4. GENERAL PURPOSE COMMANDS

All of the commands may be prefixed with a device address. Any command that will cause the drive to transmit information to the RS-232 port MUST be prefixed with a device address. This is to prevent several units from transmitting at the same time.

Responses and reports from the drive will have a * as a leading character to prevent the response from being interpreted as a command by other drives on the communication link.

Invalid commands will be ignored by the drive.

You may send either upper or lower case characters to the K drive, However the Echoed characters from the drive will always be Upper case. Thus in practice it is best to use Upper case to avoid confusion.

4.1. GENERAL COMMANDS

****

E — Enable the RS-232.

NOTE: IF YOU DO NOT GET ANY RESPONSE ON THE RS-232 LINK YOU PROBABLY DID NOT ISSUE THE E COMMAND.

The E command may be preceded by a device address 1 to 15, for example 1E will enable only device number one. Sending an E without a device address will enable all of the RS-232 ports on all of the drives on the daisy chain at the same time.

Enabling the RS-232 tuning function will disable the pushbutton tuning.

SV
SAVE — Save new values.

This is the same as pushing all three mode buttons down and releasing them. The "SV" command will cause the controller to save the gains as they are now adjusted and exit the tuning process, meaning the tuning mode will be exited.

The save command will save any new values you have given the drive. For those values that were not changed the last value to have been saved will be resaved.

F Exit the RS-232 mode and return to front panel control.

The F command will return control to the front panel pushbuttons. Any changes that have been made to the controller's gains are retained in volatile memory. However if a SAVE command is not issued the values will be lost on the next power loss or reset.

OFF
STO Turns the power amplifier off.

No current flows through the motor. AC power to the amplifier remains on.

ON
ST1 Turns the power amplifier on.

Allows current to flow through the motor.

RFS Returns the drive to Factory Settings.

All settings are as they were when the drive was shipped from the factory. This is the same as pushing the P and I buttons at the same time.

DFS Display all of the servo status flags

Syntax: <a>DFSd
Type: Status, Immediate, Device Specific

Description: Returns all servo status flags as 32 bits where the response is
bbbb_bbbb_bbbb_bbbb_bbbb_bbbb_bbbb_bbbb[cr] where the order of the bits is
31,30,29,28_ ....._3,2,1,0

bit

31	27	23	19	15	these bits are all reserved for future use
30	26	22	18	14	they all return zero's
29	25	21	17	13	
29	24	20	16	12	

bit

11 enable circuit 0 = enabled 1 = disabled
10 high voltage problem no = 0 yes = 1
9 indexer sending pulse at power up no = 0 yes = 1
8 failed crc check no = 0 yes = 1

7 power dump overtemp no = 0 yes = 1
6 average current exceeded no = 0 yes = 1
5 max position error exceeded no = 0 yes =1
4 remote shutdown from indexer (non X version) no = 0 1 = yes

3 driver error undefined 0 = no error 1 = pwm hardware shutdown
2 drive over temp 0 = no 1 = yes/shutdown
1 overcurrent 0 = no 1 = yes/shutdown error
0 RS 232 CMD 0 = on/st1 1 = off/st0

RSE Reports Servo Errors.

If an error condition in the servo drive exists, such as excessive following error or an EEPROM failure, it will be reported. Errors are "soft errors" that are indicated with the ERROR LED and display codes. To clear an error one must reset the drive. The possible error messages are listed below

#11_amplifier_overheating___
#16_amplifer_off___
#17_indexer_shutdown___
#19_amplifier_overcurrent___
#20_exessive_position_error___
#22_excessive_average_current___
#23_drive_enable_plug_not_inserted___
#24_regen_overheating___
#30_failed_CRC_in_EEPROM___
#60_rs232_command___
#61_indexer_incoming_pulses___
#62_excessive_peak_current
#70_resolver_disconnect

Z Resets the drive. ("1E" must be entered after a "Z")

The drive will act as if power was cycled. This command implements a software reset of the system. Any changes that have not been saved before issuing this command will be lost.

RV Software Revision level reported.

This command is for determining the software revision level of the controller software. It will report the part number that is written on the label of the controller's EPROMs. Using this command means it is not necessary to open the Drive amplifier's box in order to determine the revision level of the software.

