-1, 4-2A or 4-2B.

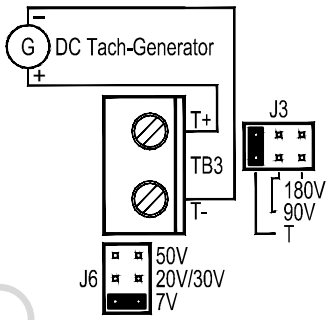
4.6 DC TACHOMETER INPUT

If tachometer feedback is required, an analog tach signal must be connected to the terminal block TB3. See Figure 4-3.

Note: For tachometer feedback, Jumper J3 must be set to the TFB position, jumper J6 must be set to the proper tach voltage, and the IR COMP must be set to minimum (ccw) position. See Section 7.2.6.

Connect the tachometer so that when the motor rotates in the desired forward direction, the positive tach voltage lead is connected to T+ and the negative tach lead is connected to T- (See Figure 4-3).

Figure 4-3 Tachometer Connection Diagram



Tachometer wires much be connected so that correct polarity is achieved when tach rotates in the desired forward direction.

Torque Specification: 12 lb-in (14 kg-cm)

WARNING: TO AVOID ERRATIC OPERATION, DO NOT BUNDLE AC LINE AND MOTOR WIRES WITH POTENTIOMETER, VOLTAGE FOLLOWING, ENABLE, INHIBIT OR OTHER SIGNAL WIRING. WSE SHIELDED CABLES ON ALL SIGNAL WIRING OVER 12", (30CM) - DO NOT GROUND SHIELD.

4.7 REMOTE SPEED REFERENCE

The control is supplied with the main speed potentiometer prewired. However, the control can also be operated from a remote potentiometer, or from an Isolated analog voltage for voltage following. To operate from an external source remove white, orange and violet potentiometer leads from terminals P1, P2 and P3. The leads may be taped and left in the control. The potentiometer itself may be removed, provided a watertight seal is used to cover the hole in the front cover.

4.7.1 Remote Potentiometer (5K Ohms)

Connect remote potentiometer wires to terminals P1, P2 and P3, so that the "high" side of the potentiometer connects to P3, the "wiper" to P2 and the "low" side to P1. See Figure 4-4A.

4.7.2 Analog Input

An isolated 0-5 or 0-10VDC analog voltage can also be used to control speed. See Figure 4-4B.

Figure 4-4A Remote Potentiometer Connection 5K

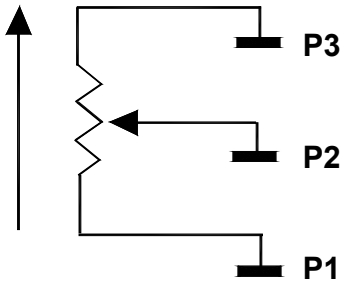
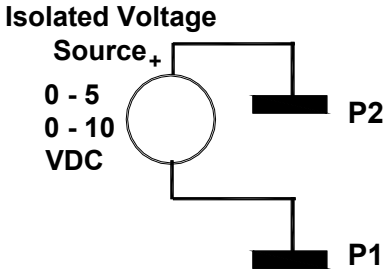


Figure 4-4B Analog Voltage Connection



Notes:

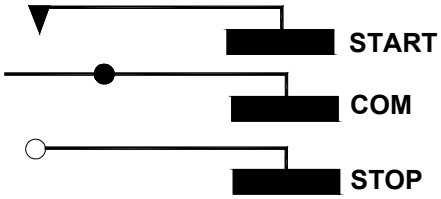
1. If the available analog speed reference signal voltage is not isolated, an optional Signal Isolator Board, model BC145, may be installed. Reference: Instruction Manual MN1373, BC145 Signal Isolator Board.
2. When using an external analog signal, the main speed potentiometer must be disconnected from terminals P1, P2, and P3. The MIN trimpot may need to be adjusted to achieve 0 output voltage.

4.7.3 Remote Start/Stop Switch

A remote Start/Stop Switch may be installed by disconnecting the wires from the “Start”, “Com”, and “Stop” terminals, and reconnecting the terminals to a remotely mounted switch. (See Figure 4-5).

Note: The Start/Stop function may be bypassed by connecting a jumper wire across the “Start” and “Com” terminals.

