BESELER

INSTRUCTION MANUAL

TD-20/30 SERIES

SHRINK TUNNELS

PARTS DEPARTMENT 1-800-690-5110

CHARLES BESELER COMPANY

SHRINK PACKAGING MACHINERY DIVISION

PH: 800-237-3537 FAX: 800-966-4515

RD 2, WEST MAIN STREET STROUDSBURG, PA 18360

INTRODUCTION

Congratulations on the receipt of your new Beseler Shrink tunnel. This tunnel was designed with the latest state of the art electronic features available in shrink packaging machinery. Among them are Digital P.I.D. Temperature Control for the most accurate of temperature, variable speed conveyor belt and variable air flow adjustments that can be electronically controlled with precise accuracy. This tunnel has the most desired features available in packaging equipment. *STRENGTH RELIABILITY LOW MAINTAINENCE.* Beseler's reputation to produce quality for over 50 years.

Your shrink tunnel has met Beseler's strict standards of quality prior to leaving the factory. The unit is simple to operate and requires very little maintenance. However, we at Beseler, caution you, your operating and maintenance personnel not to attempt to install, adjust or operate the tunnel without first reading the contents of this manual. You can be assured that this machine will provide exceptional service for many years when operated properly and if appropriate care is maintained.

Upon receipt, remove the Tunnel from the shipping packaging and inspect for possible damage. If any damage is noted, contact the delivery carrier immediately, regardless of the external condition of the packaging. Do nothing further until the carrier's agent has made an inspection and evaluation (if necessary) of the damage to the unit. Also, do not destroy packaging materials or boxes until the carrier's agent has examined them. If no damage is evident, proceed with the installation.

TD20/30 SERIES TUNNEL	
BEARING, BLOWER WHEEL SHAFT TD-20	560-70-24
BEARING, BLOWER WHEEL SHAFT TD-30	560-70-25
BEARING, DRIVE ROLLER	560-70-21
BEARING, FLANGES FOR DRIVE ROLLER (REQUIRES 2 PER BEARING)	560-70-10-02
BEARING, MOUNTING PLATE, blower shaft - front TD-20	10-19359-01
BEARING, MOUNTING PLATE, blower shaft - rear TD-20	10-19359-02
BEARING, MOUNTING PLATE, blower shaft - front TD-30	10-19783-01
BEARING, MOUNTING PLATE, blower shaft - rear TD-30	10-19783-02
BELT, CONVEYOR MESH (19") TD-20	10-19507-02
BELT, CONVEYOR MESH (28") TD-30	10-19507-03
BELT, TIMING DRIVE ROLLER TO conveyor motor	562-32-02
BELT, V MOTOR TO BLOWER WHEEL SHAFT	562-36-02
BLOWER WHEEL (SQUIRREL CAGE) TD-20	10-19409
BLOWER WHEEL (SQUIRREL CAGE) TD-30	620-50-18
BLOWER WHEEL HOUSING TD-20/30	10-19882
BOLT, CONVEYOR BELT TENSION ADJUSTER	527-68-40-01
CASTER TD-20	570-20-02
CASTER TD-30	570-20-07
CIRCUIT BREAKER 1 PH 60 AMP TD-20	610-70-25
CIRCUIT BREAKER 3 PH 40 AMP TD-20	610-70-24
CIRCUIT BREAKER 3 PH 60 AMP TD-20-19 TD30-12	610-70-35
CIRCUIT BREAKER 3 PH 70 AMP TD-20-26 TD30-19 TD-30-26	610-70-34
CIRCUIT BREAKER 3 PH 25 AMP 460VOLT	610-70-02
CIRCUIT BREAKER MOUNTING BRACKET	610-30-18
CRIMP CONNECTOR (RING) HIGH TEMP	600-40-42
CURTAINS T-20-12 INSIDE 1 PER PACK PER SIDE	10-19669-12
CURTAINS T-20-12 OUTSIDE 2 PER PACK PER SIDE	10-19669-14
CURTAINS T-20-19 INSIDE 1 PER PACK PER SIDE	10-19669-15
CURTAINS T-20-19 OUTSIDE 2 PER PACK PER SIDE	10-19669-16
CURTAINS T-30-12 INSIDE 1 PER PACK PER SIDE	10-19669-10
CURTAINS T-30-12 OUTSIDE 2 PER PACK PER SIDE	10-19669-09
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DEFLECTOR AND BAFFLE ASSEMBLY	10-19448-02
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ELECTRICAL COVER FOR (4X4) BOX	10-19881
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FUSE 1.5 AMP	600-62-27
FUSE 15 AMP	600-62-38
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INSULATION, PANELS 3 REQUIRED	502-70-03
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LEGS (ADJUSTABLE) RIGHT TD-20	10-19594-01
LEGS (ADJUSTABLE) TD-30	10-19573
LOCK NUT FOR FITTING	600-90-13
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METAL FASTENERS INTERNAL STRAPS	10-19502
MOTOR, BLOWER AC 3 PHASE INVERTER DUTY 1 HP	615-42-28
MOTOR, BRUSHES FOR CONVEYOR	640-45-11
MOTOR, CONVEYOR WITH GEAR BOX	615-40-11
PULLEY, BLOWER MOTOR	10-19952
PULLEY, BLOWER WHEEL	10-19957
RELAY CONTACTOR	610-60-15
RELAY CUBE	610-50-32
RELAY CUBE BASE	610-50-31
RELAY SOLID STATE	610-50-05
RISER BAR TD-20	10-19574-02
ROLLER, DRIVE TD-20	562-66-27
ROLLER, DRIVE TD-30	562-66-13
ROLLER, IDLER TD-20	562-66-07
ROLLER, IDLER TD-30	562-66-10
RTV SEALANT HIGH TEMP	573-10-02-01
SHAFT, BLOWER SHAFT TD-20	10-19493-02
SHAFT, BLOWER SHAFT TD-30	10-40548
SPEED CONTOLLER BLOWER MOTOR (INVERTER DRIVE)	610-50-06
SPEED CONTROL KNOB	568-30-02
SPEED CONTROLLER KIT FOR CONVEYOR MOTOR	10-54344
SPROCKET ON CONVEYOR MOTOR	562-22-06
SPROCKET ON DRIVE ROLLER	562-22-08
SWITCH, ON/OFF	610-14-30
TEMPERATURE CONTROL (LOVE)	610-22-28
TEMPERATURE COOL DOWN DISC	660-20-09
TEMPERATURE OVER HEAT DISC	660-20-10
TEMPERATURE THERMOCOUPLE PROBE FOR LOVE CONTROL	610-22-29
TOP PANEL TD-20	10-19495-02
TOP PANEL TD-30	10-19819
TOUCH UP PAINT CAN BLACK	575-75-54
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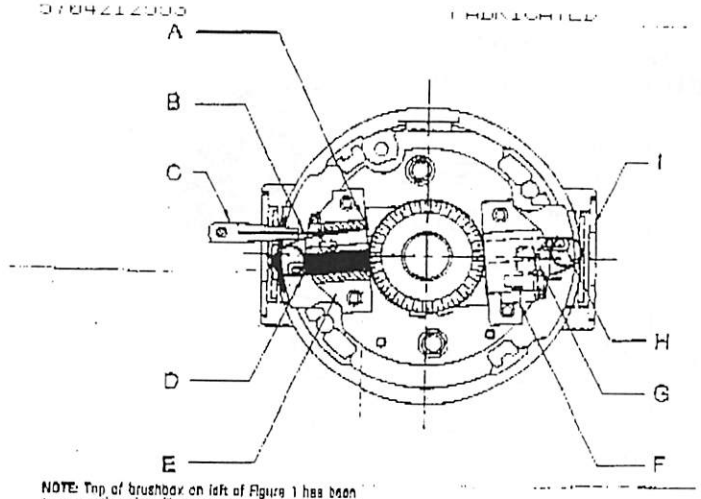
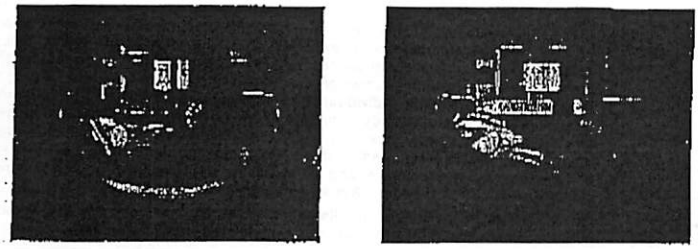
TRANSFORMER 208/230/460 TO 120V 150VA	640-10-23
WIRE, HIGH TEMP (per foot)	605-12-02



NOTE: Top of brushbox on left of Figure 1 has been cross sectioned to illustrate proper assembly. Long nose pliers are the most appropriate "common tool" for replacement of brush spring.

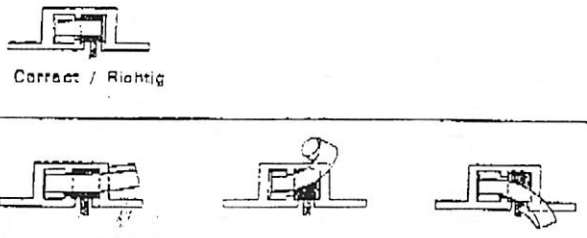
Figure 4



32 Frame / Taille 32 / 32 Baugröße 42 Frame / Taille 42 / 42 Baugröße

IMPORTANT: The lead terminals and brush pigtail terminals are to be positioned as shown, in order to permit unrestricted travel of brushes in the brushholders.

Figure 5



ENGLISH

BRUSH REMOVAL

Refer to Figure 1. Brush caps are held in place with screw threads. Unscrew the brush caps using largest possible screwdriver dp. Brushes are retained by constant-force, roll-type springs. To remove springs, press inward on the end of the spring retaining bracket using the tip of a pair of long nose pliers or other appropriate tool. Springs should "pop" out. If they don't, they can be removed by pulling outward on the spring brackets with a pair of long nose pliers after unhooking the inside ends. Brushes can now be removed by pulling them out of the brush boxes by their "pigtails." It is not necessary to remove the brush pigtail terminal from its connection to the brush box for brush inspection.

BRUSH INSPECTION AND CLEANING

Brush wear rate varies depending on the individual application's duty cycle, and should be inspected at frequent intervals to determine an appropriate inspection schedule. Brushes should be replaced before they are less than .375 inch (9.5 mm) in length. Carbon dust accumulation should be removed periodically. If the end shield has been removed from the drive, a clean, dry, non-linting cloth can be used for cleaning. Do not use solvents as they may damage non-metallic parts and adversely affect subsequent brush commutation.

CAUTION: *Make certain that the ground wire is securely reconnected to the ground terminal if removed. Leads, internal to the shield, must be routed away from the armature, (eg.: be close to the inside wall of the aluminum shield) to prevent a safety hazard and / or damage to the motor.*

REASSEMBLY OF BRUSHES

If brushes require replacement, complete removal of the existing brushes may be accomplished by disconnecting their brush pigtail terminals from the terminal connection bracket. Use a screwdriver to loosen the screws just enough to remove the brush pigtail terminal. Assemble the terminals of the new brushes in the same manner. Make sure that terminal screw for brush pigtail has been tightened. If the screw has been completely removed, a split-wedge screwdriver is best for replacement. Complete reassembly of new or existing brushes as follows:

There is a slot in the base of each brush box (refer to Figure 2). Brush pigtails come already attached to one side of each brush. Position and insert each brush so that the pigtail of the brush aligns with the slot in the brush box. The brush pigtail must be capable of moving freely in the slot. Refer to Figure 3 for proper positioning of terminals.

REASSEMBLY OF BRUSH SPRINGS

Correct replacement of brush springs is critical to assure optimum drive performance (refer to Figure 1). Grasp the tip of the spring bracket such that the roll-type spring will be on the "brush side" of the brush box, and resting on the brush when the brush spring is brought up to the brush box. Push the spring bracket slowly into its slot while letting its two attaching hooks slide on the wall of the brush box. Stop, but do not release the spring bracket when its hooks slip around the edge of the brush box. While still grasping the spring bracket with the pliers, slowly bring the bracket back out of the brush box until the hooks latch around the edge of the brush box as shown in Figure 1. Release the pliers. If the spring bracket is properly seated it

Figure 2

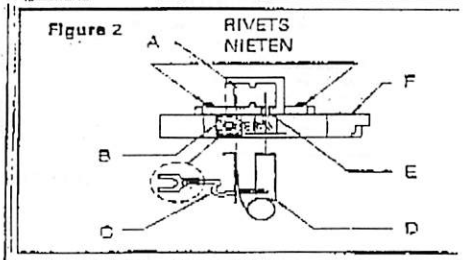
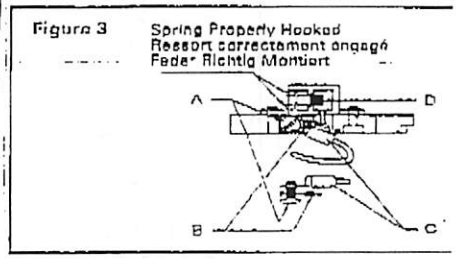


Figure 3 Spring Properly Hooked
Ressort correctement engagé
Feder Richtig Montiert



KBLC™* DC Motor Speed Control
Installation and Operating Instructions

*Patent Pending

TABLE 1. ELECTRICAL RATINGS

MODEL NUMBER	AC LINE VOLTAGE (VAC)**	MOTOR VOLTAGE (VDC)	RATING WITHOUT AUXILIARY HEATSINK: AC LOAD CURRENT (RMS AMPS)	RATING WITHOUT AUXILIARY HEATSINK: DC LOAD CURRENT (AVG. AMPS)	RATING WITHOUT AUXILIARY HEATSINK: MAX. HP	RATING WITH AUXILIARY HEATSINK: AC LOAD CURRENT (RMS AMPS)	RATING WITH AUXILIARY HEATSINK: DC LOAD CURRENT (AVG. AMPS)	RATING WITH AUXILIARY HEATSINK: MAX. HP
KBLC-120	120	90-130	9.0	6.0	½	18.0	12.0	1
KBLC-240*	240	180	9.0	6.0	1	18.0	12.0	2

*240 volt models are available with step down output. They provide a 90 volt DC output with a 240 VAC input. Models are designated with an "S" suffix (eg.: KBLC-120S). If motor is shunt type use half voltage field connection F+ and L1.

FOR TECHNICAL ASSISTANCE CALL TOLL FREE (OUTSIDE NY STATE ONLY) 1-800-221-6570

TABLE 2. PLUG-IN HORSEPOWER RESISTOR® CHART

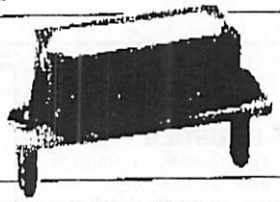
MOTOR HORSEPOWER RANGE*		Plug-In Horsepower Resistor® Resistance** Value (Ohms)	KB P/N
Armature Voltage 90-130V DC	Armature Voltage 180V DC		
1/100-1/50	1/50-1/25	1.0	9833
1/50-1/30	1/25-1/15	.51	9834
1/30-1/20	1/15-1/10	.35	9835
1/20-1/12	1/10-1/6	.25	9836
1/12-1/8	1/6-1/4	.18	9837
1/8-1/5	1/4-1/3	.1	9838
1/4	1/2	.05	9839
1/3	3/4	.035	9840
1/2	1	.025	9841
3/4	1-1/2	.016	9842
1	2	.01	9843

* Motor horsepower and armature voltage must be specified when ordering so that proper resistor will be supplied.

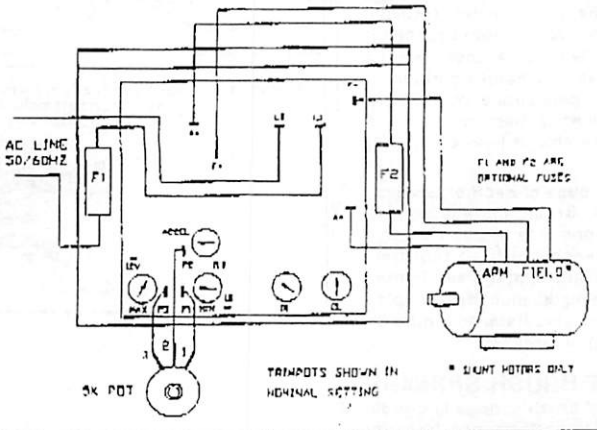
** For overlapping motor horsepower range use lower value Plug-In Horsepower Resistor.

PLUG-IN HORSEPOWER RESISTOR®

A Plug-In Horsepower Resistor® must be installed to match the KBLC® to the motor horsepower and voltage. See Table 2 for the correct value. Plug-In Horsepower Resistor® are stocked by your distributor.



KBLC® CONNECTION DIAGRAM



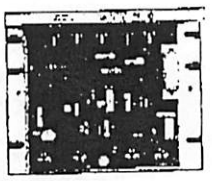
CAUTION: If control is wired to a transformer, it is advisable to switch the secondary to disconnect power, if the primary is switched, additional snubber capacitors may have to be added across the transformer output to prevent damage to the power bridge.

NOTE: (Shunt motors only) For 90 Volt dc motors with 50VDC fields and 180 Volt dc motors with 100VDC fields use half voltage field connections F+ and L_1.

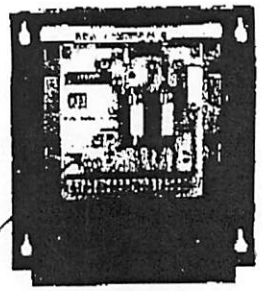
CAUTION: Do not bundle potentiometer connections (P_1, P_2, P_3) and inhibit* connections (I_1, I_2) with AC line or motor wires.

WARNING: Armature Switching. Do not switch the armature in and out of circuit or catastrophic failure will result. If armature switching is required for dynamic brake or reversing, use Models KBPB, KBCC-R or KBRG.

BASIC KBLC®



Auxiliary Heatsink Part No. 9881



Barrier Terminal Board Part No. 9864

KBLC® mounted on KB Auxiliary Heatsink (optional) and with Barrier Terminal Board (optional).

Please read Safety Warning below

LOCATION AND MOUNTING: The KBLC® controls should be mounted on a flat surface and located in an area where it will not be exposed to contaminants such as water, metal chips, solvents or excessive vibration.

When mounting in an enclosure the air space should be large enough to provide adequate heat dissipation. The maximum allowable ambient temperature at full rating is 50°C/122°F. Consult factory if more information is required.

SAFETY WARNING—PLEASE READ CAREFULLY: This product should be installed and serviced by a qualified technician, electrician or electrical maintenance personnel familiar with its operation and the hazards involved. Proper installation which includes wiring, mounting in proper enclosure, fusing or other overcurrent protection and grounding, can reduce the chance of electric shocks, fires or explosion in this product or products used with this product, such as electric motors, switches, coils, solenoids and/or relays. Eye protection must be worn and insulated adjustment tools must be used when working with control under power. This product is constructed of materials (plastics, metals, carbon, silicon, etc.) which may be a potential hazard. Individual material safety data sheets (MSDS) are available upon request. Proper shielding, grounding and filtering of this product can reduce the emission of radio frequency interference (RFI) which may adversely affect sensitive electronic equipment. If information is required on this product, contact our factory. It is the responsibility of the equipment manufacturer and individual installer to supply this safety warning to the ultimate user of this product. (SW effective 3/91.)

Do not use Inhibit or Enable circuits as safety disconnects. Use only the AC Line for that purpose. The circuitry of this control is not isolated from the AC line.

INITIAL SETUP AND WIRING

1. Install proper size Plug-In Horsepower Resistor® (See chart).
2. The KBLC can be connected to a standard 120V or 240V 50/60 Hz AC line (Be sure the AC input voltage corresponds to the control voltage rating and the motor rating (e.g. 90-130VDC motor on 120VAC and 180VDC motor on 240VAC)).
3. Follow the recommended supply wire sizes.
4. Follow the NEC and other electrical codes that apply. Be sure to fuse each AC line conductor which is not at ground (earth) potential. (Do not fuse neutral or grounded, earthed conductors).
5. Connect control in accordance to connection diagram.