KILL
K STOP POWERING THE MOTOR
STOP
S

Issuing this command will cause the microprocessor to stop commanding power to the motor until the ON, ST1, or Z command is received. All pulses/position will be lost. These commands remove power from the amplifier and allow the motor to freewheel. These commands were added so that if during the tuning procedure over the RS-232 link the user makes the servo go unstable he has some means of stopping the system. This will normally be a panic situation so the commands were selected to be those most likely to be selected in this situation. The commands function exactly the same as the OFF or ST0 command.

4.2. CONFIGURATION COMMANDS
****

The following configuration commands are designed to let you the user set up the system to meet your requirements. Normally the factory settings for the motor driver combination are all that you would need. However, to allow for your special situation we have added the following commands. In the event that you have to replace a motor the first command that you would execute is the CMTR if and only if you have changed the type of motor that the drive was origionally set up for.

The next command needed will be the CMR command. This selects the motor resolution that you desire to work with. (The drive must be in shutdown mode before the CMR can be executed). The motor resolution will affect any command or report that is in motor steps. Therefore you should choose the motor resolution before you do much else.

CMTR	Configure/report Motor Type

Use this command to configure the drive to the motor size that is being used with the drive. Normally this is done for you at Compumotor's factory. This command selects the proper current values and factory defaults for the various motor sizes used with the drive. Only one motor is available at this time (1CMTR530).

CMR	Configure Motor Resolution definition/report numeric parameter expected (1000 to 16,384).

The drive must be shut down before the CMR cmd can be executed.

Define/report motor resolution. Enter a number between 1000 and the maximum allowable resolution of 16,384. The value entered represents the number of steps of resolution you want the resolver reading to have per revolution of the motor. If you choose a binary value the positioning will be slightly more accurate than a non binary value will provide. The math is done as an interger value so truncation error within a single revolution can occur. This error is not cumulative.

If a valid integer number is sent then the new resolution will be that number of steps per motor revolution. If no value is sent then the current resolution is reported. Factory Default is 4096 steps per revolution.

FOR EXAMPLE: If the resolution is set to 5000 steps per rev we compute the scale factor as (32,768*65536)/5000 = 429496.7296 but because we have 16 bit precision the .7296 is truncated.

If you command a move with D500000 Then the conversion from user friendly units back to resolver units is done as follows:

(500,000 *429496)/65536 = 3276794.434 but because we can't move to a fractional position the motor actually moves to 3276794 counts of the resolver. So where you would expect the motor to go exactly 100 revolutions (500,000 / 5000) for this move the motor will actually go 3276794/32768 = 99.99981689 revolutions. This error does not accumulate because if you gave a second move of the same distance the calculation will use the absolute distance to calculate the next move.

If all of this turns out to be a bother and the truncation error is a problem to you. You can simply choose a resolution that does Divide evenly into (32,768 * 65536) or 2147483648. e.g. 4096, 8192, 16384 etc.

Since a change in resolution could cause major dynamic discontinuities the motor resolution can not be changed while the system is active. You must issue the ST0 or OFF command to disable the drive before you can change the motor resolution.

Be certain to save any changes you wish to retain before cycling power to the drive. **NOTE:THIS COMMAND CHANGES THE VALUES AND RESPONSES OF ANY OTHER COMMAND THAT USES MOTOR STEPS. YOU SHOULD CONFIGURE MOTOR RESOLUTION BEFORE USING ANY OF THE OTHER CONFIGURE COMMANDS.**

Before the CMR command is active you must issue either the OFF or STO command to shut down the drive. This is to prevent the motor from making large unexpected moves when the Resolution is changed. After the CMR is implimented you will need to issue the ON or ST1 to reenable the drive. The new Resolution you have just issued will not take effect until you issue a Distance command after the CMR command.

NOTE

The internal positioning servo loop always operates at the maximum motor resolution of 16,384 steps/rev.

CCA	Configure Current, Average, limit- Definition/report. Numeric parameter expected.(0 to 7.5 Amps)

If no parameter is supplied this command will report the currently defined maximum allowed average current, in amps. If a parameter is supplied that approximate number will be used as the new maximum average current. The acutal resolution of the control is .00122 amps so integer values are rounded to the nearest approximation. The controller continuously computes an average current to the amplifiers over a 2.56 second time span. If the average current command exceeds the value defined by the this command the controller will disable the amplifier and indicate an error.