Figure 4-5 Remote Start/Stop Switch Connection



WARNING! WHEN A JUMPER IS INSTALLED, THE DRIVE AND MOTOR WILL START AND RUN WHEN THE AC SUPPLY POWER IS APPLIED, WHEN POWER IS RESTORED AFTER MOMENTARY POWER LOSS, OR AFTER AN OVERLOAD OR TCL FAULT IS RESET. THE USER MUST INSURE THAT THE AUTOMATIC START UP OF THE DRIVEN EQUIPMENT WILL NOT CAUSE INJURY TO OPERATING PERSONNEL OR DAMAGE TO THE DRIVEN EQUIPMENT. THE USER IS RESPONSIBLE FOR PROVIDING SUITABLE AUDIBLE OR VISUAL ALARMS OR OTHER DEVICES TO INDICATE THAT THE DRIVE MAY START AT ANY MOMENT. FAILURE TO OBSERVE THIS WARNING COULD RESULT IN SEVERE BODILY INJURY OR LOSS OF LIFE.

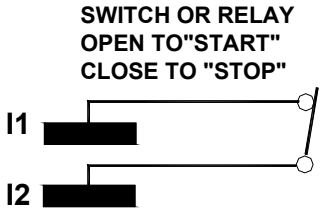
WARNING! DO NOT USE START/STOP, INHIBIT OR ENABLE FUNCTIONS AS A SAFETY DISCONNECT. USE ONLY AN AC LINE DISCONNECT FOR THAT PURPOSE.

4.7.4 Inhibit

The control can be electronically stopped and started with the Inhibit circuit. To “Stop” the control, Terminals I1 & I2 must be connected as shown via a contact. The control can be restarted by opening the contact. (See Figure 4-6A).

Note: The Inhibit Circuit is not isolated. Do not common or ground inhibit leads.

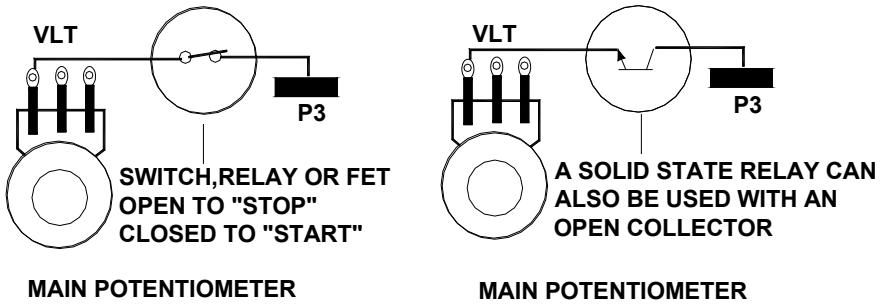
Figure 4-6A Inhibit Circuit Wiring



4.7.5 Enable

The control can also be started and stopped with an Enable circuit (the Enable circuit functions opposite to that of the inhibit circuit; Inhibit: open to start, close to stop, Enable: open to stop, close to start). The Enable function is established by connecting a contact in series with the violet potentiometer lead, connected to terminal P3. The Enable circuit is not isolated. Do not common or ground Enable connection. See Figure 4-6B.

Figure 4-6B – Enable Circuit Wiring



Note: The MIN speed trimpot must not be set higher than 70% CW rotation (approximately 2:00 o'clock position) or Enable will not function.

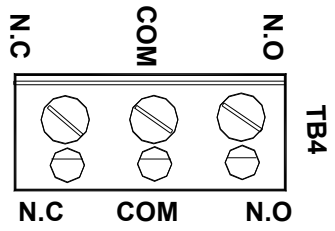
4.8 RUN/FAULT RELAY CONNECTION

The Run/Fault Relay, K1, Output Contacts are located at TB4 and can be used to turn on or off equipment. See Figure 4-7.

The Run/Fault Relay Contact status for various drive operating conditions is shown in Table 4-2.

Relay Contacts Ratings: 1 Amp at 30 Volts DC, 0.5 Amps at 125 Volts AC, and 0.25 Amps at 250 Volts AC.