TABLE 3. MINIMUM SUPPLY WIRE SIZE REQUIREMENTS

MAX. MOTOR AMPS (DC AMPS)	MAX. MOTOR HP 90V	MAX. MOTOR HP 180V	MINIMUM WIRE SIZE (AWG) Cu Only: MAX. 50 FOOT RUN	MINIMUM WIRE SIZE (AWG) Cu Only: MAX. 100 FOOT RUN
6.0	½	1	18	14
12.0	1	2	14	12*

* Maximum recommended wire size.

VOLTAGE FOLLOWING: All models can be controlled with an **isolated** analog reference voltage (0-9VDC) in lieu of the main speed potentiometer. The voltage is connected to P_2(+) and F−. The control output voltage will linearly follow the input voltage. The source impedance of the input should be 10K ohms or less. The Min trimpot can be used to provide an offset speed. If an offset is not required adjust the Min to 0+ or 0− speed as desired. The Max trimpot is rendered inoperative in the voltage following mode. Use auxiliary trimpot to limit the control range. If the input signal is not isolated, or is a current signal (4-20ma), the KBSI-240D Signal Isolator must be used. It will allow direct connection to process controllers and microprocessors.

CAUTION: 1. The voltage feeding P_2 and F− must be isolated from the AC line. Do not ground P_2 or F− to set up a zero or ground reference.
2. Do not bundle signal wires to P_2 and F− with AC line or motor connections. If signal wires are over 18", use shielded cables.

FUSING: The KBLC has provision for adding a built-in AC line fuse and armature fuse. The AC line fuse protects the control against catastrophic failure. If the fuse blows, the control is miswired, the motor is shorted or grounded, or the control is defective. The armature fuse provides overload protection for the motor and control. Choose the proper size armature fuse by multiplying maximum dc motor amps by 1.7. **NOTE: Be sure to fuse each ungrounded AC line supply conductor. Do not fuse neutral or grounded conductors. All fuses should be normal blow ceramic 3AG, ABC or equivalent.**

1. *AC Line Fuse* is chosen according to the maximum rating of the control:
   8 Amp fuse for all motors up to ½ HP-90V and 1 HP-180VDC.
   12 Amp fuse for all motors up to ¾ HP-90V and 1½ HP-180VDC.
   15 Amp fuse for all motors up to 1 HP-90V and 2 HP-180VDC.
   (Use Buss ABC, Litt. 326 ceramic fuse or equivalent.)
2. *Armature Fuse* can be chosen in accordance with the fuse chart. **Note:** The armature fuse is calculated based on the approximate full load DC current rating of the motor times a form factor of 1.5. If motor has characteristics not consistent with these approximations, a different fuse value may have to be used. Fuses are available from your distributor. Also available is a Fuse Kit (KB Part #9870) containing 700 assorted fuses.

TABLE 4. ARMATURE FUSE CHART

90VDC MOTOR	180VDC MOTOR	APPROX. DC MOTOR CURRENT (AMPS)	FUSE RATING (AC AMPS)
HORSEPOWER			
1/30	1/15	.33	1/2
1/20	1/10	.5	3/4
1/15	1/8	.65	1
1/12	1/6	.85	1-1/4
1/8	1/4	1.3	2
1/6	1/3	1.7	2-1/2
1/4	1/2	2.5	4
1/3	3/4	3.3	5
1/2	1	5.0	8*
3/4	1-1/2	7.5	12*
1	2	10.0	15*

*Also used as AC Line Fuse.

ADJUSTMENTS AND CONTROL FUNCTIONS

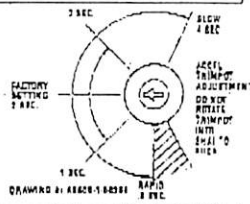
The KBLC® has been factory adjusted to provide 0 to full speed range using the speed control knob. Minimum and maximum speed trimpots are provided to change the speed range from other than 0 to full speed. An acceleration start trimpot (located directly behind the MIN trimpot) is factory set to provide motor acceleration from 0 to full speed over a time period of 2 seconds (approx.) each time the AC power is applied. The current limiting (CL, or torque output) adjustment is factory set to approximately one and a half times the motor rating. The IR Compensation (IR) is factory adjusted to provide excellent motor regulation under normal operation. **Safety warning must be read and understood before making adjustments.**

NOTE: In order for the IR comp and CL trimpot settings to be correct, the proper Plug-In Horsepower Resistor® must be installed for the particular motor and input voltage being used. Do not attempt to change the settings of the trimpots unless absolutely necessary since they are factory adjusted to near optimum settings.

IMPORTANT NOTE: Readjusting the Accel time will affect the Max speed and IR Comp settings which will have to be readjusted (see this Section). If the Accel time is decreased to the minimum time of .5 seconds (6 o'clock trimpot position), then increase the IR trimpot 25% CW rotation and decrease the MAX trimpot 20% CCW rotation. If the Accel time is increased to the maximum time of 4 seconds (full rotation), then decrease the IR and increase the MAX as per above percentages of rotation.

The following procedure, presented in order of adjustment sequence, should be used when readjusting all trimpot functions:

A. Acceleration Start. (ACCEL trimpot is located directly behind the MIN trimpot.) If the ACCEL is to be readjusted to different times, adjust the trimpot to the desired time according to diagram.



B. Maximum Speed Adjustment. Turn Speed Control Knob to full speed (maximum CW position). Adjust max. speed trimpot to new desired setting.

NOTE: Do not attempt to adjust the max. speed above the rated motor RPM since unstable motor operation may occur. For moderate changes in the max. speed, there will be a slight effect on the min. speed setting when the min. speed is set at zero. There may be significant variation in the min. speed setting if the min. speed is at a higher than zero setting.

C. Minimum Speed Adjustment. If a higher than zero minimum speed is desired, readjust the minimum speed by turning the speed control knob to zero setting (full CCW position). Then adjust the Min. Speed Trimpot to the desired setting.

NOTE: The min. speed adjustment will affect the max. speed setting. Therefore, it is necessary to readjust the max. speed after the min. speed, and it may be necessary to repeat the sequence until both the min. and max. speeds are set to the desired levels.

D. Current Limit (CL/Torque Adjustment). CL circuitry is provided to protect the motor and control against overloads. The CL also limits the inrush current to a safe level during start-up. The CL is factory set to approximately 1.5 times the full load rating of the motor. (CL trimpot is nominally set to approx. 50% of full CW rotation.)

NOTE: The correct value Plug-In Horsepower Resistor® must be installed in order for the CL and IR comp. to operate properly.

To set the CL to factory specifications adjust as follows:

1. Set speed control knob at approximately 30-50% CW rotation. Set CL trimpot to full CCW position.
2. Connect a DC ammeter in series with the armature lead.
3. Lock shaft of motor (be sure CL pot is in full CCW position). Apply power and rotate CL pot CW until DC ammeter reads 1.5 times motor rating (do not exceed 2 times motor rating).

E. IR Compensation Adjustment. IR compensation is provided to substantially improve load regulation. If the load presented to the motor does not vary substantially, the IR adjustment may be set at a minimum level (approximately 1/4 of full setting). The control is factory adjusted to approximately 3% regulation. If superior performance is desired (less than 1% speed change of base speed from 0 to full load), then the IR comp should be adjusted as follows:

NOTE: Excessive IR comp. will cause control to become unstable, which causes motor cogging.

1. Set IR comp. trimpot at approximately 25% of CW rotation. Run motor unloaded at approximately 1/3 speed and record RPM.
2. Run motor with maximum load and adjust IR comp. trimpot so that the motor speed under load equals the unloaded speed per step 1.
3. Remove load and recheck unloaded RPM. If unloaded RPM has shifted, repeat procedure for more exact regulation.

The control is now compensated to provide minimal speed change under large variations of applied load.

SWITCHING CIRCUITS

AC Line Switching. The KBLC® can be turned "on" and "off" using the AC Line. Auto Inhibit® circuitry contained in the KBLC® automatically resets critical components each time the AC line is interrupted. This, along with Acceleration Start and CL, provides a smooth start each time the AC line is connected.

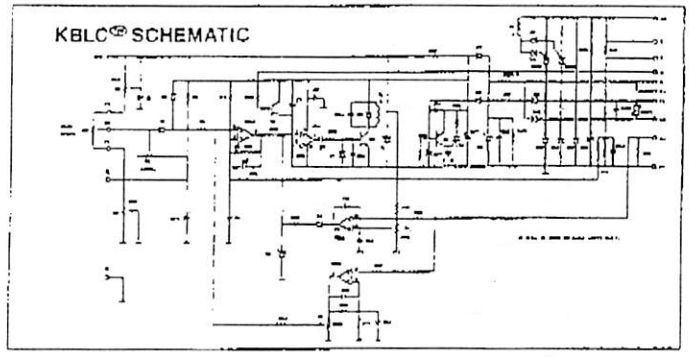
WARNING: Do not disconnect and reconnect the Armature with the AC line applied or catastrophic failure will result.

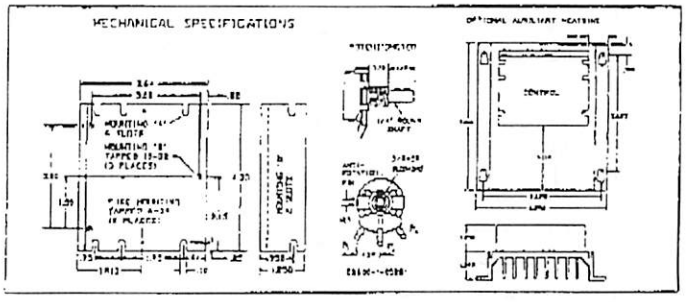
Armature Switching. If the armature is to be disconnected and reconnected with AC power applied the Inhibit Circuit® must be simultaneously activated and deactivated. Connect I_1 and I_2 together to activate the Inhibit Circuit®.

Reversing and Dynamic Brake. KB has developed the APRM® * which provides anti-plug "instant" reversing and solid state dynamic braking. The APRM® is built in as standard in all KBCC-R suffix models and in all KBPB® models. *Patented

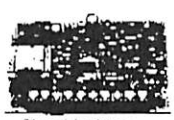
LIMITED WARRANTY

For a period of 18 months from date of original purchase KB will repair or replace without charge devices which our examination proves to be defective in material or workmanship. This warranty is valid if the unit has not been tampered with by unauthorized persons, misused, abused, or improperly installed and has been used in accordance with the instructions and/or ratings supplied. The aforegoing is in lieu of any other warranty or guarantee expressed or implied, and we are not responsible for any expense (including installation and removal), inconvenience, or consequential damage, including injury to any person, caused by items of our manufacture or sale. Some states do not allow certain exclusion or limitations found in this warranty so that they may not apply to you. In any event, KB's total liability, under all circumstances, shall not exceed the full purchase price of this unit. (Rev. 10/84)





ACCESSORY ITEMS FOR KBLC® CONTROLS available from your distributor


Signal Isolator
KBSI-240D
Part No. 9431


Auxiliary
Heatsink
Part No. 9561


Current Sensing
Relay/Overload
Protector
Part No. 9106


Radio Frequency
Interference Filter
Part No. 9107


Knob/Dial Kit
Part No. 9832


Potentiometer Kit
P/N 9111 Carbon
P/N 9831 Wire Wound


AC Line/Armature
Fuse Block Kit
Part No. 9849


Barrier Terminal
Board-P/N 9984, Also
available with Signal
Isolator-P/N 9443

The information contained in these instructions is intended to be accurate. However, the manufacturer retains the right to make changes in design which may not be included herein.

KB ELECTRONICS, INC.
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Outside Florida Call TOLL FREE (800) 221-6570 • Email – info@kbelectronics.com •
www.kbelectronics.com

A-EE7308

THREE PHASE
DUAL VOLTAGE MOTOR

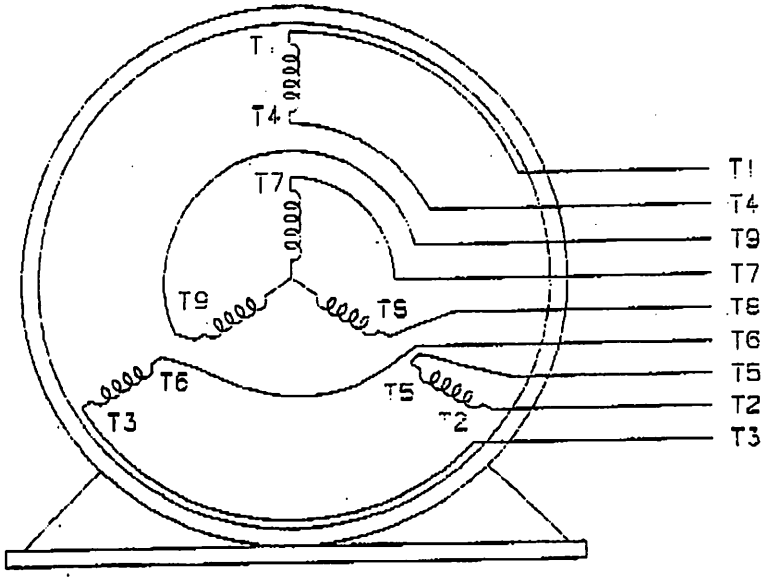
HIGH VOLTAGE

T1 — L1
T2 — L2
T3 — L3
T4
T7
T5
T8
T6
T9

208-230 VOLTS

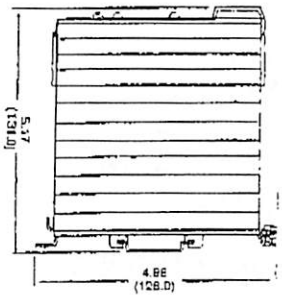
LOW VOLTAGE

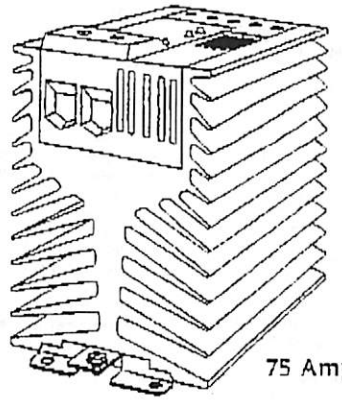
T1
T7 — L1
T2
T8 — L2
T3
T9 — L3
T4
T5
T6



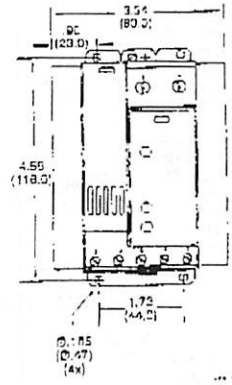
VIEW OF TERMINAL END

Fully Integrated "Intelligent" Solid State Relay





75 Amp

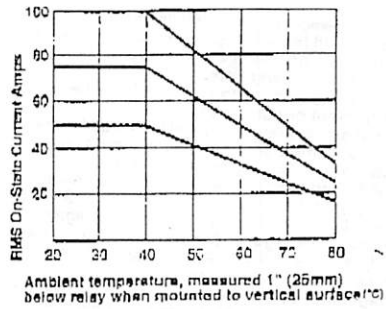


75 Amp

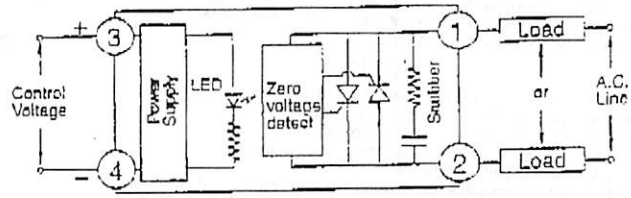
FEATURES / BENEFITS

- Automatic shutdown on overtemperature
- Built in, replaceable, semiconductor fuse
- Integrated heat sink
- Mounts on DIN rail or panel
  Optically isolated
- Touch safe
- L.E.D. indicator (function and alarm)
- Built-in snubber
- 4000 volt isolation
- Zero voltage turn on
- Direct Copper Bonded SCRs
- 1200 volt peak blocking voltage
- 100% tested
- U.L. recognized
- C.S.A. certified
- C.E. compliance

DERATING CURVES



SCHEMATIC



DC CONTROL

Part Number	Line Voltage Range (VAC)	Load Current Range (A_{RMS})	Min Control Voltage & Current Draw	Max Control Voltage & Current Draw	Must Release Voltage (VDC)	Fuse Code*
RSDA-660-75-100	48-660	.10-75	4VDC/6mA	28VDC/9mA	1	H

Terminals:

Input:
- Will accept #24-10 AWG wire
- Torque to 7-9 inch lbs.

Output:
- Will accept #8-3 AWG wire
- Torque to 40 inch lbs.

Digital Controller
SA200 Instruction Manual

IMR01D01-E3

Thank you for purchasing the RKC product. In order to achieve maximum performance and ensure proper operation of your new instrument, carefully read all the instructions in this manual. Please place this manual in a convenient location for easy reference.

⚠ WARNING

- An external protection device must be installed if failure of this instrument could result in damage to the instrument, equipment or injury to personnel.
- All wiring must be completed before power is turned on to prevent electric shock, fire or damage to instrument and equipment.
- This instrument must be used in accordance with the specifications to prevent fire or damage to instrument and equipment.
- This instrument is not intended for use in locations subject to flammable or explosive gases.
- Do not touch high-voltage connections such as power supply terminals, etc. to avoid electric shock.
- RKC is not responsible if this instrument is repaired, modified or disassembled by other than factory-approved personnel. Malfunction can occur and warranty is void under these conditions.

CAUTION

- This is a Class A instrument. In a domestic environment, this instrument may cause radio interference, in which case the user may be required to take adequate measures.
- This instrument is protected from electric shock by reinforced insulation. Provide reinforced insulation between the wire for the input signal and the wires for instrument power supply, source of power and loads.
- Be sure to provide an appropriate surge control circuit respectively for the following:
  - If input/output or signal lines within the building are longer than 30 meters.
  - If input/output or signal lines leave the building, regardless the length.
- This instrument is designed for installation in an enclosed instrumentation panel. All high-voltage connections such as power supply terminals must be enclosed in the instrumentation panel to avoid electric shock by operating personnel.
- All precautions described in this manual should be taken to avoid damage to the instrument or equipment.
- All wiring must be in accordance with local codes and regulations.
- All wiring must be completed before power is turned on to prevent electric shock, instrument failure, or incorrect action. The power must be turned off before repairing work for input break and output failure including replacement of sensor, contactor or SSR, and all wiring must be completed before power is turned on again.
- To prevent instrument damage or failure, protect the power line and the input/output lines from high currents with a protection device such as fuse, circuit breaker, etc.
- Prevent metal fragments or lead wire scraps from falling inside instrument case to avoid electric shock, fire or malfunction.
- Tighten each terminal screw to the specified torque found in the manual to avoid electric shock, fire or malfunction.
- For proper operation of this instrument, provide adequate ventilation for heat dispensation.
- Do not connect wires to unused terminals as this will interfere with proper operation of the instrument.
- Turn off the power supply before cleaning the instrument.
- Do not use a volatile solvent such as paint thinner to clean the instrument. Deformation or discoloration will occur. Use a soft, dry cloth to remove stains from the instrument.
- To avoid damage to instrument display, do not rub with an abrasive material or push front panel with a hard object.
- Do not connect modular connectors to telephone line.

NOTICE

- This manual assumes that the reader has a fundamental knowledge of the principles of electricity, process control, computer technology and communications.
- The figures, diagrams and numeric values used in this manual are only for purpose of illustration.
- RKC is not responsible for any damage or injury that is caused as a result of using this instrument, instrument failure or indirect damage.
- Periodic maintenance is required for safe and proper operation of this instrument. Some components have a limited service life, or characteristics that change over time.
- Every effort has been made to ensure accuracy of all information contained herein. RKC makes no warranty expressed or implied, with respect to the accuracy of the information. The information in this manual is subject to change without prior notice.
- No portion of this document may be reprinted, modified, copied, transmitted, digitized, stored, processed or retrieved through any mechanical, electronic, optical or other means without prior written approval from RKC.