NOTE: It is possible to set this value higher than 7.5 Amps. The actual maximum is 10.0 Amps. However, settings between 7.5 and 10.0 Amps should only be used temporarily for tests. Running the current continuously above 7.5 Amps may cause damage to the drive and/or motor.

CCP	Configure Current Peak definition/report. Numeric parameter expected.(0 to 12 Amps)

Define/report the peak current limit. This number defines the maximum current command that will be sent to the motor. This command is included for diagnostic and other special purposes. If a valid number in amperes is entered, the approximation will become the new peak current limit.The actual resolution of the value is .1568 amps so integers are rounded to the nearest value. If no value is sent this command will report the present value defined for the maximum peak current, in amps. The maximum current is the absolute maximum current that will be sent to the motor, it is not the maximum average current command but the maximum transient current. It is the upper limit of how large the current can ever be. The Factory setting will depend upon the motor size. This is not an error or shutdown limit. This command sets the maximum current that the drive will put out. In effect it is a torque limit.

CDB	Configure DeadBand definition/report. Numeric parameter expected.(0 to 32,767)

If no parameter is supplied this command will report the current value of the deadband, in motor steps. If a number is supplied that number becomes the new deadband. The slip fault line to the indexer is used to indicate when the absolute value of the following error is within the deadband region. The slip fault line to the indexer connector will be on to indicate that the following error exceeds the deadband and off to indicate that the absolute value of the following error is within the deadband. (The slip fault line is active high). The default factory setting is zero. This is useful in situations when you need to know if the motor rotor is within a certain tolerance range with respect to the indexer command. If you wish to use this output to an external computer, you will need to connect wires from pin 10 and pin 22 of the indexer connector on the KQ to your computer.

CPE	Configure Position Error definition/report Numeric parameter expected (0 to 65,535 Steps)

Define/report maximum following error. If the absolute position error is greater than this number, the amplifier will shut itself off. If a valid number in steps is entered, it will become the new maximum following error. Otherwise, the current setting is reported. Exceeding the maximum following error is an error condition that will cause the amplifier to be shutdown. If the maximum following error is defined as zero the "shutdown motor on following error exceeded" function is disabled and no amount of following error will generate an error condition or shutdown the motor. The factory default setting is one revolution of the motor.

The value of the following error is only calulated when the CPE command is given. The stored number is in terms of motor revolutions. So that Changes of the CMR resolution will leave the following error actual distance unchanged unless a new CPE command is issued.

This command differs from the CDB command in that being outside deadband only affects the slip fault output. The CPE settings will shut off the drive.

You should be certain to SAVE your settings to the EEPROM if you wish it to be permanent.

Example: 1CMR5000 1CPE1000 will set the following error to one fifth of a revolution of the motor. issuing 1CMR25000 1CPE will get a response of *position error 5000 since it is still one fifth of a rev. 1CPE1000 issued after the 1CMR25000 would set the position error to 1/25th of a rev.

4.3. TUNING COMMANDS
****

The following tuning commands are accessed via pushbutton tuning or the RS-232 communication link. The values represent a percentage of the maximum value that the term is allowed to achieve. The following commands change the percentage only and the range is limited from 1 to 99.To change the maximum value of the term it is necessary to use the configuration maximum commands. push buttons allow only integer values of the percentage. The display will show only the integer.

the form of the equation for the tuning set up is:
Gain value = term maximum x term percentage

CVG Configure Velocity Gain definition/report. numerical parameter expected (0 to 99)

The velocity gain is related to the error in the motor speed with respect to the commanded velocity from the indexer. If a valid numerical parameter is enter then the Velocity gain will be recalculated using the new percentage of the maximum. Otherwise, the current setting will be reported.

CDG Configure Differential Gain definition/report. numerical parameter expected (0 to 99)

The differential gain is related to position error changes with respect to time. If a valid number is entered, a new differential gain will be calculated using the percentage of the maximum. Otherwise, the current setting is reported.

CIG Configure Integral Gain definition/ report. numerical parameter expected (0 to 99)

The integral gain is related to position error with respect to time. If a valid number is entered, a new integral gain will be calculated using the percentage. Otherwise, the current setting is reported.