Figure 4-7 – Run/Fault Relay Connections



N.O - Normally Open
COM - Common
N.C - Normally Closed

Torque Specification: 12 lb-in (14 kg-cm)

Table 4-2 Drive Operating Condition and Run/Fault Relay Contact Status

Drive Operating Condition	Description	Run Relay Operation (J5 Installed in "NTCL" Position) (Factory Setting)		Fault Relay Operation (J5 Installed in "TCL" Position)	
		Normally Open Contact	Normally Closed Contact	Normally Open Contact	Normally Closed Contact
Power Off	Main Power Disconnected	Open	Closed	Open	Closed
Run Mode	Normal Drive Operation	Closed	Open	Closed	Open
Stop Mode	Selected by Operator	Open	Closed	Open	Closed
Fault*	Drive Tripped	-	-	Open	Closed

Note: *TCL Fault.

5. IMPORTANT APPLICATION INFORMATION

WARNING! DO NOT USE THIS DRIVE IN AN EXPLOSIVE ENVIRONMENT. AN EXPLOSION CAN CAUSE SERIOUS OR FATAL INJURY. THIS DRIVE IS NOT EXPLOSION PROOF.

5.1 MOTOR TYPE

The BC160 is an SCR DC motor control used to operate Permanent Magnet, (PM), and Shunt Wound DC motors. Do not use the control in applications where specified ratings would be exceeded. Reference Tables 1-5 and 1-6.

5.2 TORQUE REQUIREMENTS

When replacing an AC induction motor with a DC motor and speed control, consideration must be given to the maximum torque requirements. The full load torque rating of the DC motor must be equal to, or greater than, that of the AC motor.

CAUTION! Be sure the BC160 is used within its maximum ratings. Follow all installation instructions carefully (See Table 1-6).

6. SETTING SELECTABLE JUMPERS

This control has selectable jumpers which can be changed to accommodate various applications. Jumpers must be set before the control can be used. See Figure 2-1 for location of jumpers.

Note: Jumpers J2 and J4 have not been installed in this control. Factory setting for J1 is Speed Mode. Refer to Figure 2-1.

6.1 SPEED AND TORQUE MODE - J1

6.1.1 Speed Control Mode

When Jumper J1 (See Figure 6-1) is placed in the "SPD" position the drive will control motor speed as a linear function of the main speed potentiometer setting or analog voltage input. The range of output speed can be adjusted with the MIN and MAX trimpots. The motor will maintain the preset speed as long as the maximum load does not exceed the current limit set point. If the motor load exceeds the current limit setting, the Overload LED will turn on and the motor will stall. See Figure 6-2A below and 6-2B.

Figure 6-1 Jumper Position

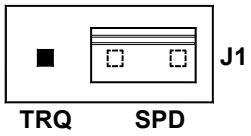


Figure 6-2A Motor Speed vs. Potentiometer Rotation

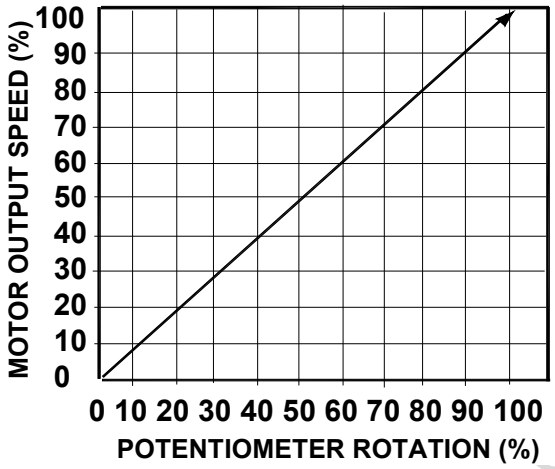
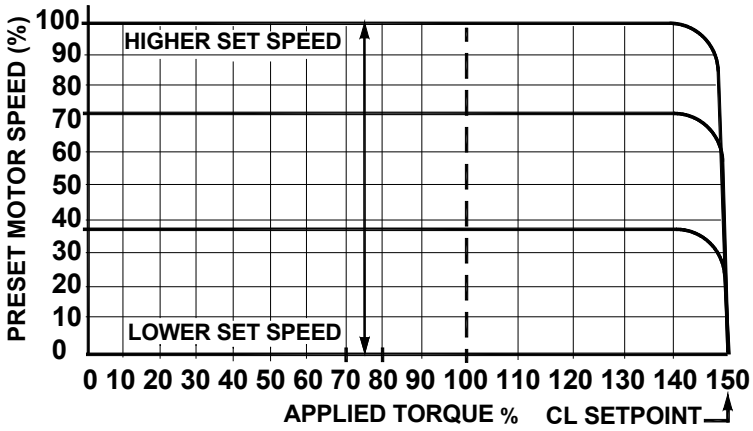