1. PRODUCT CHECK

SA200 □ □□□ - □ □ - □*□ □ - □ □ / □ / □□ /Y
(1) (2) (3) (4) (5) (6) (7) (8) (9) (10) (11)

(1) Control action
F: PID action with autotuning (Reverse action)
D: PID action with autotuning (Direct action)
W: Heat/cool PID action with autotuning (Water cooling)
A: Heat/cool PID action with autotuning (Air cooling)

(2) Input type/Range code: See 9. INPUT RANGE TABLE

(3) Output 1 (control output or alarm output)
M: Relay contact output
V: Voltage pulse output

(4) Output 2 (control output or alarm output)
N: No output
V: Voltage pulse output
M: Relay contact output

(5) Power supply voltage
3: 24 V AC/DC
4: 100 to 240 V AC

(6) Alarm 1 [ALM1] and (7) Alarm 2 [ALM2]
N: No alarm
A: Deviation high alarm
B: Deviation low alarm
C: Deviation high/low alarm
D: Band alarm
E: Deviation high alarm [1]
F: Deviation low alarm [1]
G: Deviation high/low alarm [1]
H: Process high alarm
J: Process low alarm
K: Process high alarm [1]
L: Process low alarm [1]
R: Control loop break alarm [2]
V: SV high alarm
W: SV low alarm

(8) Option function
N: No function
5: RS-485 (RKC communication)
D: Contact input (RUN/STOP, STEP)
6: RS-485 (Modbus)

(9) Waterproof/dustproof
N: No waterproof/dustproof
1: Waterproof/dustproof

(10) Case color
N: White
A: Black

(11) Output assignment code
No symbol: Standard output [3]
03: PID action + ALM1 [OUT1: Control output OUT2: ALM1 output [4]]
04: PID action + ALM1, ALM2 [OUT1: Control output OUT2: AND output of ALM1 and ALM2 [4]]
05: PID action + ALM1, ALM2 [OUT1: Control output OUT2: OR output of ALM1 and ALM2 [4]]
06: PID action + ALM1, ALM2 [OUT1: Control output OUT2: AND output of ALM1 and ALM2 [4]]
07: PID action + ALM1, ALM2 or ALM1 only [OUT1: Control output OUT2: No output (The alarm state can be checked via communication or by lamp lighting)]
08: PID action + ALM1, ALM2 [OUT1: Control output OUT2: ALM1 output [5]] (ALM2 can be checked via communication or by lamp lighting)
09: ALM1 + ALM2 [OUT1: ALM1 output [5] OUT2: ALM2 output [5]]
10: ALM1 + ALM2 [OUT1: ALM1 output [5] OUT2: ALM2 output [4]]
11: ALM1 + ALM2 [OUT1: ALM1 output [5] OUT2: ALM1 output [4]]

[1] With hold action.
[2] LBA can be selected for only ALM1.
[3] PID action:
OUT1: Control output
OUT2: No alarm, ALM1 (Energized) or OR output of ALM1 and ALM2 (Energized)
Heat/cool PID action:
OUT1: Heat-side control output
OUT2: Cool-side control output
[4] De-energized
[5] Energized

Accessories
Mounting brackets: 2
Mounting screws: 2
Instruction Manual (IMR01D01-E3): 1

2. MOUNTING

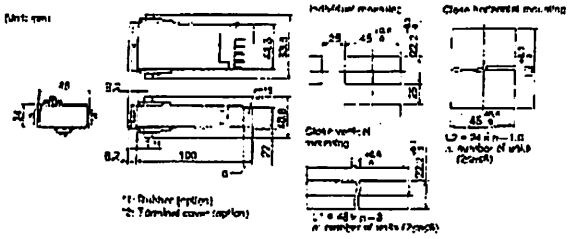
2.1 Mounting Environment

(1) This instrument is intended to be used under the following environmental conditions. (IEC61010-1) [OVERVOLTAGE CATEGORY II, POLLUTION DEGREE 2]

(2) Use this instrument within the following ambient temperature and ambient humidity.
- Allowable ambient temperature: 0 to 50 °C
- Allowable ambient humidity: 5 to 95 %RH (Absolute humidity: MAX. W. C 29 g/m³ dry air at 101.3 kPa)

(3) Avoid the following when selecting the mounting location.
- Rapid changes in ambient temperature which may cause condensation.
- Corrosive or inflammable gases.
- Direct vibration or shock to the mainframe.
- Water, oil, chemicals, vapor or steam splashes.
- Excessive dust, salt or iron particles.
- Excessive induction noise, static electricity, magnetic fields or noise.
- Direct air flow from an air conditioner.
- Exposure to direct sunlight.
- Excessive heat accumulation.

2.2 Dimensions



For mounting of the SA200, panel thickness must be between 1 to 10 mm. When mounting multiple SA200s close together, the panel strength should be checked to ensure proper support.

Installation Conditions:
The display can not be seen from the outside of the visual field range. The visual field range of SA200 is 40 degrees to the upper side, and 30 degrees to the lower side from the center of the display vertically.

2.3 Mounting Procedures

1. Prepare the panel cutout as specified in **2.2 Dimensions.**
2. Insert the instrument through the panel cutout.
3. Insert the mounting bracket into the mounting groove of the instrument. (Fig.1)
4. Push the mounting bracket forward with a blade screwdriver until the bracket is firmly secured to the panel. (Fig.2)
5. The other mounting bracket should be installed the same way described in **3.** and **4.**

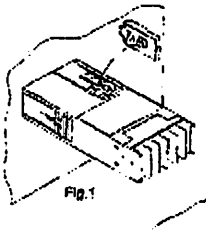


Fig.1

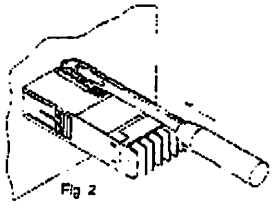


Fig. 2

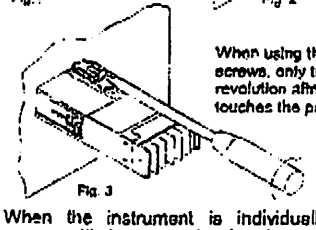


Fig. 3

When using the mounting screws, only turn one full revolution after the screw touches the panel.

When the instrument is individually mounted, always secure with two mounting brackets either top and bottom or right and left.

In addition, the mounting assembly also include two screws which can be used with the brackets to secure the instrument to the panel. See Fig. 3.

The waterproof/dustproof option on the front of the instrument conforms to IP66 when mounted on the panel. For effective waterproof/dustproof, the gasket must be securely placed between instrument and panel without any gap. If gasket is damaged, please contact RKC sales office or the agent.

■ Close Mounting

Secure the mounting brackets in the positions as shown in Fig.4 and Fig.5.

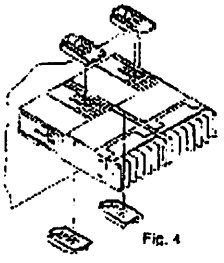


Fig. 4

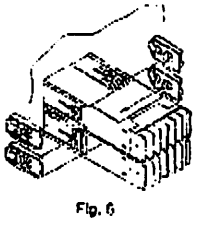


Fig. 5

If the SA200s have waterproof/dustproof options, protection will be compromised and not meet IP66 by close mounting.

Two SA200s cannot be inserted into a panel cutout of 48 × 48 mm.

3. WIRING

3.1 Wiring Cautions

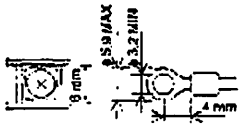
- For thermocouple input, use the appropriate compensation wire.
- For RTD input, use low resistance lead wire with no difference in resistance between the three lead wires.
- To avoid noise induction, keep input signal wire away from instrument power line, load lines and power lines of other electric equipment.
- If there is electrical noise in the vicinity of the instrument that could affect operation, use a noise filter.
  - Shorten the distance between the twisted power supply wire pitches to achieve the most effective noise reduction.
  - Always install the noise filter on a grounded panel. Minimize the wiring distance between the noise filter output and the instrument power supply terminals to achieve the most effective noise reduction.
  - Do not connect fuses or switches to the noise filter output wiring as this will reduce the effectiveness of the noise filter.
- About four seconds are required as preparation time for contact output every time the instrument is turned on. Use a delay relay when the output line is used for an external interlock circuit.
- Power supply wiring must be twisted and have a low voltage drop.
- For an instrument with 24 V power supply, supply power from a SELV circuit.
- This instrument is not furnished with a power supply switch or fuse. Therefore, if a fuse or power supply switch is required, install close to the instrument.
  - Recommended fuse rating: Rated voltage 250 V
    Rated current 1 A
  - Fuse type: Time-lag fuse
- For the current input specification, a resistor of 250 Ω (±0.02 % ±10 ppm, 0.25 W or more) must be connected between the input terminals. If this resistor is installed, close vertical mounting is not possible. This resistor must be provided by the customer.
- The input and output terminals for the voltage pulse output are not isolated. Always use an isolating type SSR. If the grounded type sensor is used, do not ground output wiring. Do not connect any output wires to the terminals with any other output wires.

3.2 Restrictions on Wiring

- Always use recommended solderless terminal lugs or equal.

Screw size:
M3 × 6 (With 5.8 × 5.8 square washer)
Recommended tightening torque:
0.4 N·m (4 kgf·cm)
Applicable wire:
Solid/twisted wire of 2 mm²
Recommended solderless terminals:
Circular terminal with isolation
(M3 screw, width 5.5 mm,
hole diameter 3.2 mm)

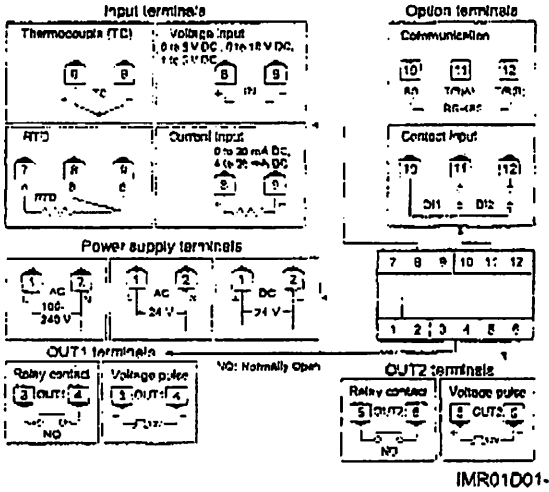
Recommended dimension.



- Always connect external wires starting from the lower terminals (No.1 to 6). Disconnect the wires starting from the upper terminals (No.7 to 12).
- When multiple instruments are vertically closely mounted, do not connect two or more solderless terminal lugs to one terminal.
- If multiple instruments are vertically closely mounted, it is necessary to bend the terminal lugs when they are connected to the lower terminals. (Fig. 6)

Fig. 6

3.3 Terminal Configuration



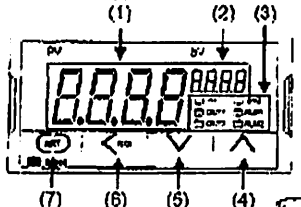
■ Specifications

Input:
Input type:
Thermocouple: K, J, R, S, B, E, T, N, PLII, W5Re/W26Re, U, L
Input impedance: Approx. 1 MΩ
RTD: Pt100, JPt100
Voltage: 0 to 5 V DC, 1 to 5 V DC, 0 to 10 V DC
Current: 0 to 20 mA DC, 4 to 20 mA DC
Sampling cycle: 0.5 seconds
Input range: See Input range table
Control method: PID control (ON/OFF, P, PI, or PD actions is available)
Outputs (OUT1, OUT2):
Relay contact output: 240 V AC, 2 A (Resistive load) 1a contact
Electrical life 300,000 times or more (Rated load)
Voltage pulse output: Input/output terminals are not isolated.
0/12 V DC (Load resistance 600 Ω or more)
Contact input (option): Dry contact input: At open 500 kΩ or more
At close 10 Ω or less

Performance:
Display accuracy (at the ambient temperature 23 °C ±2 °C):
Thermocouple: ±(0.3 % of display value +1 digit) or ±2 °C [4 °F]
R, S and B input: 0 to 399 °C [0 to 751 °F] (Accuracy is not guaranteed.)
T and U input: −199.9 to −100.0 °C [−199.9 to −148.0 °F] (Accuracy is not guaranteed.)
RTD: ±(0.3 % of display value +1 digit) or ±0.8 °C [1.6 °F]
Voltage/Current: ±(0.3 % of span +1 digit)
Memory backup:
Backed up by Nonvolatile Memory
Number of write times: Approx. 100,000 times
Data storage period: Approx. 10 years
Power:
Power supply voltage:
85 to 264 V AC (Power supply voltage range), 50/60 Hz
Rating: 100 to 240 V AC
21.6 to 26.4 V AC (Power supply voltage range), 50/60 Hz
Rating: 24 V AC
21.6 to 26.4 V DC (Power supply voltage range)
Rating: 24 V DC
Power consumption:
4 VA max. (at 100 V AC) 7 VA max. (at 240 V AC)
4 VA max. (at 24 V AC) 100 mA max. (at 24 V DC)

Weight: Approx. 110 g

4. PARTS DESCRIPTION



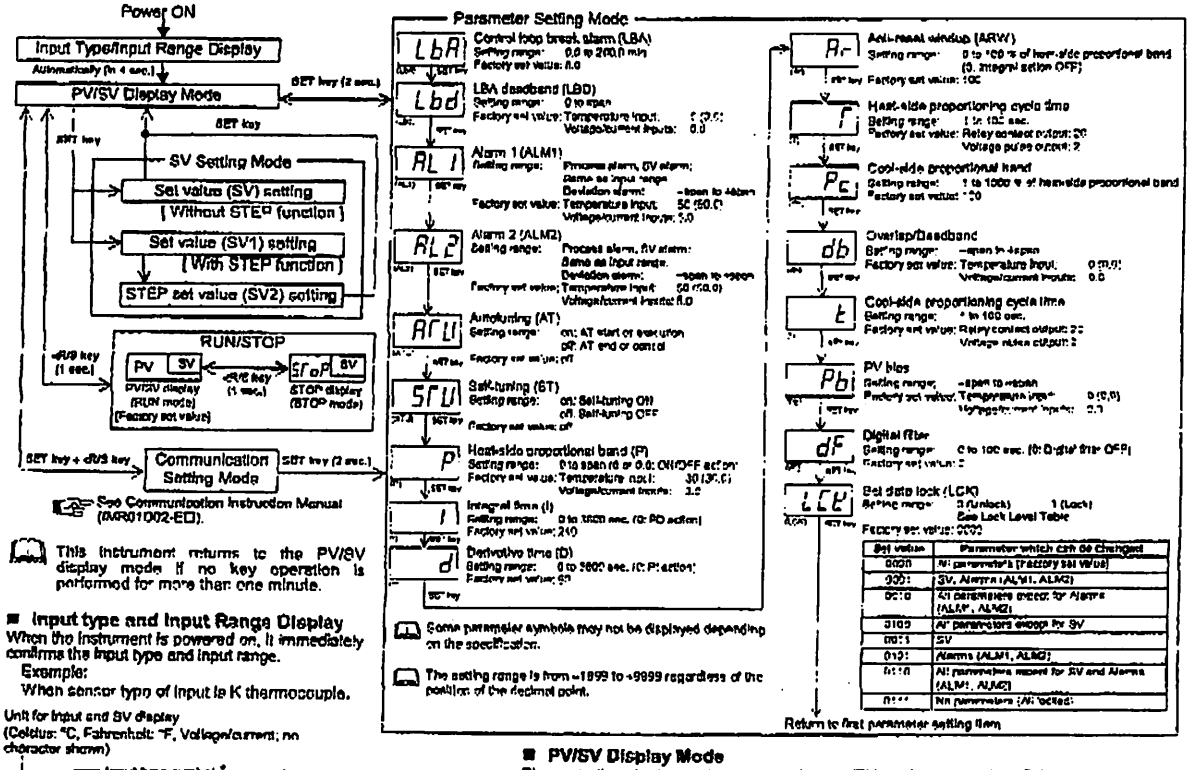
(1) Measured value (PV) display [Green]
Displays PV or various parameter symbols.
(2) Set value (SV) display [Orange]
Displays SV or STEP set value (SV1, SV2). Displays various parameter set values.
(3) Indication lamps
Autotuning (AT) lamp [Green]
Flashes during autotuning activated. (After autotuning is completed: AT lamp will become OFF)

Output lamps (OUT1, OUT2) [Green]
OUT1: Lights when output 1 is turned on.
OUT2: Lights when output 2 is turned on.
STEP set value (SV2) lamp [Orange]
Lights when the SV2 of STEP function is selected.
Alarm lamps (ALM1, ALM2) [Orange]
ALM1: Lights when alarm 1 is turned on.
ALM2: Lights when alarm 2 is turned on.

(4) UP key
Increase numerals.
(5) DOWN key
Decrease numerals.
(6) Shift & R/S key
Shift digits when settings are changed.
Selects the RUN/STOP function.
(7) Set key
Used for parameter calling up and set value registration.

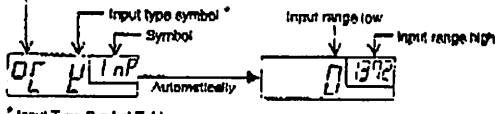
To avoid damage to the instrument, never use a sharp object to press keys.

5. SETTING



■ Input type and Input Range Display

When the instrument is powered on, it immediately confirms the input type and input range.
Example:
When sensor type of input is K thermocouple.



* Input Type Symbol Table

Symbol	K	J	R	S	B	E	T	N	PL II	W5Re/W26Re	U	L	JPt100	Pt100	Voltage (Current)
Input type	Thermocouple (TC)												RTD		

■ PV/SV Display Mode

The controller will display the measured value (PV) and the set value (SV).
- If the STEP function is provided, the SV display will show the set value (SV1) or STEP set value (SV2) depending on whether the contact input is opened or closed.
- The controller can be switched to RUN or STOP mode.

■ SV Setting Mode

The blinking digit on the SV display indicates which digit can be set.
Setting range: Within input range
Factory set value: Temperature input 0 (0.0) °C [°F], Voltage/current inputs 0.0 %
If the STEP function is provided, the following parameter symbols are displayed on the PV.
Set value (SV1): SV 1 STEP set value (SV2): SV2

■ Changing Parameter Settings

Procedures to change parameter settings are shown below.

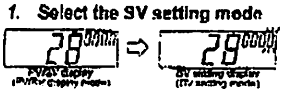
> **To store a new value for the parameter, always press the SET key. The display changes to the next parameter and the new value will be stored.**
> - A new value will not be stored without pressing SET key after the new value is displayed on the display.
> - After a new value has been displayed by using the UP and DOWN keys, the SET key must be pressed within one minute, or the new value is not stored and the display will return to the PV/SV display mode.

When the set data is locked, the digits on the SV display are brightly lit and the set value cannot be changed.

● Change the set value (SV)

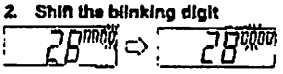
Change the set value (SV) from 0 °C to 200 °C

1. Select the SV setting mode



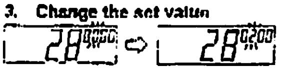
Press the SET key at PV/SV monitor screen until SV setting screen is displayed.

2. Shift the blinking digit



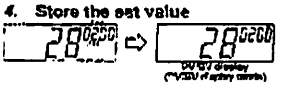
Press the <R/S key to blink the hundreds digit. The blinking digit indicates which digit can be set.

3. Change the set value



Press the UP key to change the number to 2.

4. Store the set value



Press the SET key to store the new set value. The display returns to the PV/SV display mode.

● Change parameters other than the set value (SV)

The changing procedures are the same as those of example 2. to 4. in the above "● Change the set value (SV)." Pressing the SET key after the setting end shifts to the next parameter. When no parameter setting is required, return the instrument to the PV/SV display mode.

6. OPERATION

6.1 Operating Precautions

(1) All mounting and wiring must be completed before the power is turned on.
(2) The settings for the SV and all parameters should be appropriate for the controlled object.
(3) A power supply switch is not furnished with this instrument. It is ready to operate as soon as the power is turned on.
(Factory set value: RUN (operation start))

Connect the input signal wiring and turn the power on. If the input signal wiring is not complete prior to turning the power on, the instrument determines that burnout has occurred.