CPG Configure Proportional Gain Definition/report. numerical parameter expected (0 to 99)

The proportional gain is related to the position error. If a valid number is entered, a new proportional gain will be calculated based on the percentage. Otherwise, the current setting is reported.

4.4. CONFIGURE TERM MAXIMUMS

****

The following tuning commands are accessed only via the RS-232 communication link. The values:

CVM	Configure Velocity Maximum. Definition/report. numerical parameter expected (1 to 32767)

This command allows you to change the factory value for the Maximum gain that the Velocity term can achieve. This would normally be changed only if the values provided for your motor were not satisfactory for your application.The default values are motor dependant. If a valid parameter is sent that value will become the new maximum, otherwise the current setting is reported.

CDM	Configure Differential Maximum Definition/report numerical parameter expected (1 to 32767)

This is the gain of the portion of the controller which amplifies the derivative of the position error with respect to time. If a valid number is entered, it will become the new differential gain maximum. Otherwise, the current setting is reported.

CIM	Configure Integral Maximum Definition/report. numerical parameter expected (1 to 32767)

Defines the maximum of the integral of the position error with respect to time. If a valid number is entered, it will become the new integral gain maximum. Otherwise, the current setting is reported.

CPM	Configure Proportional Maximum Definition/report. numerical parameter expected (1 to 32767)

Defines the maximum of the term which amplifies the position error. If a valid number is entered, it will become the new proportional gain maximum. Otherwise, the current setting is reported.

NOTES

If you supply an invalid parameter to a command the command will not be performed. Invalid commands are simply ignored.

Any changes made to parameters using these commands are NOT permanent UNTIL THEY ARE SAVED. To make a change permanent the SAVE command (SV) must be issued. The SAVE command will save all changes that have been made into the EEPROM. Thus, if changes are made with these commands and then the machine is reset the changes are lost unless the SAVE command was issued before resetting the machine.

4.5. DISPLAY/REPORT COMMANDS
****

Each of the display/report commands results in the drive periodically reporting the appropriate parameter to the terminal where it is displayed Approximately every 130 milliseconds as the value is reported to the terminal. When any of these commands is issued no other command may be issued until the reporting is terminated. To terminate a report hit any key to send a character to the drive. All display report commands must be prefixed with a device address. This is to prevent several units from trying to report at once. These commands do NOT display values to the two number display on the pushbutton tuning panel.

DCA periodically Displays/reports Current (average) in Amperes.

The average current flowing through the motor is reported and repeatedly updated until a key is pressed. To get this number 256 data points of the instantaneous current are read at 10 millisecond intervals. These 256 points are averaged to provide a value computed at 10 millisecond intervals. This value is averaged with the last 256 similar values to provide the average current over the last 2.56 seconds. A new average current is reported at 130 millisecond intervals.

DCI periodically Displays/reports Current on an Instantaneous basis

This number is reported in Amperes and is repeatedly updated until a key is pressed. This number is a single sampling of the current at read and reported at a 128 millisecond rate.

DCP periodically Displays/reports the Peak Current

This number is reported in Amperes and is repeatedly updated until a key is pressed. This command samples the instantaneous current at 500 microsecond intervals. Each reading is compared to the largest previous reading, if the new value is larger then it will become the new value. This value is reported at 128 millisecond intervals. This reading accumulates from the time the command is sent. so that the highest instantaneous current ever seen by the motor over long periods of time may be captured.

DPA periodically Displays/reports the Position Actual

This number is reported in steps and is repeatedly updated until a key is pressed. This number is the absolute resolver position scaled in motor steps since the drive was enabled. The resolver of the KQ actually counts at 32,768 counts per revolution of the motor shaft. The value that is displayed is calculated by creating a scale factor when the CMR command is issued. (32,768*65536)/CMR = scale factor. The scale factor is carried out to 16 bits. The rest is truncated this can cause a small non cumualative error in position if the CMR resolution does not evenly divide into 2147483648.

The value is read and reported at about 150 millisecond intervals

DPE periodically Displays/reports Position Error.