Figure 6-2B Motor Speed vs. Motor Load



6.1.2 Torque Control Mode

When Jumper J1 (See Figure 6-1) is placed in the “TRQ” position, the drive will control motor torque as a linear function of main potentiometer rotation. If the motor load exceeds the torque setting, the motor will stall, the Overload LED will light, and the drive will apply a constant preset torque based on the potentiometer setting. The Overload LED will light when the load torque approaches the current limit set point. The torque limits are set via the CL trimpot. See Figures 6-3A below and 6-3B.

Note: When operating in the Torque Mode, Jumper J5 must be in the “NTCL” position or drive will shut down when CL Timer, times out.

Figure 6-3A Motor Output Torque vs. Potentiometer Rotation

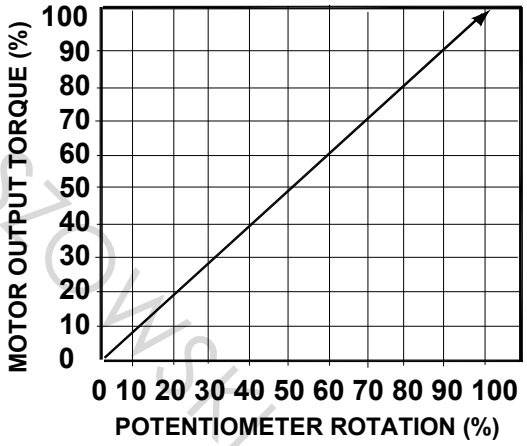
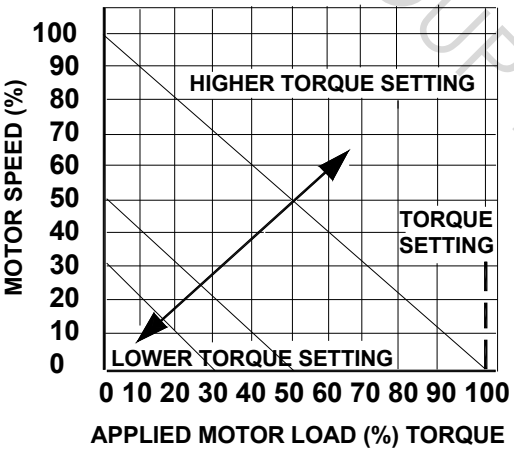


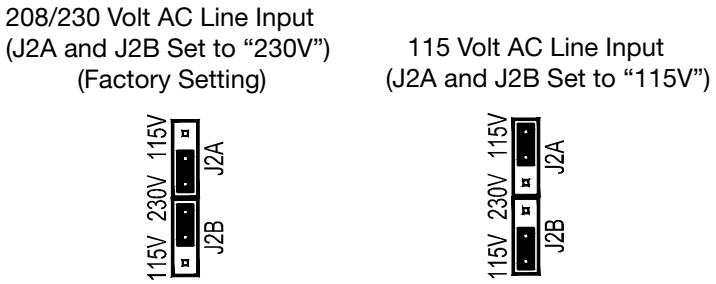
Figure 6-3B Preset Motor Speed vs. Applied Motor Load



6.2 AC INPUT LINE VOLTAGE - JUMPERS J2A, J2B

Select the proper input line voltage, 115VAC or 230VAC by placing both, J2A and J2B in the correct positions, “115V” or “230V”. See Figure 6-4.

Figure 6-4 AC Line Input Voltage Selection (Jumpers J2A and J2B)



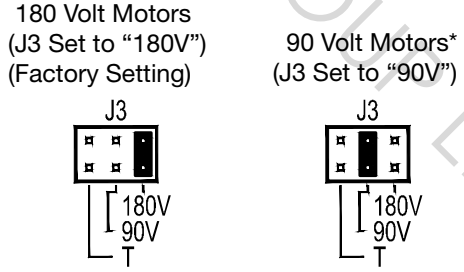
6.3 ARMATURE VOLTAGE/TACHOMETER FEEDBACK- JUMPER J3

Select the desired armature voltage by placing J3 in the proper position, “90V” for 20 - 130VDC motors or “180V” for 180 - 220VDC motors. For 115VAC line input the armature voltage must be set to “90V”. See FIgure 6-5.