A power failure of 20 ms or less will not affect the control action. When a power failure of more than 20 ms occurs, the instrument assumes that the power has been turned off. When power returns, the controller will retain the conditions that existed prior to shut down.

The alarm hold action is activated when the power is turned on or the SV is changed, including an SV change made with the STEP function.

6.2 RUN/STOP

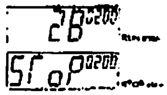
RUN/STOP can be selected by contact input (option) other than the key operation. In addition, at STOP the key operation and contact state are displayed on the PV display. Relationships between key operation, RUN/STOP and the characters to indicate the STOP state are shown in the following.

		RUN/STOP with Contact Input [1]	
		RUN (Contact closed)	STOP (Contact open)
RUN/STOP with Key Operation	RUN	RUN	STOP
		STOP is not displayed	dSTP (dSTP) [2]
	STOP	STOP	STOP
		KSTP (KSTP) [2]	SToP (SToP) [2]

[1] Contact input: Terminal No.10, 12
[2] Characters in parentheses are those shown on the PV display:
dSTP : Only contact input is in the STOP mode
KSTP : Only key operation is in the STOP mode
SToP : Both key operation and contact input are in the STOP mode

Conditions when changed to STOP mode:
- Control, Alarm: Control OFF, Alarm OFF
- Output: OUT1 output OFF (OPEN), OUT2 output OFF (OPEN)
- Autotuning (AT): AT canceled (The PID constants are not updated)

■ RUN/STOP transfer by key operation

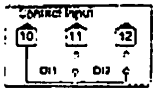


1. Press the <R/S key for 1 second in PV/SV display mode.
2. The mode is changed to STOP from RUN. The PV display shows the characters of showing the relevant STOP state.

Also when changing from STOP to RUN, press the <R/S key for 1 second while in the PV/SV display mode.

■ RUN/STOP transfer by contact input

RUN/STOP can be selected according to the open or closed state of the terminal numbers 10 to 12.



Terminal No.	RUN	STOP
10 – 12	Contact closed	Contact open

6.3 Set Data Lock (LCK)

The set data lock restricts parameter setting changes by key operation. This function prevents the operator from making errors during operation.

Set value	Parameters which can be changed
0000	All parameters (Factory set value)
0001	SV, Alarms (ALM1, ALM2)
0010	All parameters except for Alarms (ALM1, ALM2)
0100	All parameters except for SV
0011	SV
0101	Alarms (ALM1, ALM2)
0110	All parameters except for SV and Alarms (ALM1, ALM2)
0111	No parameters (All locked)

Set Data Lock can be changed in both RUN and STOP mode.

Parameters protected by Set Data Lock function are still displayed for monitoring.

6.4 Autotuning (AT)

Autotuning (AT) automatically measures, calculates and sets the optimum PID and LBA constants. The following conditions are necessary to carry out autotuning and the conditions which will cause the autotuning to stop.

Caution for using the Autotuning (AT)
When a temperature change (UP and/or Down) is 1 °C or less per minute during Autotuning, Autotuning may be cancelled before calculating PID values. In that case, adjust the PID values manually. It is possible to happen when the set value is around the ambient temperature or is close to the maximum temperature achieved by the load.

■ Requirements for AT start

Start the autotuning when all following conditions are satisfied:
- Prior to starting the AT function, end all the parameter settings other than PID and LBA.
- Confirm the LCK function has not been engaged.

When the autotuning is finished, the controller will automatically returns to PID control.

■ Requirements for AT cancellation

The autotuning is canceled if any of the following conditions exist.
- When the set value (SV1, SV2) is changed.
- When the power is turned off.
- When the PV bias value is changed.
- When the RUN/STOP mode is changed to the STOP mode.
- When the PV becomes abnormal due to burnout.
- When the AT does not end in 9 hours after autotuning started.
- When power failure longer than 20 ms occurs.

If the AT is canceled, the controller immediately changes to PID control. The PID values will be the same as before AT was activated.

When AT is completed, the controller immediately changes to PID control. If the control system does not allow the AT cycling process, set each PID constant manually to meet the needs of the application.

6.5 Self-tuning (ST)

The ST function is used to automatically calculate and set adaptive PID constants anytime the power is turned on, the SV is changed or the controller detects unstable control conditions.

The ST function should be turned off when the controlled system is affected by rippling that occurs due to periodic external disturbances.

The power to the controlled system must be turned on before the power to the instrument is turned on or SV is changed. This is required when ST function is on.

To activate the ST function, the following parameters must not be set to zero: P≠0, I≠0, D≠0, ARW≠0.

When heat/cool PID action is selected, the ST function can not be activated.

When the AT function is activated, the ST function can not be turned on.

When the ST function is activated, the PID and ARW settings can be monitored, but not changed.

7. FUNCTIONS

7.1 PV Bias

The value set in the PV bias is added to the input value (actual measured value) to correct the input value. The PV bias is used to correct the individual variations in the sensors or when there is difference between the measured values (PV) of other instruments.

7.2 Digital Filter

This is a software filter which reduces input value variations caused by noise. If the time constant of this filter is set appropriately to match the characteristics of the controlled object and the noise level, the effects of input noise can be suppressed. However, if the time constant is too small, the filter may not be effective, while if the time constant is too large, then the input response may actually deteriorate.

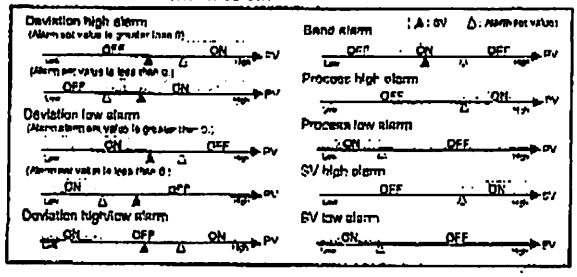
7.3 STEP (Option)

The instrument has two set values (SV). This STEP function selects these two set values (SV) by contact input (Terminal No.10, 11).

Contact open: Set value (SV1)
Contact closed: STEP set value (SV2)

7.4 Alarms

Each alarm action is shown below.



■ Control Loop Break Alarm (LBA)

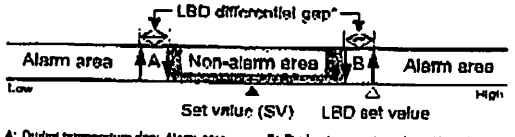
The LBA function is used to detect a load (heater) break or a failure in the external actuator (power controller, magnet relay, etc.), or a failure in the control loop caused by an input (sensor) break. The LBA function is activated when control output reaches 0 % (low limit with output limit function) or 100 % (high limit with output limit function). LBA monitors variation of the measured value (PV) for the length of LBA time. When the LBA time has elapsed and the PV is still within the alarm determination range, the LBA will be ON.

Precaution for LBA setting:

- Displayed only for when LBA is selected as Alarm 1.
- No control loop break alarm can be used at heat/cool PID control action.
- The LBA function can not be activated when AT function is turned on.
- The LBA function is activated when control output reaches 0 % or 100 %. The time required for the LBA output to turn on includes both the time from the initial occurrence of loop failure and the LBA setting time. Recommended setting for LBA is for the set value of the LBA to be twice the value of the integral time (I).
- If LBA setting time does not match the controlled object requirements, the LBA setting time should be lengthened. If setting time is not correct, the LBA will malfunction by turning on or off at inappropriate times or not turning on at all.

■ LBA Deadband (LBD)

The LBA may malfunction due to external disturbances. To prevent malfunctioning due to external disturbance, LBA deadband (LBD) acts a neutral zone in which LBA is not activated. When the measured value (PV) is within the LBD area, LBA will not be activated. If the LBD setting is not correct, the LBA will not work correctly.



A: During temperature rise: Alarm area / During temperature fall: Non-alarm area
B: During temperature rise: Non-alarm area / During temperature fall: Alarm area
* TC and RTD inputs: 0.8 °C (°F) (fixed)
Voltage/Current inputs: 0.8 % of span (fixed)

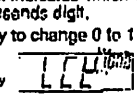
8. INITIAL SETTING

WARNING

Parameters in the Engineering mode should be set according to the application before setting any parameter related to operation. Once the Parameters in the Engineering mode are set correctly, those parameters are not necessary to be changed for the same application under normal conditions. If they are changed unnecessarily, it may result in malfunction or failure of the instrument. RKC will not bear any responsibility for malfunction or failure as a result of improper changes in the Engineering mode.

8.1 Go to Engineering Mode

1. Turn on the power to the controller. The instrument goes to the PV/SV display after confirming input type symbol and input range.
2. Press the SET key for two seconds to go to the Parameter Setting Mode from the PV/SV display.
3. Press the SET key until "LCK" (Set Data Lock display) will be displayed.
4. The blinking digit indicates which digit can be set. Press <R/S key to move to the thousands digit.
5. Press the UP key to change 0 to 1.



6. Press the SET key to store the new set value. The display goes to the next parameter, and the Engineering mode is unlocked.
7. Press the SET key for two seconds to change to the PV/SV display mode.
8. Press the <R/S key for one second to change the operation mode from RUN mode to STOP mode.

Before the setting is changed in engineering mode, it is necessary to set the operation mode to the STOP mode.

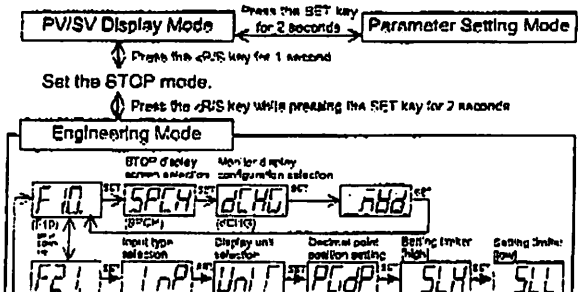
The STOP message to be displayed varies depending on the specification.

9. Press the <R/S key for two seconds while pressing the SET key to go to the Engineering Mode. Thus, the symbol "F10" for function block is displayed first.

8.2 Engineering Menu

Display flowcharts in engineering mode are shown in the following.

Do not change to the ☐ section parameters and any parameter in the engineering mode which is not described in the engineering menu below. It may result in malfunction or failure of the instrument.



8.3 Attention Items in Setting

If any of the following settings are changed, the relevant set value is initialized or is automatically converted.

Before changing the set values, always record all of them (SV setting mode, parameter setting mode and engineering mode).

After changing the set values, always check all of them (SV setting mode, parameter setting mode and engineering mode).

■ When the input type or engineering unit is changed

The set value is initialized.

Mode	Description	Default value: Temperature input	Default value: Voltage/current inputs
Engineering mode	Decimal point position	0 (Without decimal point)	1
	Setting limiter (high)	Maximum settable value	100.0
	Setting limiter (low)	Minimum settable value	0.0
	Alarm 1 hold action selection	0 (Without alarm hold action)	
	Alarm 1 differential gap	2 °C [°F]	0.2 % of span
	Alarm 1 process abnormality action	Alarm 1 not provided or LBA: 0 (Normal) Alarm 1 provided: 1 (Forcibly turned on)	
	Alarm 2 hold action selection	0 (Without alarm hold action)	
	Alarm 2 differential gap	2 °C [°F]	0.2 % of span
	Alarm 2 process abnormality action	Alarm 2 not provided: 0 (Normal) Alarm 2 provided: 1 (Forcibly turned on)	
	ON/OFF action differential gap	2 °C [°F]	0.2 % of span
Parameter setting mode	Alarm 1 set value	50 °C [°F]	5.0 % of span
	Alarm 2 set value		
	Control loop break alarm	8.0 minutes	
	LBA deadband	0 °C [°F]	0.0
	Heat-side proportional band	30 °C [°F]	3.0 % of span
	Integral time	240 seconds	
	Derivative time	60 seconds	
	Anti-reset windup	100 %	
	Deadband	0 °C [°F]	0.0
	Cool-side proportional band	100 %	
	PV bias	0 °C [°F]	0.0
	Digital filter	0 second (off)	
PV/SV display mode, SV setting mode	Set value (SV) — STEP function not provided	0 °C [°F]	0.0
	Set value (SV1) — STEP function provided		
	Set value (SV2)		

■ When the setting limiter is changed

If the setting limiter [high] (SLH) or setting limiter [low] (SLL) is changed as follows, the related set values are changed. (See Table 1)

<Only for temperature input>

- If SLH is set to SLH < SLL, it is changed to SLH = SLL.
  Example: If SLL is set to 200 with SLH set to 100, SLH is changed to 200.
- If SLL is set to SLH < SLL, it is changed to SLH = SLL.
  Example: If SLH is set to 100 with SLL set to 200, SLL is changed to 100.

<For temperature input, voltage/current inputs>

If the setting is made so that the span becomes narrower, there may be a case where the related set value becomes smaller or 0.

Table 1

Mode	Description	
Engineering mode	Alarm 1 differential gap	
	Alarm 2 differential gap	
	ON/OFF action differential gap	
Parameter setting mode	Alarm 1 set value	
	Alarm 2 set value	
	LBA Deadband	
	Deadband	
	Heat-side proportional band	
	PV bias	
PV/SV display mode, SV setting mode	Set value (SV)	STEP function not provided
	Set value (SV1)	STEP function provided
	Set value (SV2)	

■ When the position of the decimal point is changed

The set value is automatically converted.

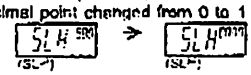
- After the position of the decimal point is changed, conduct automatic conversion so that the following values may not be changed.

Engineering mode:
Setting limiter (high), Setting limiter (low), Alarm 1 differential gap, Alarm 2 differential gap, ON/OFF action differential gap

Parameter setting mode:
Alarm 1 set value, Alarm 2 set value, LBA deadband, Heat-side proportional band, Deadband, PV bias

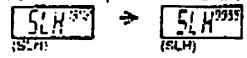
PV/SV display/SV setting mode:
Set value (SV) [STEP function not provided],
Set value (SV1), Set value (SV2) [STEP function provided]

Example: When the position of the decimal point changed from 0 to 1 with SLH set to 800 °C.
(Changed from 800 to 800.0.)



- If the setting range is not between −1999 and +9999 regardless of the position of the decimal point, it is limited by the range from −1999 to +9999.

Example: When SLH is 1372 °C with no decimal position, and the decimal position is changed from 0 to 1 (one decimal position), SLH will become 999.9.



- If the number of digits below the decimal point is changed in the decreasing direction, the decreased number of digits is omitted.

Example: When SHL is 99.99 with two decimal positions, and the decimal position is changed from 2 to 0, SLH will become 99 by discarding the digits below the decimal point.

■ When the type of alarm is changed

The set value is initialized.

Mode	Description	Default value: Temperature input	Default value: Voltage/current inputs
Engineering mode	Alarm 1 hold action selection	0 (Without alarm hold action)	
	Alarm 1 differential gap	2 (2.0) °C [°F]	0.2 % of span
	Alarm 1 process abnormality action	Alarm 1 not provided or LBA: 0 (Normal) Alarm 1 provided: 1 (Forcibly turned on)	
	Alarm 2 hold action selection	0 (Without alarm hold action)	
	Alarm 2 differential gap	2 (2.0) °C [°F]	0.2 % of span
	Alarm 2 process abnormality action	Alarm 2 not provided: 0 (Normal) Alarm 2 provided: 1 (Forcibly turned on)	
Parameter setting mode	Alarm 1 set value	50 (50.0) °C [°F]	5.0 % of span
	Alarm 2 set value		

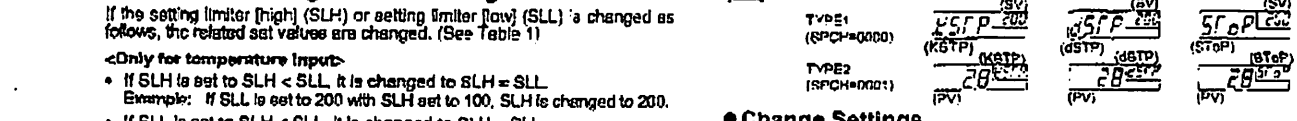
8.4 Function Block 10 (F10)

(1) STOP display screen selection (SPCH)

Set value	Description
0000	STOP is displayed on the PV display unit. (TYPE 1)
0001	STOP is displayed on the SV display unit. (TYPE 2)
0002	No selection from RUN to STOP by the front key can be made*.

* If "Set value" is set to 0002, no selection from RUN to STOP can be made, but selection from STOP to RUN can be made. In addition, RUN/STOP can be selected via communication or by contact input regardless of the SPCH setting.

Displays in the STOP mode become as follows.



● Change Settings

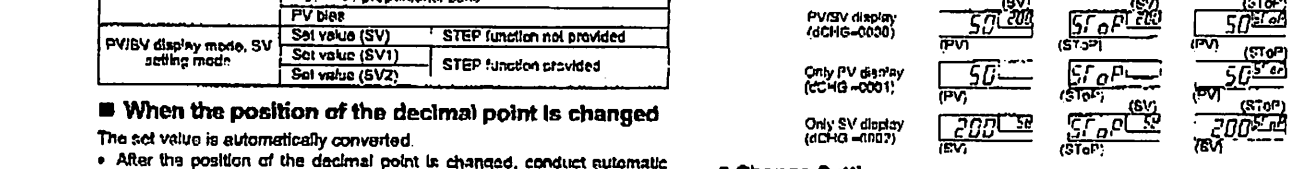
Example: Change the STOP display from "TYPE 1" to "TYPE 2"

1. Change the instrument to the function block symbol display "F10".
   See 8.1 Go to Engineering Mode (P. 5).
2. Press the SET key to change to "SPCH (STOP display)". Then, press the UP key to enter 1 in the units digit of the set value (SV) display.
3. Press the SET key to store the new set value. The display goes to the next parameter.

(2) Monitor display configuration selection (dCHG)

Set value	Description	Set value	Description
0000	PV/SV display	0002	Only SV display
0001	Only PV display	—	—

Displays become as follows.



● Change Settings

Example: Change the monitor display configuration selection from "PV/SV display" to "Only PV display"

1. Press the SET key at "F10" until "dCHG (Monitor display configuration selection)" is displayed.
2. Press the UP key to change the number to 0.
3. Press the SET key to store the new set value. The display goes to the next parameter.

8.5 Function Block 21 (F21)

(1) Input type selection (inP)

Factory set value varies depending on the input type.

Set value	Input type		Set value	Input type	
0000	K	Thermocouple (TC)	0010	U	Thermocouple [1] (TC)
0001	J		0011	L	
0002	R		0012	Pt100 Ω (JIS/IEC)	RTD [1]
0003	S		0013	JPt100 Ω (JIS)	
0004	B		0014	0 to 5 V DC	Voltage [1]
0005	E		0015	1 to 5 V DC	
0006	N		0016	0 to 10 V DC	
0007	T		0014	0 to 20 mA DC	Current [1] [2]
0008	W5ReW26Re		0015	4 to 20 mA DC	
0009	PL II		—	—	—

[1] Input type (TC/RTD to voltage/current inputs or voltage/current inputs to TC/RTD) cannot be changed because the hardware is different.
[2] For the current input specification, a resistor of 250 Ω must be connected between the input terminals.

●Change Settings

Example: Change the input type from "K" to "J"

1. Change the instrument to the function block symbol display.

See 8.1 Go to Engineering Mode (P. 5).

As "InP" belongs to the "F21," press the UP key to change the display from "F10" to "F21."

2. Press the SET key to change to "InP." Then, press the UP key to enter 1 in the units digit of the set value (SV) display.
3. Press the SET key to store the new set value. The display goes to the next parameter.

(2) Display unit selection (UnIT)

Invalid in case of the voltage/current inputs.

See 8.3 Attention Items in Setting (P. 6).

Factory set value: 0000

Set value	Description	Set value	Description
0000	°C	0001	°F

●Change Settings

Example: Change the temperature unit of the Heat only type from "°C (0000)" to "°F (0001)"

1. Press the SET key several times at "F21" until "UnIT" is displayed.
2. Press the UP key to change the number to 1.
3. Press the SET key to store the new set value. The display goes to the next parameter.