For 230VAC line input, the Armature Voltage is normally set to “180V”. However, it is also possible to operate in a Step-Down Mode, (90 -180VDC motor with a 230VAC line), by setting J3 to “90V”. However, reduced performance may result.

If Tachometer feedback is to be used, J3 must be placed in the “T” position and an external DC tachometer must be connected. See Section 4.6 and Section 6.5 for additional information.

Figure 6-5 Motor Voltage Selection (Jumper J3)



*Use “90V” setting for Step-Down Operation (90 Volt DC Motors with 208/230 Volt AC Line input).

Table 6-1 Relationship of AC Line Input and Motor Voltage with Jumper J2 and J3 Position

AC Input Voltage	J2A, J2B Position	J3 Position**	Motor Voltage
115	115	90	90
230	230	180	180
230	230	90*	90*

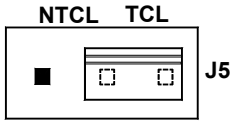
* A 90VDC motor can be used with a 230VAC line. However, speed range may be reduced and motor derating may be required.

** Position J3 to “T” if tachometer feedback is used.

6.4 CURRENT LIMIT MODE - J5

(Factory set for “TCL”) This control contains electronic current limiting which limits the maximum DC current to the motor (the current limit set point is established with the setting of the CL trimpot). Two modes of current limit operation are provided:

Figure 6-6 J5 (Jumper Position)



6.4.1 Timed Current Limit “TCL”

In this mode the drive will turn off after being in current limit for a preset time. This time period is adjustable with the TCL trimpot from 0.5-15 seconds and is factory set for approximately seven (7) seconds. This provides motor overload protection. See Figure 6-6.

Application Note

After the control times out in TCL, it can be reset using the Start Switch by setting the switch to the “STOP” position and then to “START,” or by disconnecting and reconnecting the AC line. If the Start Switch is jumpered out, the control can be restarted after timing out in TCL, by cycling the AC power On and Off.

6.4.2 Non-Timed Current Limit “NTCL”

In this mode the drive will reach the preset current limit during overload and stay at that level until a fuse blows or the drive is manually turned off. If non-timed CL operation is desired, move jumper J5 from the factory set “TCL” position to the “NTCL” position. The NTCL position must be used when operating in the Torque Mode. See Figure 6-6.

6.5 TACHOMETER VOLTAGE - J6

Note: Selection of this jumper position is not required if tachometer feedback is not used.

If tachometer feedback is used, select the J6 position (See Figure 6-7) (7V, 20/30V, 50V) which corresponds to the tachometer voltage in Volts/1000 RPM. The selection of J6 position is based on a maximum motor speed of 1800 RPM. If other than standard tachometer voltages and motor speeds are used, an external resistor (RT) may be used (1/2 watt rating). Refer to the following:

6.5.1 Place J6 in “7V” position

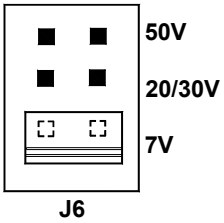
6.5.2 Calculate the value of (RT) as follows:

RT = [(0.9 x VT x S) - 20,000] ohms
VT = Tach Voltage in Volts/1000 RPM
S = Base speed of motor in RPM

6.5.3 Install resistor (RT) in series with either tachometer lead

Note: For tachometer feedback, Jumper J3 must be in the “T” position, and IR Comp trimpot must be set to minimum (ccw) position.

Figure 6-7 J6 (Jumper Position)

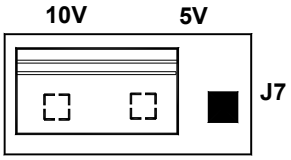


6.6 SIGNAL INPUT VOLTAGE - J7

The output of this control is normally controlled with the main speed adjust potentiometer. However, an Isolated analog voltage may also be used in place of a potentiometer. The control can be scaled for either a 0-5VDC or 0-10VDC by placing J7 in the appropriate position “5V” or “10V”. The scaling can be further adjusted with the “Max” trimpot. See Figure 6-8.

Note: If an Isolated input signal is not available an accessory Signal Isolator Model BC145 can be installed. The BC160 accepts a wide range of signal voltage and current. An Installation Kit (BC158) containing Auto/Man Switch and required wiring is also available.

Figure 6-8 J7 (Jumper Position)



7. START-UP AND ADJUSTMENT

WARNING! READ SAFETY NOTICES BEFORE ATTEMPTING TO OPERATE THE CONTROL OR SEVERE INJURY OR DEATH CAN RESULT. FAILURE TO FOLLOW THE SAFETY NOTICES MAY RESULT IN ELECTRIC SHOCK, FIRE OR EXPLOSION.

Once the control has been set up properly with the jumpers set to the desired positions, and the electrical connections have been completed, apply AC power. Observe the “ON” LED and the “STOP” LED indicators are illuminated. Before starting, be sure the main speed adjust potentiometer is fully CCW.

7.1 VERIFY CORRECT DIRECTION OF MOTOR ROTATION

WARNING! BE PREPARED TO STOP THE DRIVE WITH THE STOP SWITCH OR BY DISCONNECTING THE AC POWER IF MOTOR DIRECTION IS INCORRECT. IF A TACHOMETER IS CONNECTED AND THE TACHOMETER FEEDBACK SIGNAL POLARITY IS REVERSED, THE MOTOR MAY ACCELERATE TO A HIGH RATE OF SPEED. FAILURE TO OBSERVE THIS WARNING MAY RESULT IN EQUIPMENT DAMAGE OR BODILY INJURY.

To start the control, move the START/STOP switch to the “START” position and release. The “STOP” LED should extinguish and the motor should rotate as the potentiometer knob is rotated clockwise. Verify the motor shaft is rotating in the desired “forward” direction. If the direction of rotation is wrong, stop the drive and disconnect AC power. Switch the A+ and A- motor leads. If a tachometer is connected, the leads may also need to be switched for correct signal polarity.

7.2 TRIMPOT ADJUSTMENTS

The control contains trimpots which have been factory adjusted for most applications. Figure 2-1 illustrates the location of the trimpots and their approximate adjustment positions. Some applications may require re-adjustment of the trimpots in order to tailor the control to exact requirements. See Table 1-3 for range and factory setting of all trimpots. Re-adjust trimpots as follows:

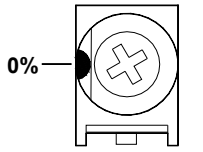
WARNING! DO NOT ADJUST TRIMPOTS WITH MAIN POWER ON IF POSSIBLE. IF ADJUSTMENTS ARE MADE WITH POWER ON, INSULATED ADJUSTMENT TOOLS MUST BE USED AND SAFETY GLASSES MUST BE WORN. HIGH VOLTAGE EXISTS IN THIS CONTROL. ELECTROCUTION AND/OR FIRE CAN RESULT IF CAUTION IS NOT EXERCISED. SAFETY WARNINGS MUST BE READ AND UNDERSTOOD BEFORE PROCEEDING.

7.2.1 Minimum Speed (MIN)

The MIN trimpot is used to set the minimum voltage of the drive. This sets the minimum speed of the motor (See Figure 7-1). Adjust the MIN trimpot as follows:

a. Rotate Main potentiometer, to minimum speed position (full counterclockwise).
b. Increase setting of the MIN trimpot so that motor runs at desired minimum speed.

Figure 7-1 Minimum Speed Trimpot Range

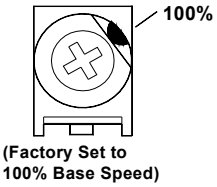


7.2.2 Maximum Speed (MAX)

The MAX trimpot is used to set the maximum voltage of the drive. This sets the maximum speed of the motor. Use the MAX trimpot to change the factory setting. (See Figure 7-2).
Adjust the MAX trim pot as follows:

a. Rotate the Main potentiometer to maximum speed position (full clockwise).
b. Adjust MAX trimpot setting to desired setting of motor speed.

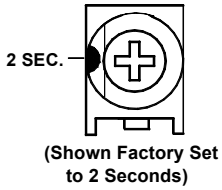
Figure 7-2 Maximum Speed Trimpot Range



7.2.3 Acceleration (ACCEL)

The ACCEL trimpot sets the amount of time it takes the control to reach full output. The acceleration circuit operates when rapidly rotating the main speed potentiometer to full clockwise position, or when starting the control when the main speed potentiometer is rotated clockwise. The trimpot is factory set to 2 seconds. If more rapid acceleration is desired, rotate the trimpot counterclockwise. (See Figure 7-3).