(3) Decimal point position (PGdP)

Factory set value varies depending on the instrument specification.

Set value	Description	Set value	Description
0000	No decimal place (□□□□)	0002	Two decimal places (□□.□□)
0001	One decimal place (□□□.□)	0003	Three decimal places (□.□□□)

●Change Settings

Example: Change the decimal point position from "One decimal place (0001)" to "No decimal place (0000)"

1. Press the SET key several times at "F21" until "PGdP" is displayed.
2. Press the DOWN key to change the number to 0.
3. Press the SET key to store the new set value. The display goes to the next parameter.

(4) Setting limiter [high] (SLH) Setting limiter [low] (SLL)

Set the setting limiter referring to the Input Range Table (P. 8).

See 8.3 Attention Items in Setting (P. 6).

Factory set value varies depending on the instrument specification.

Input type		Setting range
TC	K	−199 to +1372 °C (−328 to +2502 °F)
		−199.9 to +999.9 °C (−199.9 to +999.9 °F)
	J	−199 to +1200 °C (−328 to +2192 °F)
		−199.9 to +999.9 °C (−199.9 to +999.9 °F)
	R	0 to 1769 °C (0 to 3216 °F)
	S	0 to 1769 °C (0 to 3216 °F)
	B	0 to 1820 °C (0 to 3308 °F)
	E	0 to 1000 °C (0 to 1832 °F)
	N	0 to 1300 °C (0 to 2372 °F)
		0.0 to 999.9 °C (0 to 999.9 °F)
	T	−199 to +400 °C (−328 to +752 °F)
		−199.9 to +400.0 °C (−199.9 to +752.0 °F)
	W5ReW26Re	0 to 2320 °C (0 to 4208 °F)
	PL II	0 to 1390 °C (0 to 2534 °F)
	U	−199 to +600 °C (−328 to +1112 °F)
		−199.9 to +600.0 °C (−199.9 to +999.9 °F)
	L	0 to 900 °C (0 to 1652 °F)
RTD	Pt100 (JIS/IEC) [1]	−199.9 to +649.0 °C (−199.9 to +999.9 °F)
	JPt100 (JIS)	
Voltage [2]	0 to 5 V DC	−1999 to +9999 (programmable scale)
	1 to 5 V DC	
	0 to 10 V DC	
Current [2] [3]	0 to 20 mA DC	−1999 to +9999 (programmable scale)
	4 to 20 mA DC	

[1] IEC (International Electrotechnical Commission) is equivalent to JIS, DIN and ANSI.
[2] In case of voltage/current inputs, SLH can be set below SLL.
[3] For the current input specification, a resistor of 250 Ω must be connected between the input terminals.

●Change Settings

Example: When the display range is scaled to 0.0 to 400.0 for a voltage input of 1 to 5 V DC.

1. Set "F21," and press the SET key. The display will go to SLH.
2. The blinking digit indicates which digit can be set. Press the <R/S key to move to the thousands digit.
3. Press the UP key to change the number to 4.
4. Press the SET key to store the new set value. The display goes to SLL. For the "SLL (Setting limiter [low])," check that the display is set to "0.0."

8.6 Function Block 30 (F30)

■ Output logic operation selection (LoGC)

Match the setting with the instrument specification. Otherwise malfunction may result.

No heat-side or cool-side proportional cycle (T or I) corresponding to a parameter setting mode made may not be displayed depending on the selected output allocation code.

- Not displayed when no control output is selected.
- Not displayed when control output corresponds to current output.

Factory set value varies depending on the instrument specification.

Set value	OUT1	OUT2	Remarks
001	Control output	OR output of alarm 1 and alarm 2 (Energized)	PID action – No alarm function * PID action + Alarm 1 * PID action + OR output of Alarm 1, alarm 2 (Energized) *
002	Heat-side control output	Cool-side control output (In case of direct action or reverse action, it is OFF).	Heat/cool PID action * (W or A type)
003	Control output	Alarm 1 output (De-energized)	PID action + Alarm 1
004	Control output	AND output of alarm 1 and alarm 2 (Energized)	PID action + Alarm 1, alarm 2
005	Control output	OR output of alarm 1 and alarm 2 (De-energized)	PID action – Alarm 1, alarm 2
006	Control output	AND output of alarm 1 and alarm 2 (De-energized)	
007	Control output	No output (The alarm state can be checked via communication or by lamp lighting).	PID action + Alarm 1, alarm 2 or alarm1 only
008	Control output	Alarm 1 output (Energized) (Alarm 2 can be checked via communication or by lamp lighting).	PID action + Alarm 1, alarm 2
009	Alarm 1 output (Energized)	Alarm 2 output (Energized)	Alarm 1 – Alarm 2 (The PID operation can choose only F type.)
010	Alarm 1 output (Energized)	Alarm 2 output (De-energized)	
011	Alarm 1 output (De-energized)	Alarm 2 output (De-energized)	

* Standard output when no output code is specified.

8.7 Function Block 41 (F41), 42 (F42)

(1) Alarm 1 type selection (AS1) Alarm 2 type selection (AS2)

See 8.3 Attention Items in Setting (P. 6).

Factory set value varies depending on the instrument specification.

Set value	Description	Set value	Description
0000	Alarm not provided	0005	Deviation high alarm
0001	SV high alarm	0006	Deviation low alarm
0002	SV low alarm	0007	Deviation high/low alarm
0003	Process high alarm	0008	Band alarm
0004	Process low alarm	0009	Control loop break alarm (LBA)*

* Available only with Alarm 1 type

●Change Settings

Example: Change the Alarm 1 type from "Deviation high alarm (0005)" to "Deviation low alarm (0006)"

1. Press the SET key at "F41" until "AS1" is displayed.
2. Press the UP key to change the number to 6.
3. Press the SET key to store the new set value. The display goes to the next parameter.

(2) Alarm 1 hold action selection (AHo1) Alarm 2 hold action selection (AHo2)

The alarm hold action function can not be added to the SV alarm.

See 8.3 Attention Items in Setting (P. 6)

Factory set value: 0000

Set value	Description
0000	Without alarm hold action
0001	Effective when the power is turned on, or operation is changed from STOP to RUN.
0002	Effective when the power is turned on, or operation is changed from STOP to RUN or the SV is changed.

●Change Settings

Example: Change the Alarm 1 hold action selection from "Without alarm hold action (0000)" to "Effective when the power is turned on, or operation is changed from STOP to RUN (0001)"

1. Press the SET key at "F41" until "AHo1" is displayed.
2. Press the UP key to change the number to 1.
3. Press the SET key to store the new set value. The display goes to the next parameter.

(3) Alarm 1 differential gap (AH1)
Alarm 2 differential gap (AH2)

Setting range:
TC and RTD inputs, Voltage/current inputs: 0 (0.0) to span

Factory set value:
TC and RTD inputs: 2 °C [°F] or 2.0 °C [°F]
Voltage/current inputs: 0.2 % of span

● Change Settings

Example: Change the Alarm 1 differential gap from "2 °C" to "4 °C"

1. Press the SET key at "F41" until "AH1" is displayed.
2. Press the UP key to change the number to 4.
3. Press the SET key to store the new set value. The display goes to the next parameter.

(4) Alarm 1 process abnormality action selection (AEo1)
Alarm 2 process abnormality action selection (AEo2)

It is judged that the input is abnormal when over-scale or underscale occurs.

Set value	Description
0000	Normal processing: The alarm action set by AS1 (Alarm 1 type selection) is taken even if the input is abnormal.
0001	Forcibly turned on when abnormal: The alarm is forcibly turned on regardless of the alarm type set by AS1 (Alarm 1 type selection) when the input is abnormal. However, for a voltage input of 0 to 5 V DC or 0 to 10 V DC, or a current input of 0 to 20 mA DC, as over-scale or underscale does not occur when the input breaks, no alarm is turned on.

Factory set value:
Alarm 1 not provided or LBA: 0 (Normal processing)
Alarm 1 provided: 1 (Forcibly turned on when abnormal)
Alarm 2 not provided: 0 (Normal processing)
Alarm 2 provided: 1 (Forcibly turned on when abnormal)

● Change Settings

Example: Change the Alarm 1 process abnormality action selection from "Normal processing (0000)" to "Forcibly turned on when abnormal (0001)"

1. Press the SET key at "F41" until "AEo1" is displayed.
2. Press the UP key to change the number to 1.
3. Press the SET key to store the new set value. The display goes to the function block symbol (F41).

8.8 Function Block 51 (F51)

■ ON/OFF Action differential gap (oH)

Setting range:
TC and RTD inputs, Voltage/current inputs: 0 (0.0) to span

Factory set value:
TC and RTD inputs: 2 °C [°F] or 2.0 °C [°F]
Voltage/current inputs: 0.2 % of span

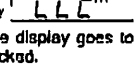
● Change Settings

Example: Change the On/Off Action differential gap from "2 °C" to "4 °C"

1. Press the SET key at "F51" until "oH" is displayed.
2. Press the UP key to change the number to 4.
3. Press the SET key to store the new set value. The display goes to the function block symbol (F51).

8.9 Exit Engineering Mode

1. Transfer to function block symbol display (FDD) after each parameter is set.
2. Press the <R/S key for two seconds while pressing the SET key from any display in the Engineering Mode.
3. Press the SET key for two seconds in the PV/SV display.
4. Press the SET key until "LCK" (Set Data Lock display) will be displayed.
5. The blinking digit indicates which digit can be set. Press the <R/S key to move to the thousands digit.
6. Press the DOWN key to change 1 to 0.

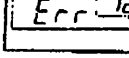


Set data lock function display

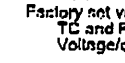
7. Press the SET key to store the new set value. The display goes to the next parameter, and the Engineering Mode is locked.

9. ERROR DISPLAYS

■ Error display

Display	Description	Solution
Err 	The error codes are shown in the SV display. When two or more errors occur simultaneously, the error code numbers are totaled and displayed as one number.	Turn off the power once. If an error occurs after the power is turned on again, please contact RKC sales office or the agent.

■ Overscale and Underscale

Display	Description	Solution
Measured value (PV) is flashing	PV is outside of input range	⚠ WARNING To prevent electric shock, always turn off the power before replacing the sensor. Check the sensor or input lead.
0000 flashing 	Overscale - PV is above the high input display range limit.	
---- flashing 	Underscale - PV is below the low input display range limit.	

10. INPUT RANGE TABLE

●TC/RTD

Type	Range	Code	Range	Code	Range	Code
K	0 to 200 °C	01	0 to 400 °C	02	0 to 800 °C	03
	0 to 400 °C	04	0 to 600 °C	05	0 to 1200 °C	06
	0 to 1372 °C	07	−199.9 to 400.0 °C	08	0.0 to 752.0 °F	09
	0.0 to 752.0 °F	10	0 to 1000 °C	11	0 to 1800 °F	12
	0 to 2192 °F	13	0 to 2000 °F	14	0.0 to 999.9 °F	15
	0.0 to 999.9 °F	16	−199.9 to +400.0 °F	17	0 to 400 °C	A1
	0 to 800.0 °C	37	−199.9 to +800.0 °C	38	0 to 800 °F	A2
	0 to 1999 °F	A3	0 to 2502 °F	A4	0 to 1000 °F	A5
	200 to 700 °F	A6	−199.9 to +999.9 °F	A7		
J	0 to 200 °C	01	0 to 400 °C	02	0 to 600 °C	03
	0 to 800 °C	04	0 to 1000 °C	05	0 to 1200 °C	06
	−199.9 to +300.0 °C	07	0.0 to 400.0 °C	08	0.0 to 752.0 °C	09
	0 to 1999 °F	10	0.0 to 752.0 °F	11	0 to 1800 °F	12
	−199.9 to +600.0 °F	35	0 to 800 °F	A1	0.0 to 999.9 °F	A2
	0 to 2192 °F	A3	0 to 400 °C	A4	−199.9 to +999.9 °F	A6
	0.0 to 999.9 °F	B6				
R	0 to 1600 °C	01	0 to 1760 °C	02	0 to 1920 °C	03
	0 to 3200 °F	A1	0 to 3216 °F	A2		
S	0 to 1600 °C	01	0 to 1760 °C	02		
	0 to 3200 °F	A1	0 to 3200 °F	A2		
B	400 to 1800 °C	01	0 to 1820 °C	02		
	752 to 3200 °F	A1	0 to 3308 °F	A2		
E	0 to 800 °C	01	0 to 1000 °C	02		
	0 to 1600 °F	A1	0 to 1832 °F	A2		
N	0 to 1000 °C	01	0 to 1300 °C	02	0 to 1535 °C	03
	0 to 2000 °F	A1	0 to 2372 °F	A2	0.0 to 999.9 °C	A5
T	−199.9 to +400.0 °C	01	−199.9 to +400.0 °F	02	−199.9 to +752.0 °F	03
	0.0 to 400.0 °C	04	−199.9 to +752.0 °F	A1	−100.0 to +200.0 °F	A2
	−199.9 to +400.0 °F	A3	0.0 to 400.0 °F	A4	0.0 to 752.0 °F	A5
W5Re/W26Re	0 to 2000 °C	01	0 to 2320 °C	02	0 to 4200 °F	A1
PLII	0 to 1390 °C	A1	0 to 1390 °C	A2	0 to 1535 °C	A3
	0 to 2490 °F	A4	0 to 2534 °F	A5		
U	−199.9 to +400.0 °C	01	−199.9 to +400.0 °F	02	0.0 to 400.0 °C	04
	−199.9 to +999.9 °F	A1	−199.9 to +752.0 °F	A2	0.0 to 999.9 °F	A3
L	0 to 400 °C	A1	0 to 800 °C	A2		
	0 to 752 °F	A3	0 to 1652 °F	A4		
Pt100	−199.9 to +649.0 °C	01	−199.9 to −100.0 °C	02	−100.0 to +100.0 °C	03
	−199.9 to +100.0 °C	04	−199.9 to +200.0 °C	05	0.0 to +649.0 °C	06
	0.0 to 100.0 °C	07	0.0 to 200.0 °C	08	0.0 to 300.0 °C	09
	0.0 to 600.0 °C	10				
JPt100	−199.9 to +649.0 °C	01	−199.9 to −100.0 °C	02	−100.0 to +100.0 °C	03
	−199.9 to +100.0 °C	04	−199.9 to +200.0 °C	05	0.0 to +649.0 °C	06
	0.0 to 100.0 °C	07	0.0 to 200.0 °C	08	0.0 to 300.0 °C	09
	0.0 to 600.0 °C	10				

*1 Accuracy is not guaranteed between 0 to 399 °C (0 to 751 °F).
*2 Accuracy is not guaranteed between −199.9 to −100.0 °C (−199.9 to −148 °F).

●Voltage/current inputs

Type	Range	Code	Type	Range	Code
0 to 5 V DC	0.0 to 100.0 %	4	0 to 20 mA DC	0.0 to 100.0 %	7
0 to 10 V DC	0.0 to 100.0 %	5	4 to 20 mA DC	0.0 to 100.0 %	8
1 to 5 V DC	0.0 to 100.0 %	6			

11. REMOVING THE INTERNAL ASSEMBLY

Usually, this instrument is not necessary to remove the internal assembly from the case. When removing the internal assembly without disconnecting the external wiring, take the following steps.

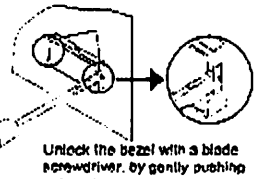
⚠ **WARNING**

- To prevent electric shock or instrument failure, only qualified personnel should be allowed to pull out the internal assembly.
- To prevent electrical shock or instrument failure, always turn off the power before pulling out the internal assembly.
- To prevent injury or instrument failure, do not touch the internal printed wiring board.

Apply pressure very carefully when removing internal assembly to avoid damage to the frame.

To conform to IEC61010-1 requirements for protection from electric shock, the internal assembly of this instrument can only be removed with an appropriate tool.

Recommended tool: Blade screwdriver
(Blade width: 3 mm or less)



Unlock the bezel with a blade screwdriver, by gently pushing outward.

The first edition: NOV. 1999
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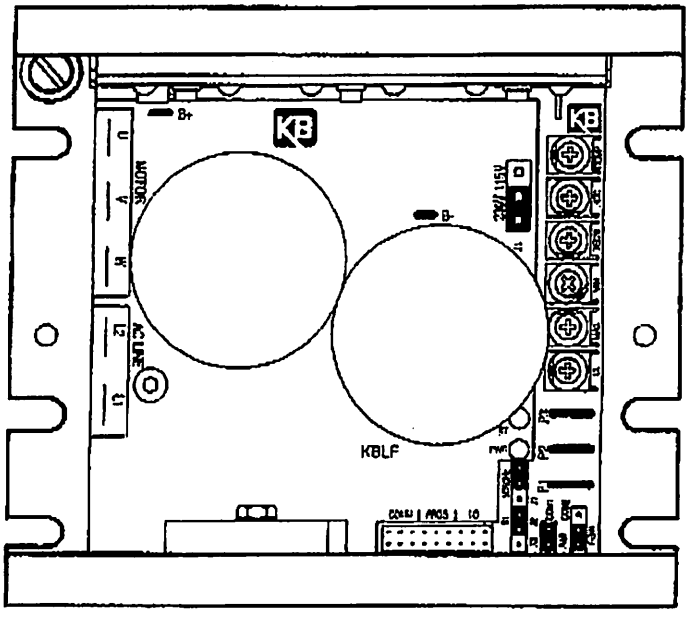
INSTALLATION AND OPERATION MANUAL

KBLF

ADJUSTABLE FREQUENCY DRIVE

Variable Speed / Soft-Start AC Motor Control with
I^2t Electronic Overload Protection
for 3-Phase Induction Motors through 1 HP



CE

c UL us
Pending

This Manual Covers the Following Model Numbers
KBLF-13D, 23, 23D, 14, 24, 24D and 26D

See Safety Warning on Page 1

PENTA KB POWER™

A COMPLETE LINE OF MOTOR DRIVES

TABLE OF CONTENTS

Electrical Hazard Warning Symbol: Failure to observe this warning could result in electrical shock or electrocution.

Operational Hazard Warning Symbol: Failure to observe this warning could result in serious injury or death.

I. SAFETY WARNING! Please read carefully

This product should be installed and serviced by a qualified technician, electrician, or electrical maintenance person familiar with its operation and the hazards involved. Proper installation, which includes wiring, mounting in proper enclosure, fusing or other over current protection, and grounding can reduce the chance of electrical shocks, fires, or explosion in this product or products used with this product, such as electric motors, switches, coils, solenoids, and/or relays. Eye protection must be worn and insulated adjustment tools must be used when working with control under power. This product is constructed of materials (plastics, metals, carbon, silicon, etc.) which may be a potential hazard. Proper shielding, grounding and filtering of this product can reduce the emission of radio frequency interference (RFI) which may adversely affect sensitive electronic equipment. If further information is required on this product, contact the Sales Department. It is the responsibility of the equipment manufacturer and individual installer to supply this Safety Warning to the ultimate end user of this product. (SW effective 9/2000).

This control contains electronic Start/Stop circuits that can be used to start and stop the control. However these circuits are never to be used as safety disconnects since they are not fail-safe. Use only the AC line for this purpose.

The input circuits of this control (potentiometer, start/stop, enable) are not isolated from AC line. Be sure to follow all instructions carefully. Fire and/or electrocution can result due to improper use of this product. After disconnecting AC power, high voltage exists on this control until both LED's are extinguished.

CE This product complies with all CE directives pertinent at the time of manufacture. Contact factory for detailed installation and Declaration of Conformity. Installation of a CE approved RFI filter (KBRF-350A [P/N 9511] or equivalent) is required (also see KB Publication No. 321). Additional shielded motor cable and/or AC line cables may be required along with a signal isolator (SIVF [P/N 9474] or equivalent).

I. INTRODUCTION

The KBLF Adjustable Frequency Drive is designed to provide variable speed control of standard three-phase AC induction motors. Adjustable linear acceleration and deceleration are provided, making the drive suitable for soft start applications. The output voltage is sinewave coded PWM operating at a carrier frequency of 16 kHz, which provides high motor torque, high efficiency and low noise. The KBLF is a full featured drive, and due to its user friendly design, it is easy to install and operate. Simple trimpot adjustments eliminate the computer-like programming required on other drives. However, for most applications, no adjustments are necessary.