Figure 7-3 Acceleration Trimpot Range

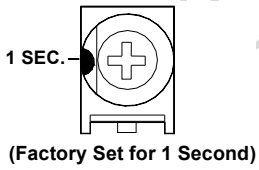


Note: Rapid ACCEL setting may cause the current limit circuit to activate which will extend the acceleration time. For a longer acceleration time, rotate ACCEL trimpot clockwise. 50% rotation represents approximately seven (7) seconds and full rotation is approximately fifteen (15) seconds.

7.2.4 Deceleration (DECEL)

The DECEL trimpot sets the amount of time it takes the control to go from full speed to minimum speed when rotating the main potentiometer CCW. The trimpot is factory set to one 1 second, and can be readjusted to full counterclockwise position for more rapid DECEL. (See Figure 7-4).

Figure 7-4 Deceleration Trimpot Range



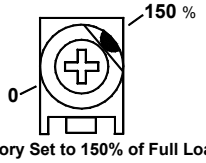
Notes:

1. On high inertial loads, a rapid DECEL setting may cause the motor to coast to a stop slower than the DECEL setting. To increase deceleration time, rotate DECEL trimpot clockwise. 50% rotation represents approximately seven (7) seconds and full rotation is approximately fifteen (15) seconds.
2. The Deceleration circuit works when rotating the main speed pot in the CCW direction or when opening the P3 lead of the main pot or when placing the Start/Stop switch to the STOP position. It does not operate when power is removed.

7.2.5 Current Limit (CL)

This trimpot is used to set the maximum amount of DC current that the motor can draw. The amount of DC current determines the amount of maximum motor torque in both the Speed Control Mode and Torque Mode. The CL trimpot is factory set at 150% of the motor current. Also see Section 8.1-C. The value can be set to a lower value by adjustment of the CL trimpot. Some applications require a lower torque limiting value so as not to damage the process material or the drive train. (See Figure 7-5).

Figure 7-5 Current Limit Trimpot Range



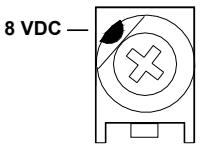
CAUTION! Adjusting the CL above 150% of motor rating can cause overheating and demagnetization of some PM motors. Consult motor manufacturer.

7.2.6 IR Compensation (IR)

The IR comp circuit is used to stabilize motor speed under varying loads. (See Figure 7-6).

Note: If control is in Tach Feedback mode, the IR trimpot should be set to minimum - ccw.

Figure 7-6 IR Compensation Trimpot Range



Factory Set to 8 Volts DC for Controls with 180 Volt DC Output.

Re-adjust the IR trimpot as follows:

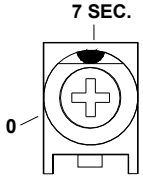
a. Run the motor at approximately 30-50% of rated speed under no load and measure actual speed.
b. Load the motor to rated current. Rotate IR trimpot so that the loaded speed is the same as the unloaded speed measured in step 7.2.5. Control is now compensated so that minimal speed change will occur over a wide range of motor load.

Note: Too much IR Comp will cause unstable (oscillatory) operation.

7.2.7 Timed Current Limit (TCL)

Jumper J5 must be in the “TCL” position, in order for Timed Current Limit to be operational. This trimpot determines the approximate amount of time the drive will stay in Current Limit before trip out. The trimpot has an adjustment range of .5-15 seconds and is factory set for seven (7) seconds. The trimpot can be reset according to the desired trip time. Rotating the trimpot clockwise, increases the trip time. (See Figure 7-7) This function provides motor overload protection. See Section 6.4.1, and “Application Note,” for TCL, Operation.

Figure 7-7 Timed Current Limit Trimpot Range



(Factory Set to 7 Seconds)

7.2.8 Jog Speed (JOG)

The trimpot is only operational when the optional RUN-STOP-JOG Switch (BC157) is installed. In the JOG position the JOG trimpot can be adjusted to the JOG speed See Figure 7-8.

Figure 7-8 Jog Speed Trimpot Range

8. DIAGNOSTIC LEDs

WARNING! DO NOT DEPEND ON PANEL MOUNTED LED'S, AS A GUARANTEED POWER OFF CONDITION. BE SURE THE MAIN POWER SWITCH OR CIRCUIT BREAKER IS IN THE "OFF" POSITION BEFORE SERVICING THE DRIVE.

8.1 The front cover contains three LED Indicator Lamps that show the control operational status. The LED indicators are connected to the main board via CON1. See Figure 2-1.

A. Power On Indicator (ON) – This lamp will glow GREEN when the AC power is applied to the control.

B. Stop Indicator (STOP) – This lamp will glow YELLOW when the control is placed in the STOP mode with the START/STOP Switch. This indicator remains off if the control was running and INHIBIT is asserted or if ENABLE is open.

C. Overload Indicator (OL) – When the motor is loaded to the current limit setpoint, this lamp will glow RED. If the control is allowed to stay in CL and then trips out in Timed Current Limit, the OL LED will remain lighted until the control is stopped and restarted with the START/STOP switch. If the OL LED remains illuminated during control operation, a fault condition may exist. Possible causes and solutions for these conditions may be found in Table 9-1.

Note: In some applications, especially those requiring the motor to cycle on and off or, changing from one speed to another, the OL indicator may blink indicating a transient overload. This may be a normal condition for the application.

9. TROUBLESHOOTING

WARNING! HIGH VOLTAGE IS PRESENT IN THIS DRIVE. DISCONNECT MAIN POWER BEFORE MAKING CONNECTIONS TO THE DRIVE. THE COVER MUST BE PROPERLY SECURED, AFTER ALL SETUP CONNECTIONS, AND ADJUSTMENTS ARE COMPLETE. IT REDUCES ELECTRICAL SHOCK HAZARD. FAILURE TO OBSERVE THIS WARNING COULD RESULT IN ELECTRICAL SHOCK OR ELECTROCUTION.

WARNING! HIGH VOLTAGE IS PRESENT IN THE DRIVE. IF POSSIBLE, DO NOT ADJUST TRIMPOTS WITH THE MAIN POWER APPLIED. IF ADJUSTMENTS ARE MADE WITH THE MAIN POWER APPLIED, AN INSULATED ADJUSTMENT TOOL (PROVIDED) MUST BE USED AND SAFETY GLASSES MUST BE WORN. FIRE AND/OR ELECTROCUTION CAN RESULT IF CAUTION IS NOT EXERCISED.

Important Note: If the tach voltage is connected backwards, the control will drive the motor at full speed only.

9.1 TROUBLESHOOTING GUIDE

Table 9-1 provides information on symptoms, possible causes, and the suggested troubleshooting solutions for the drive.

Table 9-1 Troubleshooting Guide

Indication / Symptom	Possible Solutions
Motor is not running or, STOP LED indicator is illuminated.	START-STOP Switch is in the STOP position. If so, move the START-STOP Switch to the START position.
	The Main Speed Potentiometer is set to zero speed. Set the Main Speed Potentiometer for the desired speed.
	The Main Speed Potentiometer, signal input, or motor connections are open. Verify Main Speed Potentiometer, signal input, or motor connections.
Motor runs then stops after a short time or, the drive trips due to overload (TCL Fault).	The drive must be manually restarted by disconnecting and reconnecting the AC power. Reduce load.
Line fuse blows or circuit breaker trips.	The line fuse or circuit breaker installed is the incorrect rating. See Table 1-5 for the correct line fuse or circuit breaker rating.
	Verify that motor is not damaged and shaft is free to rotate. Check wiring between control and motor for damaged insulation or loose connections. Check for overload conditions.
OL LED indicator is illuminated.	Motor is overloaded. Check motor amps with DC ammeter in series with armature. (If motor is shunt type, field may be open or not receiving proper voltage.)
	Check motor for shorts or grounds. Motor may be defective.
	Check position of CL trimpot. The CL may be set too low.
	Rapid Acceleration change will cause the LED to illuminate. Verify potentiometer setting.
Power ON LED indicator is not illuminated.	Check to see if the AC Line connections have been made.
	Check AC Line fuse.
Motor runs at high speed and does not respond to the main speed adjust pot or remote speed signal.	Check position of Jumper, J3. If tachometer is connected, verify signal polarity.
Note: For any other problems, consult the factory representative.	

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FAX : +86 21 5760 5336

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FAX: +49 2234 3794164

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