The KBLF main features include Adjustable RMS Current Limit and I^2t Motor Overload Protection. Adjustable Slip Compensation provides excellent load regulation over a wide speed range. Power Start™ delivers over 200% motor torque to ensure startup of high frictional loads. Several models, through 2 HP, are available to control standard 208-230VAC - 50, 60 and 50/60Hz motors from either a 115 or 230VAC-50/60Hz-1ϕ AC line. The KBLF is easily tailored to specific requirements via selectable jumpers, such as Frequency Range (0-60, 0-50, 0-120, 0-100Hz), Auto/Manual Restart, and Forward-Stop-Reverse/Enable operation. Other standard features include Inrush Current Limiter (ICL), which eliminates harmful AC line inrush current, and two LED indicator lamps provide the user with diagnostic information. The drive is housed in a versatile U-frame chassis, which facilitates mounting and wiring.

TABLE 1 – ELECTRICAL RATINGS

Model No.	KB Part No.	Input Voltage (VAC-50/60 Hz) Single Phase	Nominal Output Voltage (VAC)	Maximum Horsepower Rating Hp, (kW)	Maximum Continuous Output Load Current (RMS Amps/Phase)	Maximum AC Line Input Current (Amps AC)
KBLF-13	9557	115	0 – 230	1/2, (0.37)	2.4	11.0
KBLF-23	9558	230	0 – 230	1/2, (0.37)	2.4	7.0
KBLF-23D	9559	115/230	0 – 230	1/2, (0.37)	2.4	11.0 / 7.0
KBLF-14	9577	115	0 – 230	1, (0.75)	4.0	16.0
KBLF-24	9578	230	0 – 230	1, (0.75)	4.0	10.0
KBLF-24D	9579	115/230	0 – 230	1, (0.75)	4.0	16.0 / 10.0
KBLF-28D	9580	115/230	0 – 230	1/2 [2]*, (1.3) [1.5]*	5.5	22.0 / 14.0

* 2 HP for most premium efficiency motors.

FIGURE 1A – KBLF 1/2 HP MECHANICAL SPECIFICATIONS – (Inches / [mm])

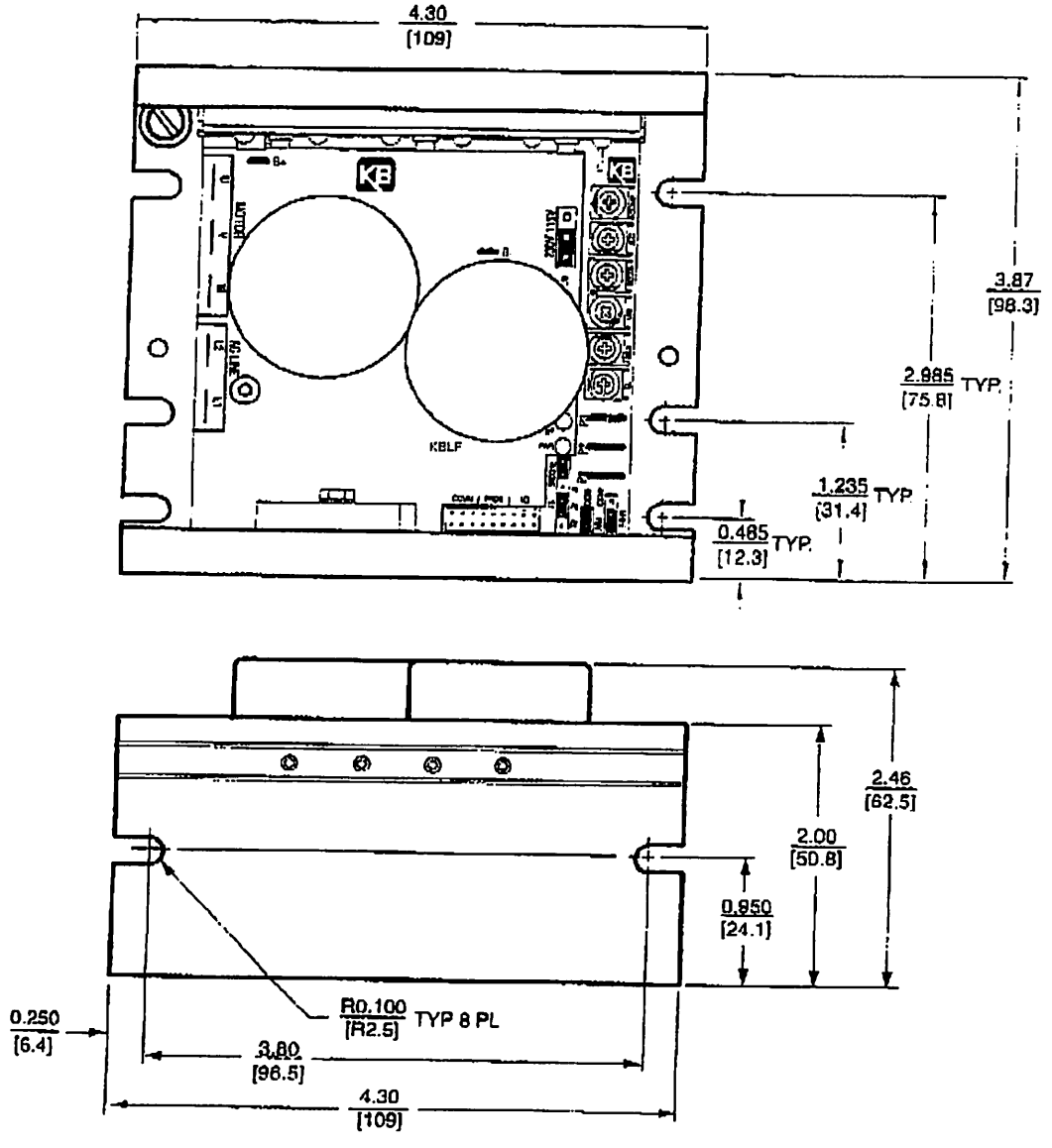
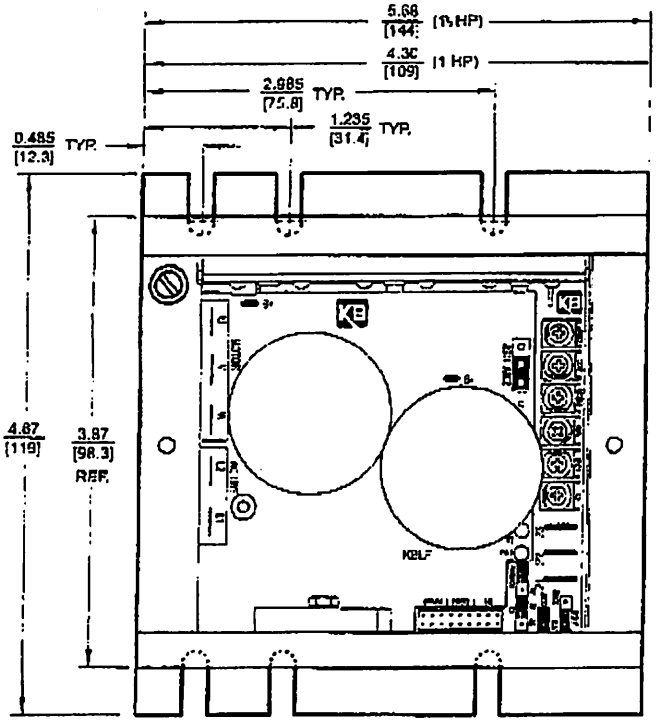


FIGURE 2 – KBLF 1 HP & 1½ HP MECHANICAL SPECIFICATIONS – (Inches / mm)



NOTES:

1) Maximum Control Height for KBLF-14, 24D: 4.96 [126]

2) Maximum Control Height for KBLF-24: 4.45 [113]

3) Maximum Control Height for KBLF-26D: 5.72 [145]

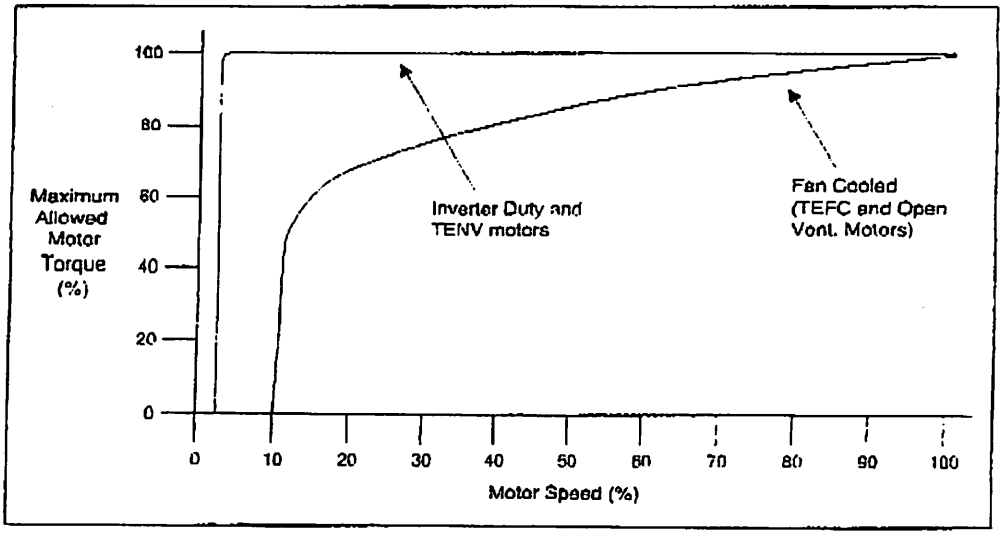
Enlarged View of Trimpots

TABLE 2 – GENERAL PERFORMANCE SPECIFICATIONS (All Models)

Parameter	Specification	Factory Setting
Recommended AC Line Input Operating Range (% of Nominal 115/230 VAC)	±10	–
Maximum Input Voltage Range, 115 VAC, 230 VAC	97 – 135, 195 – 270	–
Maximum Load (% Current Overload for 2 Minutes)	150	–
Carrier Frequency at Motor (kHz)	16	–
Signal Following Input Voltage (VDC)*	0 – 5	–
Signal Following Input Resolution (Bits, Hz)	10, 0.06	–
Minimum Speed Trimpot (MIN) Range (% Frequency Setting)	0 – 40	0
Output Frequency Setting (Hz)	0 – 50, 60, 100, 120	60
Maximum Speed Trimpot (MAX) Range (% Frequency Setting)	70 – 110	100
Speed Range (Ratio)	50:1	–
Acceleration and Deceleration Trimpot (ACC and DEC/B) Ranges (Seconds)	0.3 – 20	1.5
Boost Trimpot (DEC/B) Range (50 Hz Only) (%)	6 – 30	–
Slip Compensation Trimpot (COMP) Range (Volts/Hz/Amp)	0 – 3	1.5
CL Trimpot (CL) Range (% Full Load)	65 – 175	160
Speed Regulation (0-Full Load, 30:1 Speed Range) (% Base Speed)	2.5	–
Operating Temperature Range (°C)	0 – 45	–
Overload Protector Trip Time (Stalled Motor) (Seconds)	6	–
Bus Overvoltage Trip Point (VDC) (Equivalent AC Line Volts – 230 VAC Line)	400 (283)	–
Bus Undervoltage Trip Point (VDC) (Equivalent AC Line Volts – 230 VAC Line)	260 (184)	–
Maximum Allowable Vibration (G)	0.5	–

*Isolated Input Signal must be used.

FIGURE 3 – MAXIMUM ALLOWED MOTOR TORQUE vs SPEED



II. IMPORTANT APPLICATION INFORMATION

Most fan-cooled (TEFC and open ventilated) 3-phase motors will overheat if used with an inverter beyond a limited speed range at full rated torque. Therefore, it is necessary to reduce motor load as speed is decreased. Note: Some fan-cooled motors can be used over a wider speed range. Consult motor manufacturer for details.

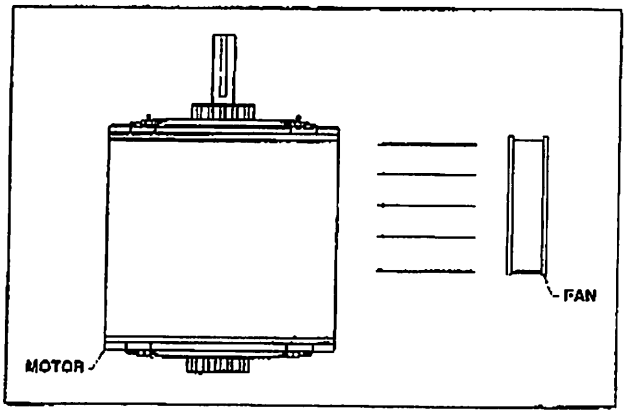
⚠ **WARNING!** There may be some motors whose characteristics may cause overheating and winding failure under light load or no load conditions. If the motor is to be operated in this manner for an extended period of time, it is recommended that the unloaded motor amperage be checked from 2-15 Hz (60-450 RPM) to ensure motor current does not exceed the nameplate rating. **Do not use the motor if the motor current exceeds the nameplate rating.**

Inverter duty and most totally enclosed nonventilated (TENV) motors can provide full rated motor torque over an extended speed range without overheating. See figure 3.

If external fan cooling is provided, open-ventilated motors can also achieve an extended speed range at full rated torque. A box fan or blower with a minimum of 100 CFM is recommended. Mount the fan a few inches from the motor so it is surrounded by the air flow.

⚠ **It is recommended that this control be used with inverter duty and totally enclosed nonventilated (TENV) motors.**

FIGURE 4 – MOTOR WITH EXTERNAL COOLING



III. SETTING SELECTABLE JUMPERS

A. Dual Voltage Controls – Models KBLF-23D, 24D and 26D have the capability of operating standard 208-230 VAC - 50/60 Hz, 3-phase motors from either a 115 VAC or 230 VAC - 50/60 Hz AC line. The jumper is factory set for 230VAC - 50/60 Hz AC line input. Use jumper J1 on the top PC board to change the voltage input.

WARNING! Do not change jumper position with AC line connected. Be sure proper input voltage is applied to control corresponding to jumper setting. Connecting 230VAC to a 115VAC control input will permanently damage control. "115VAC" and "230VAC" labels are provided. Use the appropriate label to identify the correct input voltage after setting jumpers.

FIGURE 5A – J1 SET TO 230 VOLTS

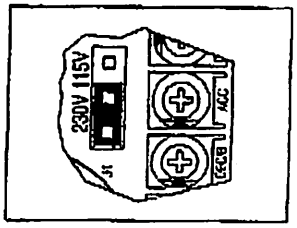
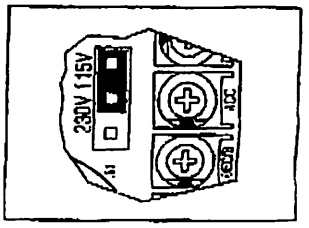


FIGURE 5B – J1 SET TO 115 VOLTS



B. Motor Frequency – The controls are factory set to operate 60 Hz and 50/60 Hz motors (Jumper J1 is set to the "60 Hz" position and Jumper J2 is set to the "X1" position). For 50 Hz operation, set Jumper J1 to the "50 Hz" position. For 120 Hz operation, Jumper J1 is set to the "60 Hz" position and Jumper J2 is set to the "X2" position. For 100 Hz operation, set Jumper J1 to the "50 Hz" position and set Jumper J2 to the "X2" position. See figure 6.

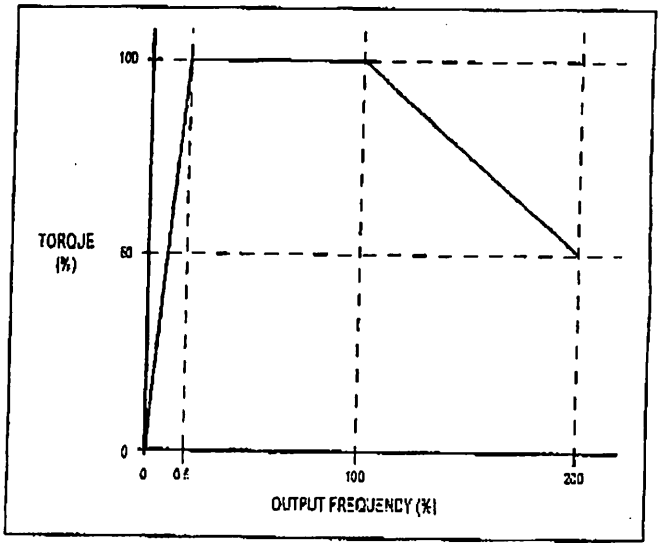
Note: When the control is set for 50 Hz operation, the DECEL trimpot will automatically change to adjustable boost. See section IX, G, page 11.

FIGURE 6 – OUTPUT FREQUENCY SETTING

Control Set for 60 Hz Motor (Factory Setting)		Control Set for 50 Hz Motor		Control Set for 120 Hz Motor		Control Set for 100 Hz Motor	
J2 Set for X1 Multiplier	J1 Set for 60 Hz	J2 Set for X1 Multiplier	J1 Set for 50 Hz	J2 Set for X2 Multiplier	J1 Set for 60 Hz	J2 Set for X2 Multiplier	J1 Set for 50 Hz
							

The control can also operate 50 Hz, 60 Hz, and 50/60 Hz motors in an overspeed mode. In this mode, the motor will produce full rated torque up to its frequency rating. Operating the motor above its frequency rating will linearly reduce the torque to 50% at the doubled frequency.

FIGURE 7 – AVAILABLE TORQUE vs OUTPUT FREQUENCY



C. Auto/Manual Operation

i. **Auto Operation** – The control is factory set to start automatically each time the AC line is connected. It will also automatically start when recovering from faults due to overvoltage, undervoltage and short circuit. If an I^2t fault occurs due to a prolonged overload, the control must be manually restarted.

Note: The control can be restarted due to an I^2t fault by one of the following methods:

1. Disconnect and reconnect the AC power ("ST" LED must change from flashing green to Red/Yellow flash - approximately 15 seconds.)
2. Turning the main speed pot to zero (MIN speed trimpot must be set to "zero" speed in order to reset with main speed pot).
3. Use Enable (Forward-Stop-Reverse) contact. See section V, F, on page 8.

Note: If the control trips in I^2t, the motor may be overloaded. Check motor current with an AC ammeter. (Use RMS responding meter.) Also, the CL setting may be set too low (see section IX, E, page 10).

ii. **Manual Operation** – To operate in the manual mode, the A/M jumper must be removed and the 2-wire connector (supplied separately, Part No. 9555) must be installed. See section. V, E, on page 7 for complete details.

D. **Forward / Reverse** – The controls are factory set for "Forward" operation. If, after wiring the control, it is determined the motor direction is incorrect, simply change the F-S-R jumper position from "F-S" to the "S-R" position.

WARNING! (Be sure to disconnect power and wait for the "PWR" LED to extinguish.)

See section V, F, on page 8 for complete details on using the F-S-R function.

Note: Two motor leads can be interchanged to change rotation.

IV. MOUNTING

Mount the control on a flat surface free of moisture, metal chips, and other contamination, including corrosive atmosphere, that may be harmful. For maximum cooling efficiency, mount the control with fins or sides in a vertical position. If controls are to be mounted in an enclosure, allow at least 6" x 8" x 12" for 1/2 HP, 8" x 8" x 16" for 1 HP, and 12" x 12" x 18" for 1½ HP. Ambient temperature is not to exceed 45 °C. Also, mount control as close as possible to the bottom of the enclosure. When mounting the 5K remote speed potentiometer, be sure to install insulating disc between potentiometer and inside of front panel.

WARNING! Do not use Start/Stop or Enable circuits as an emergency stop or severe injury may result.

WARNING! Do not wire control with power on. Fire and/or electrocution can result if caution is not exercised.

TABLE 3 – WIRING INFORMATION

Terminal Designation	Connection Designation	Type of Connector	Supply Wire Gauge	
			Minimum	Maximum
AC Line	L1, L2	1/4" QD	16	14
Motor	U, V, W	1/4" QD	16	14
Potentiometer	P1, P2, P3	1/4" QD	22	18

V. WIRING (Use the quick-connect terminals provided for AC line, motor and speed pot wiring.)

A. **AC Line** – Wire the correct input AC line voltage 115, 230VAC - 50/60 Hz to terminals L1 and L2, depending on model number and jumper selection for dual voltage models. **Be sure to connect proper input voltage to control - catastrophic control failure can result due to improper voltage.** It is recommended that a fuse be installed on each ungrounded conductor. Do not fuse neutral conductors. Follow NEC or other electrical codes that apply. See section VI, on page 8 for recommended fuse size.

Be sure to ground chassis using green ground screw. Do not ground (earth) any signal connections. See figure 8.

B. Motor – Connect motor wires to terminals "U," "V" and "W." It is recommended that the cable length be limited to 100 feet between control and motor. See figure 8. **Note:** If cable length is greater than 100 feet, special reactors may have to be installed. **Important! These controls are designed for 208 - 230 VAC motors - be sure motor is wired correctly.**

IMPORTANT - Do not bundle low voltage signal wiring (main speed potentiometer, signal following, manual start or forward-stop-reverse/enable) with any main power wiring from AC line or motor. For all signal wiring over 18" shielded cable is recommended. Do not ground (earth) shield.

C. Speed Potentiometer – Connect speed potentiometer as shown . The high side is wired to P3 and the wiper is wired to P2. See figure 9. Wire the low side to P1 - **do not ground (earth) low side of potentiometer or catastrophic control failure will result.**

D. Signal Following – The control may be operated with a 0 - 5VDC **isolated** signal in lieu of the main speed potentiometer. Connect pos (+) signal to P2 and neg (–) to P1. See figure 10. **Do not ground neg (–) signal wire.**

Note: For proper operation, "MIN" trimpot must be turned to zero (CCW). If 0-10VDC operation is required, a resistor network can be added as per figure 11. If an isolated signal is not available, a separate signal isolator must be used (SIVF or equivalent). Do not ground (earth) signal wiring.

E. Manual Start Mode – To operate in the manual start mode the A/M jumper must be removed and the 2-wire connector (supplied separately, Part No. 9555) must be installed. The connector must be wired to a momentary reset switch or contact. See figure 13 on page 8. In the Manual mode the control will trip due to all faults, overvoltage, undervoltage, short circuit and I^2t and remain tripped even when the fault condition is corrected. (See LED diagnostics, section VIII on page 8.) The control must be reset manually by closing the A/M contacts. Also, the control must be restarted each time the AC line is interrupted.

FIGURE 8 – MOTOR AND AC LINE CONNECTIONS

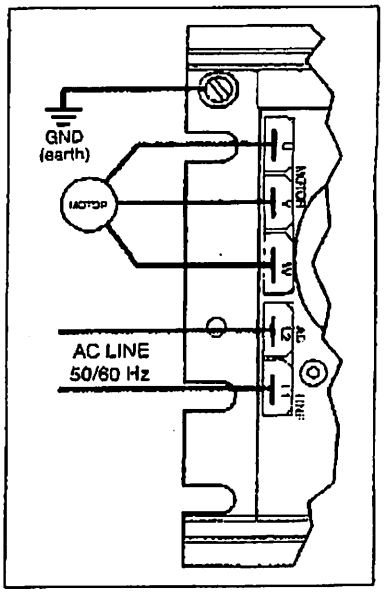


FIGURE 9 – MAIN SPEED POTENTIOMETER CONNECTIONS

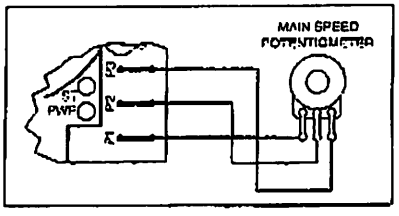


FIGURE 10 – SIGNAL FOLLOWING 0 – 5 VDC (ISOLATED)

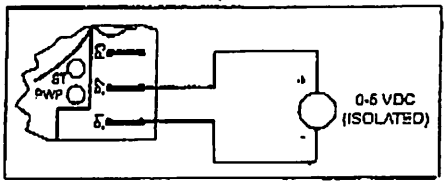


FIGURE 11 – SIGNAL FOLLOWING 0 – 10 VDC (ISOLATED)

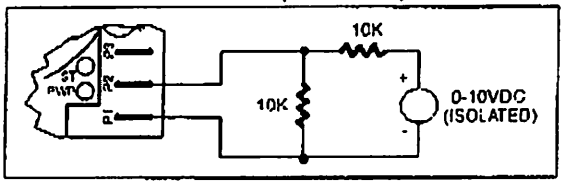
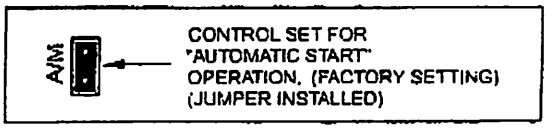


FIGURE 12 – AUTO/MANUAL SELECTION



F. Forward-Stop-Reverse/Enable – The KBLF may be controlled in several ways using the Forward-Stop-Reverse/Enable circuit. Remove the F-S-R jumper and install the 3-wire connector (supplied separately, Part No. 9555). The control can now be made to instantly reverse or start/stop electronically (Enable). See figure 14 for Start/Stop - Enable and Forward-Stop-Reverse connections.

FIGURE 13 – MANUAL START/RESET SWITCH CONNECTION

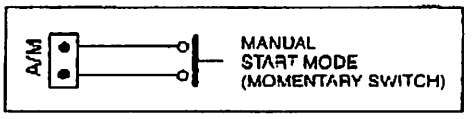
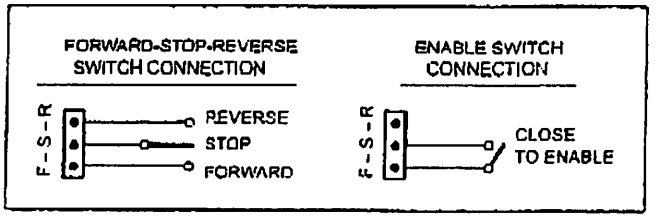


FIGURE 14 – FORWARD-STOP-REVERSE / ENABLE



VI. FUSING

It is recommended that a fuse or circuit breaker be used on each AC line connection not at ground potential. Do not fuse neutral or ground connections. Use a normal or slow blow fuse according to the table below:

TABLE 4 – FUSE SELECTION CHART

Model	AC Line Voltage	Maximum AC Line Current	AC Line Fuse (Amps)
KBLF-13	115	11.0	15
KBLF-23	230	7.0	10
KBLF-23D	115	11.0	15
	230	7.0	10
KBLF-14	115	16.0	20
KBLF-24	230	10.0	15
KBLF-24D	115	16.0	20
	230	10.0	15
KBLF-26D	115	22.0	25
	230	14.0	20

VII. OPERATION

WARNING! Read Safety Warning on page 1 before attempting to operate. Severe injury or death may result.

Caution! It is recommended that the bus capacitors be reconditioned if this product has been in storage for over one year. To recondition the capacitors, apply the AC line, with the drive in the Stop Mode, for a minimum of one hour.

After all wiring and setup is completed and rechecked, the control can be powered up. The main speed potentiometer should initially be set at the minimum position (CCW) and gradually rotated clockwise to increase motor speed. Check status LED's to verify proper operation. See section VIII.

VIII. LED STATUS INDICATORS

The KBLF Adjustable Frequency Drive contains two LED status indicators. The first LED is a tricolor lamp (ST) that indicates a fault or abnormal condition. The information provided can be used to diagnose an installation problem, such as incorrect input voltage, overload condition and control circuit miswiring. It also provides a "normal" signal that informs the user that all control and micro processor operating parameters are proper. The second LED is a Power On indicator (PWR) that senses the presence of the bus voltage and the operation of the main control logic power supply. The status functions are summarized in table 5 on page 9.

TABLE 5 – STATUS INDICATORS

LED Ref.	Function	State[1]	LED Color	Controller Status In Auto Mode	Controller Status In Manual Start Mode	LED Color– Recovered Fault (Manual Mode)
"ST" (Status)	Normal Control Operation	Slow Flash	Green	Run	Run	–
	CL (current Limit)	Steady	Red	Run	Run	Green[2]
	$I^2 x t$	Quick Flash	Red	Trip[4]	Trip[4]	Green[2]
	Short Circuit	Slow Flash	Red	Shutdown[3]	Trip[4]	–
	Undervoltage	Quick Flash	Red/Yellow	Shutdown[3]	Trip[4]	Red/Yellow/Green[5]
	Overvoltage	Slow Flash	Red/Yellow	Shutdown[3]	Trip[4]	Red/Yellow/Green[5]
	Stop	Steady	Yellow	Shutdown[3]	Shutdown[3]	Green[2]
"PWR" (Power)	Bus & Power Supply	Steady	Green	–	–	–

(1) Slow flash: 1 sec. on, 1 sec. off; Quick flash: .25 sec. on, .25 sec. off.

(2) When control recovers from CL or Stop, the Status LED returns to the "normal" flashing green.

(3) Shutdown: Control will "stop" but will resume operation after fault is cleared.

(4) Trip: Control will "stop" and not restart when fault is cleared. See instructions for restart procedure, sec. V, E, page 7.

(5) If a fault occurs in the manual start mode, such as undervoltage or loss of AC power, the drive will trip. The status "ST" LED will begin to quick flash Red/Yellow. The drive cannot be restarted if the undervoltage condition persists. When the voltage returns to normal, the "ST" LED will begin to flash Red/Yellow - Green. This signifies that there was an undervoltage or loss of voltage condition that has been corrected. The control can now be restarted with the manual start contact.

IX. TRIMPOT ADJUSTMENTS

These controls contain trimpots which have been factory adjusted for most applications. Figure 2, on page 3 illustrates the location of the trimpots and their approximate adjustment positions. Some applications may require readjustment of the trimpots in order to tailor the control to exact requirements. (See table 2 on page 3, for range and factory setting of trimpots.) Readjust 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 Warning on page 1 must be read and understood before proceeding. Failure to follow the Safety Warning instructions may result in electric shock, fire or explosion.

A. Minimum Speed (MIN) – The MIN trimpot is used to set the minimum output frequency of the drive, which sets the minimum motor speed. The minimum speed is factory set to zero. Readjust the MIN trimpot as follows:

1. Rotate main speed potentiometer to the minimum speed position (full counterclockwise).
2. Increase setting of MIN trimpot so that motor runs at desired minimum speed.

NOTE: For signal following operation, the MIN trimpot is not operational and must be set to its minimum position (full counterclockwise).

FIGURE 15 – MIN

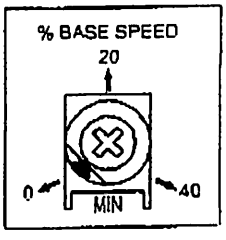
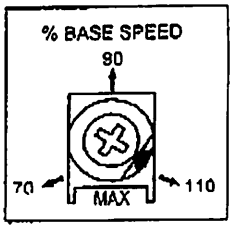


FIGURE 16 – MAX

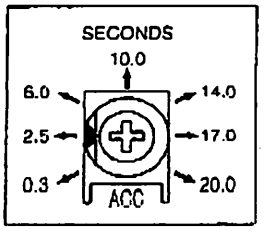


B. Maximum Speed (MAX) – The MAX trimpot is used to set the maximum output frequency of the drive. The maximum speed is factory set to full rated motor speed. Readjust the MAX trimpot as follows:

1. Rotate main potentiometer to maximum speed position (full clockwise).
2. Adjust MAX trimpot to desired setting of motor speed.

C. Acceleration (ACC) – The ACC trimpot sets the time it takes the motor to reach full speed from an initial zero start. The trimpot is factory set to approximately 2.5 seconds. Adjust the ACC trimpot as required for the application. See figure 17.

FIGURE 17 – ACC

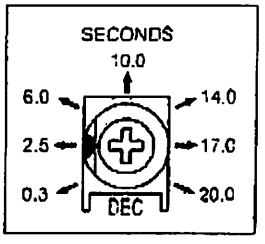


Note: When the control is set for 50 Hz operation, the ACC trimpot will automatically change to adjustable acceleration and deceleration.

Note: Rapid acceleration may cause the current limit circuit to activate. This will automatically extend the acceleration time.

D. Deceleration (DEC) – The DEC trimpot sets the time it will take the motor to reach zero speed from an initial full speed setting. The trimpot is factory set to approximately 2.5 seconds. Adjust the trimpot as required for application.

FIGURE 18 – DEC



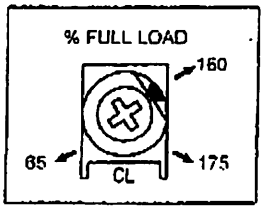
Note: When the control is set for 50 Hz operation, the DEC trimpot will automatically change to Adjustable Boost. See section IX, G on page 11.

Application Note: On applications with high inertial loads, the deceleration may automatically increase in time. This will slow down the rate of speed decrease to prevent the D.C. bus voltage from rising to the overvoltage trip point. This function is called regeneration protection.

It is recommended that for very high inertial loads that both the ACC and DEC trimpots be set to a minimum of 10 seconds.

E. Current Limit with I^2t Shutdown (CL) – The CL trimpot is used to set the maximum motor current that occurs in a stalled condition. The CL trimpot is factory set to approximately 160% of full control rating (3.8 Amps: 1/2 HP, 6.4 Amps: 1 HP, 8.8 Amps: 1½ HP). The CL trimpot can be readjusted as required.

FIGURE 19 – CL



The current limit also contains an I^2t trip function. The control will trip according to a predetermined current versus time function. The trip curve is directly related to the CL setpoint and can be changed with the CL trimpot.

The current limit with I^2t shutdown is designed to provide motor overload protection. Readjust the CL trimpot so that it is set to 160% of full rated motor current as follows.

1. Connect an AC ammeter in series with one motor phase.
2. Lock motor shaft and quickly adjust desired locked rotor motor current using CL trimpot.

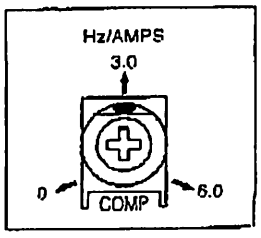
NOTE: This adjustment must be made within 6 seconds or I^2t trip will occur.

Example: A 1/2 HP motor has a full load current of 1.8 Amps. Set the CL trimpot to 1.8 x 160% = 2.9 Amps.

I^2t trip will now protect the motor against overloads.

F. **Slip Compensation (COMP)** – The COMP trimpot is used to maintain set motor speed under varying loads. The factory COMP trimpot setting of 1.5 Volts/Hz/Amps provides excellent speed regulation for most motors. The COMP trimpot can be adjusted for specific applications as required.

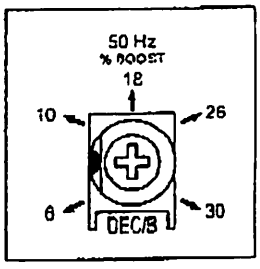
FIGURE 20 – COMP



1. Wire an AC ammeter in series with one motor phase..
2. Run motor and set unloaded speed to approximately 50% speed (900 RPM on 4-pole 1500/1725 RPM motors). Using a tachometer, record unloaded speed.
3. Load motor to rated motor nameplate current (AC Amps).
4. Adjust COMP trimpot so that loaded RPM is equal to unloaded RPM.
5. Motor is now compensated to provide constant speed under varying loads.

G. **Boost** – (When the control is set for 50 Hz motors, the DEC trimpot becomes Adjustable Boost.) Most 60 Hz motors conforming to NEMA standards can operate from a preset volts-per-hertz curve. 50 Hz motors generally differ widely in their characteristics. Therefore, it is necessary to have Adjustable Boost to obtain maximum motor performance.

FIGURE 21 – DEC/B



Since the boost trimpot was the DEC trimpot in the 60 Hz mode, it will take on the prior setting of the DEC trimpot.

In order for the 50 Hz motor to run properly, the boost must be adjusted. If the application does not require full torque below 10 Hz, the boost trimpot can be conservatively set at 8% (9 o'clock position).

If more precise speed regulation is required due to varying load, the boost can be set as follows:

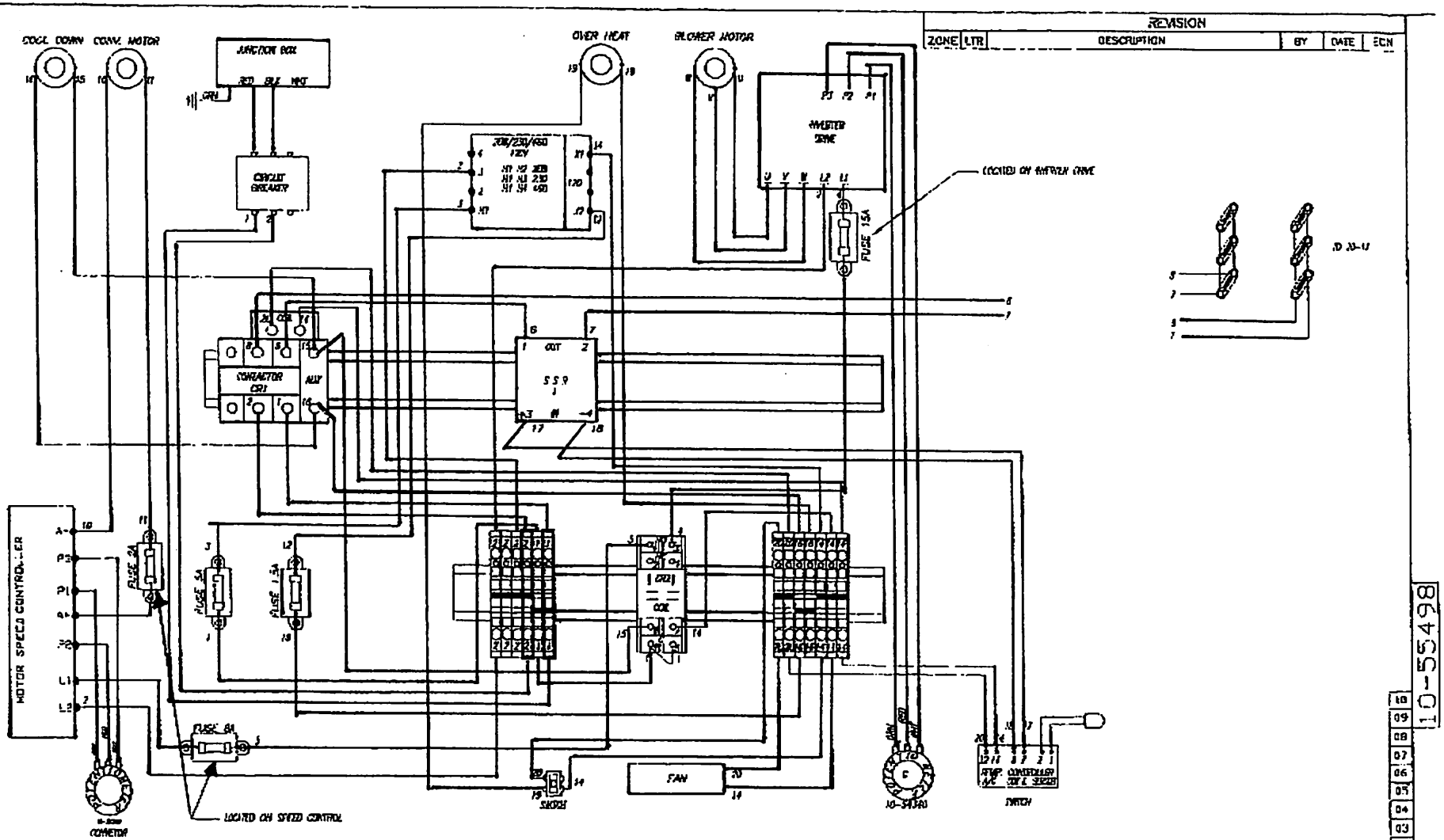
1. Place an AC analog RMS ammeter in series with one motor lead. (Generally, digital or clamp-on meters do not yield accurate readings.)
2. Run the motor unloaded* at approximately 4 Hz (or 120 RPM).

   *Note: An unloaded motor with excessive boost will draw more current than a partially loaded motor.
3. Turn up boost until the ammeter reaches the nameplate motor rating.
4. Using the main speed potentiometer, slowly adjust motor speed over a 0 – 15 Hz (0 – 450 RPM) range. If motor current exceeds nameplate rating, lower boost setting.

⚠ **WARNING! TO AVOID MOTOR WINDING, OVERHEATING AND FAILURE, DO NOT OVER BOOST MOTOR.**

X. OPTIONAL ACCESSORIES

- **SIVF Signal Isolator (Part No. 9474)** – Provides an isolated interface between non-isolated signal sources and the KBLF Adjustable Frequency Drive.
- **Multi-Speed Board (Part No. 9503)** – Provides four (4) user-selectable preset speeds.
- **RFI Filters and Chokes:** RFI Filters and Chokes are available to provide suppression for conducted radio frequency interference (RFI). They comply with the CE Directive 89/336/EEC relating to the EMC Class A Industrial Standard and Class B Residential Standard. See RFI Filters and Chokes Selection Guide Publication No. D-321.
- **Manual Start/Reset and Forward-Stop-Reverse/Enable Harness Kit (Part No. 9555)** – Provides remote connections for Manual Start/Reset Switch and Forward-Stop-Reverse/Enable Switch.



REVISION					
ZONE	LTR	DESCRIPTION	BY	DATE	ECN

ITEM	REV'D	CODE IDENT NO	PART NO	DESCRIPTION	AMOUNT	RAW MATERIAL NO

PARTS LIST

REV'D	NEXT ASSY	USED ON

UNLESS OTHERWISE SPECIFIED, DIMENSIONS ARE IN INCHES
FRACTIONS ± 1/64
3 PLACE DECIMALS ± .005
2 PLACE DECIMALS ± .01
ANGLES ± 1/4°

AUTHENTICATION

DRAWN	D.B.	9/27/02
CHECKED		
APP'D		

CHARLES BESELER COMPANY
LINDEN, N.J. 07036

WIRING DIAGRAM
T 20 1 PHASE

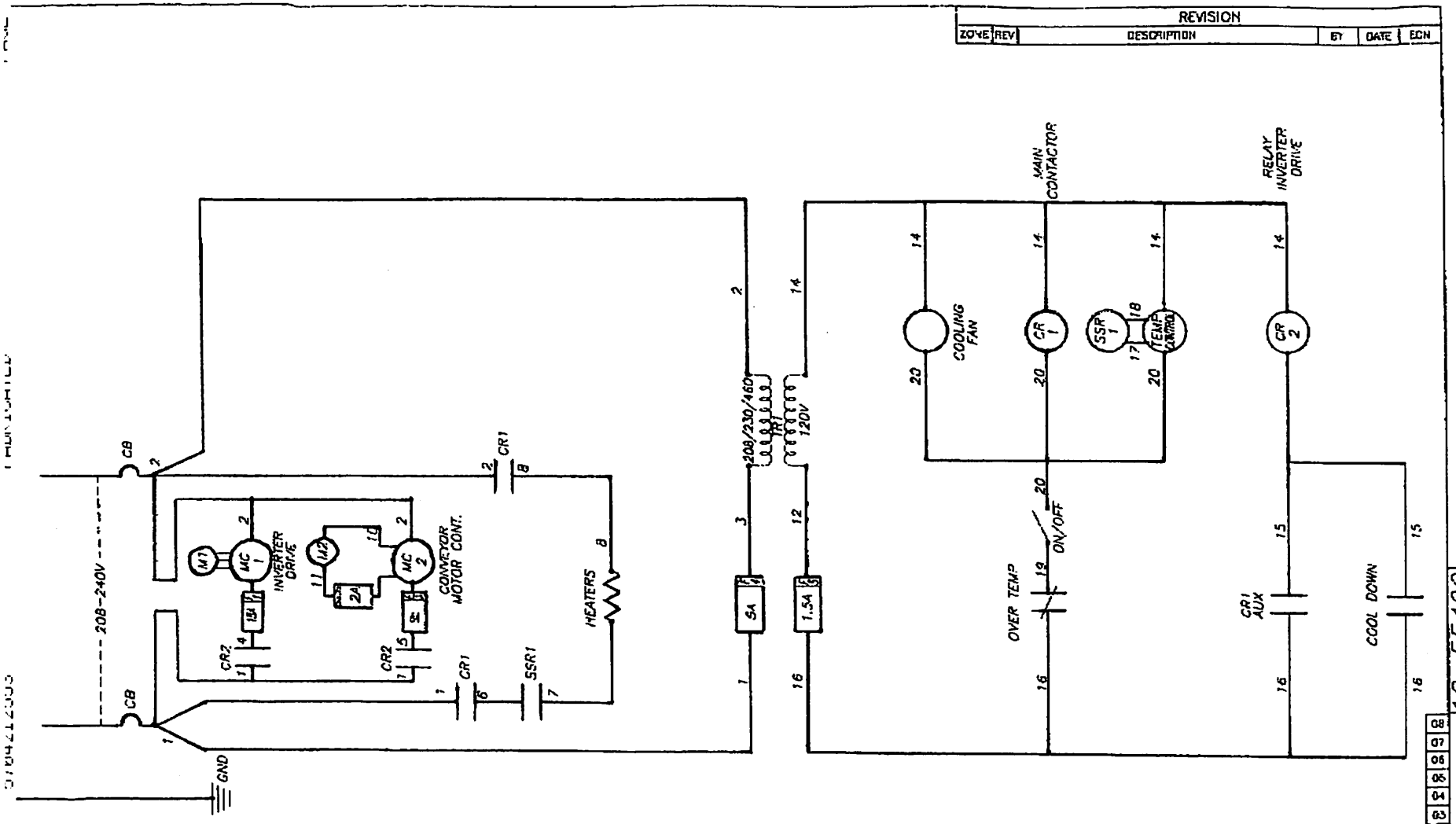
DISK # 131

SIZE C

DWG NO 10-55498 XX

SH NO

10-55498-01



TR1 = CONTROL TRANSFORMER
CB = CIRCUIT BREAKER
CR1 = MAIN CONTACTOR
CR2 = DPDT RELAY
F1 = INVERTER DRIVE FUSE
F2 = DC MOTOR FUSE
F3 = DC CONTROLLER FUSE
F4 = TRANSFORMER INPUT FUSE
F5 = TRANSFORMER OUTPUT FUSE
SSR = SOLID STATE RELAY
MC1 = DC MOTOR CONTROLLER
MC2 = MOTOR CONTROLLER AC
M1 = DC MOTOR
M2 = 3 PHASE MOTOR

ITEM	REQ'D	CODE IDENT NO	PART NO	DESCRIPTION	AMOUNT	RAW MATERIAL NO

PARTS LIST

REQ'D	NEXT ASSY	USED ON

UNLESS OTHERWISE SPECIFIED, DIMENSIONS ARE IN INCHES
FRACTIONS ± 1/64
3 PLACE DECIMALS ± .005
2 PLACE DECIMALS ± .01
ANGLES ± 1/4°

AUTHENTICATION

DRAWN	D.B.	9/27/02
CHECKED		
APP'D		

DISK # 131

CHARLES BESELER COMPANY
LINDEN, N.J. 07036

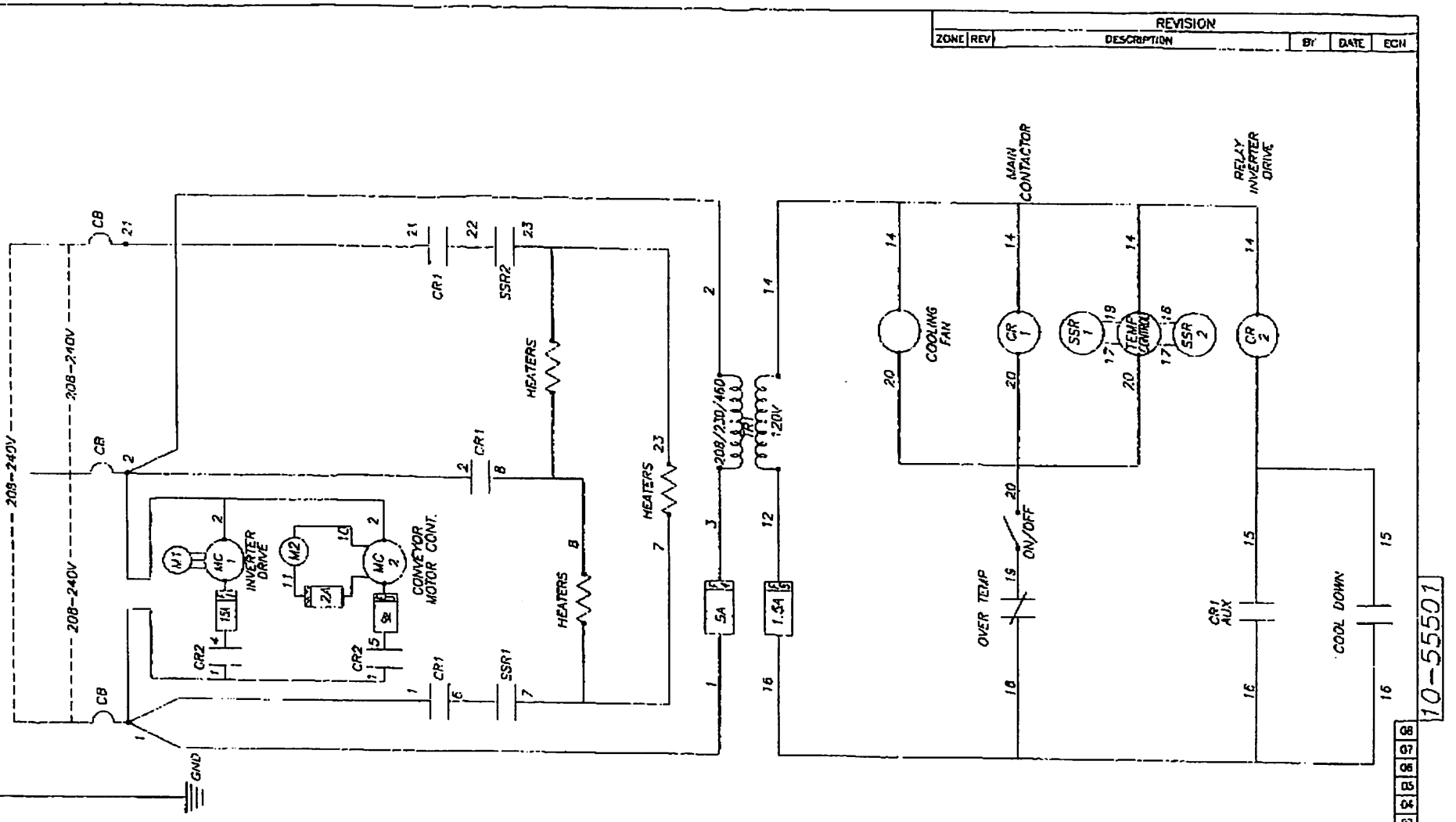
SCHEMATIC
T 20 1 PHASE

SIZE C

DRWG NO 10-554.

REV X

ES NO



TR1 = CONTROL TRANSFORMER
CB = CIRCUIT BREAKER
CR1 = MAIN CONTACTOR
CR2 = DPDT RELAY
F1 = INVERTER DRIVE FUSE
F2 = DC MOTOR FUSE
F3 = DC CONTROLLER FUSE
F4 = TRANSFORMER INPUT FUSE
F5 = TRANSFORMER OUTPUT FUSE
SSR = SOLID STATE RELAY
MC1 = DC MOTOR CONTROLLER
MC2 = MOTOR CONTROLLER AC
M1 = DC MOTOR
M2 = 3 PHASE MOTOR

ITEM	REQ'D	CODE IDENT NO	PART NO	DESCRIPTION	AMOUNT	RAW MATERIAL NO	ITEM

PARTS LIST

REQ'D	NEXT ASSY	USED ON
APPLICATION		

UNLESS OTHERWISE SPECIFIED, DIMENSIONS ARE IN INCHES
FRACTIONS ± 1/64
3 PLACE DECIMALS ± .005
2 PLACE DECIMALS ± .01
ANGLES ± 1/4°

AUTHENTICATION

DRAWN	D.B.	9/18/02
CHECKED		
APP'D		

DISK # 131

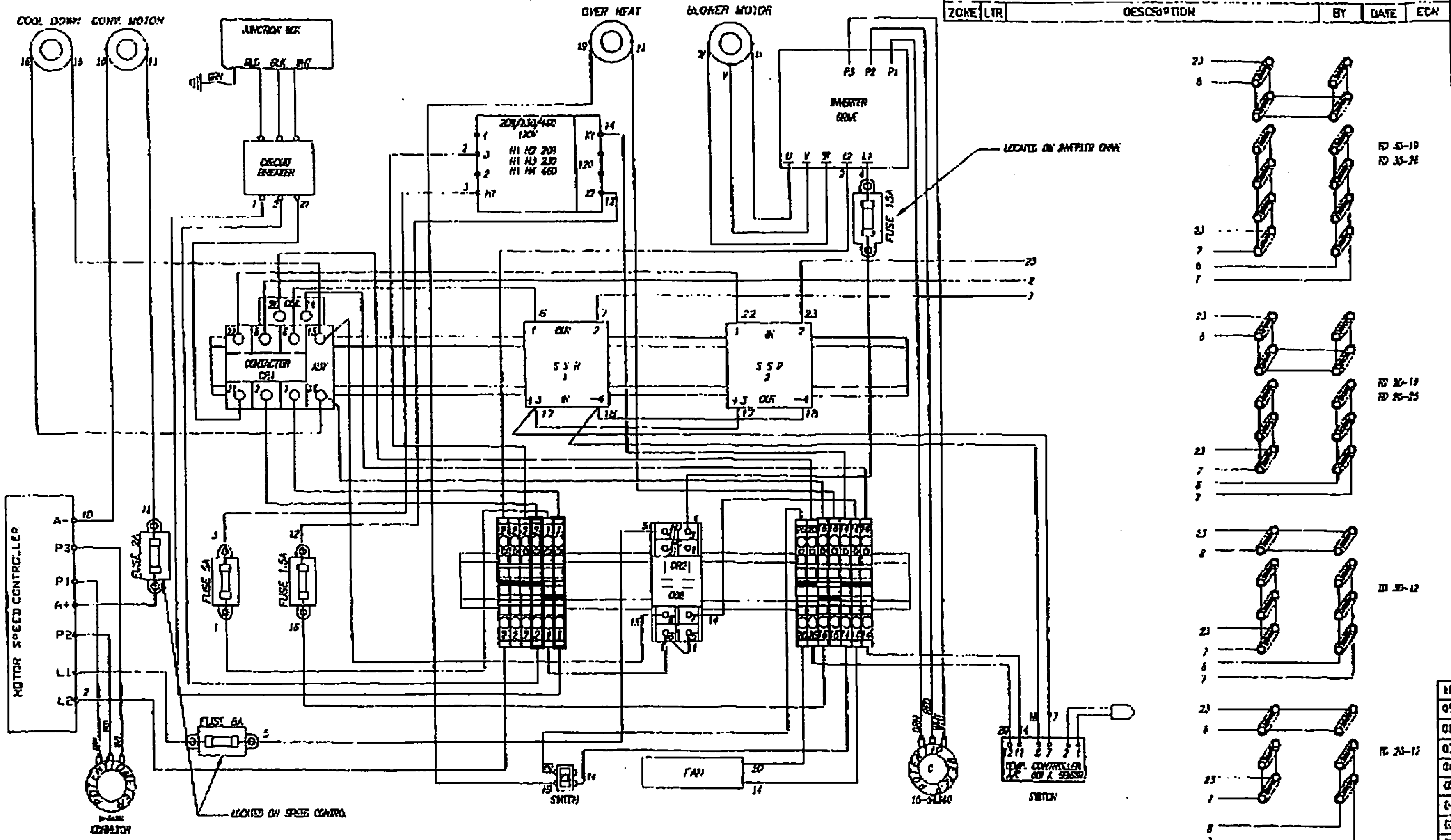
CHARLES BESELER COMPANY
LINDEN, N.J. 07036

SCHEMATIC
T 20/30 3 PHASE

SIZE	DRWG NO	REV
C	10-55501	XX

SCALE ~ SHEET 1

REVISION					
ZONE	LTR	DESCRIPTION	BY	DATE	ECN



10-55500

ITEM	REQ'D	CODE IDENT NO	PART NO	DESCRIPTION	AMOUNT	RAW MATERIAL	NO

PARTS LIST

UNLESS OTHERWISE SPECIFIED, DIMENSIONS ARE IN INCHES
FRACTIONS ± 1/64
3 PLACE DECIMALS ± .005
2 PLACE DECIMALS ± .01
ANGLES ± 1/4°

AUTHENTICATION		
DRAWN	D.B.	9/23/02
CHECKED		
APP'D		

CHARLES BESELER COMPANY
LINDEN, N.J. 07036

WIRING DIAGRAM
T 20/30 3 PHASE

DISK # 131

SIZE C

DRWG NO 10-555[illegible] XX

REQ'D	NEXT ASSY	USED ON

APPLICATION

SCALE

BESELER's One Year Limited Warranty

Charles Beseler Company warrants to the original purchaser only that this unit shall be free from defects in material and workmanship under normal use and service for a period of **One (1) Year** from the date of purchase from an authorized Beseler Dealer only; however, this warranty does not cover Normal Wear Part such as fuses and sealing pad material. These parts are warranted to be free from defects in material and workmanship as delivered with the product. Any claim for repair or replacement of Normal Wear Parts must be made within **Thirty (30) Days** from the date of purchase. No claims involving damage caused by accidental damage (including acts of God), abuse, and misuse will be honored. Nor will claims be honored if repairs are made by persons other than authorized Beseler dealer personnel. Such determinations will be made solely by Beseler. This warranty does not cover minor mechanical adjustments which are not due to any defect in material or workmanship. Any alteration or removal or defacing of the serial plate cancels all obligations of this warranty.

The purchaser must give immediate notice to Beseler's authorized dealer from whom the machine was purchased in the event that the purchaser wishes to make a warranty claim.

This Beseler One Year Limited Warranty is your exclusive remedy. Beseler's sole obligation under this warranty shall be to repair or replace (at Beseler's option) the defective part(s). Returns for servicing should be made to your Beseler authorized dealer only. If it is necessary for the dealer to return the machine or part to Beseler, transportation expenses to and from beseler are payable by the purchaser and Beseler is not responsible for damage in shipment.

THIS WARRANTY IS IN LIEU OF ALL OTHER EXPRESSED AND IMPLIED WARRANTIES INCLUDING THE IMPLIED WARRANTY OF MERCHANTABILITY AND WARRANTY OF FITNESS FOR A PARTICULAR PURPOSE, EXCEPT AS MAY BE MANDATED BY STATUTE OR RULE OF LAW. Any implied warranties of fitness for use, or merchantability, that may be created by operation of law are limited to the one-year warranty period, as herein defined. **NO LIABILITY IS ASSUMED FOR EXPENSES OR DAMAGES RESULTING FROM INTERRUPTION OF BUSINESS AND/OR EQUIPMENT OPERATION OR FOR INCIDENTAL, DIRECT OR CONSEQUENTIAL DAMAGES OF ANY NATURE.** Some states do not allow the exclusion or limitation of incidental or consequential damages; therefore, the above limitation or exclusion may not apply to you.

This warranty gives you specific legal rights and you may also have other rights, which vary from state to state. You may also have implied warranty right. In the event of a problem with warranty service or performance, you may be able to go to a Small Claims Court, a State Court, or a Federal District Court.

CHARLES BESELER CO.
R.D.#2 W. MAIN STREET
P.O. BOX 431
STROUDSBURG, PA 18360