This command reports the difference between setpoint and actual position in steps. This number is used by the position control algorithm to determine what sort of current should be sent to the motor. The difference between the command setpoint and the actual position is also used to determine if the motor is within the Deadband specified in the CDB command. This number is reported in motor steps and is repeatedly updated until a key is pressed. This number is a single instantaneous value read and reported at about 150 millisecond intervals.

DPR periodically Displays/reports the Position Resolver

This number is reported in steps and is repeatedly updated until a key is pressed.This value is the resolver position in motor steps within a single revolution of the motor shaft. This is an absolute value with the zero referenced to how the resolver is mounted on the shaft. This data would be useful to diagnose a resolver problem. This number is a single data point read and displayed at about 150 millisecond intervals

DPS periodically Displays/reports the Position Setpoint

This number is reported in steps and is repeatedly updated until a key is pressed. This number is the absolute number of pulses sent to the drive from the indexer since the drive was enabled (or reset). This counter is read and reported at about a 150 millisecond rate.

DIC	periodically Displays/reports Indexer Counter

Periodically reports the contents of the indexer counter in steps. This number is reported and repeatedly updated until a key is pressed. This is the raw number of pulses sent to the drive from the indexer. It differs from the setpoint in that the Indexer counter only displays the last 4096 counts from the indexer. This command is used to detect problems in the indexer to drive interface. The counter is read and reported at about a 150 millisecond rate.

DVA	periodically Displays/reports Velocity Actual

This number is reported in steps per second and is repeatedly updated until a key is pressed. This value is the actual velocity being read from the resolver, it is the actual shaft velocity over a 500 microsecond period. It is displayed every 28 miliseconds.

DVS	periodically Displays/reports Velocity Setpoint

This number is reported in revolutions per second and is repeatedly updated until a key is pressed.This number is calculated at 500 microsecond intervals and reported at 28 millisecond intervals. This value is the velocity being sent to the velocity part of the servo loop by the PID loop.

4.5.1. PID & V tuning

PID and V (Proportional, Integral, Differential and Velocity) tuning algorithm can be implemented with the pushbutton tuning The factory values of the tuning algorithm are based on the assumption of load to rotor inertia of 10 to 1. The load should have some frictional component, that is directly and solidly coupled to the motor. (If your system cannot be tuned with the pushbuttons then; the load to rotor inertia may be outside of the range provided for using the factory settings, or there is a significant amount of friction in the system or the coupling to the load is flexible). In situations like this you are faced with a complex series of tradeoff decisions. As with every other physical system you can't get something for nothing. You can increase the speed of your machine at the price of motor/drive heating, final position accuracy and settling time. Or you can improve system accuracy at the price of final position stability. You can trade final positional accuracy for system response time. Each application requires you the user to decide which of the variables will be traded to optimize performance in your situation.

A generalization of the functions of the PID gains are:

4.5.1.1. PROPORTIONAL GAIN

- affects the system stiffness and accuracy. As the proportional gain is adjusted higher, the influence of the feedback signal becomes greater. If the gain is sufficiently high, the system will oscillate. This happens because very small resolver changes are amplified into very large error signals, and the mechanical inertial of the motor and load will not allow the system to follow the electronic commands fast enough. The systems lag time will eventually reach a point where the feedback and the command signals are in phase. At this point oscillation results. When this occurs you have no choice except to reduce the gain back below the oscillation point.

4.5.1.2. INTEGRAL GAIN

- allows the system compensate for positional errors in static position. (Frictional type errors). The integrator also works to reduce velocity ripple. It does this by slowing down the electronic response time so that it more closely resembles the response of the mechanical components of the loop.

4.5.1.3. DERIVATIVE GAIN

- adds damping effects to the system. In the case where the system is oscillating at the end of a move or around a change in velocity increasing the derivative gain will reduce the ringing. The derivative adds phase lead to compensate for the systems natural phase lag.

4.5.1.4. VELOCITY GAIN

- this gain is used to affect the overall responsiveness of the system. If the system is too sluggish then the velocity gain can be increased. If the system is overshooting badly or there is excessive ringing that the derivative term is not able to adequately compensate, reduce the velocity gain.

Position errors due to Load inertia.

Load is the inertia (mass times the radius of rotation squared) seen by the shaft of the motor, measured in Oz.-In. sec^2. The amount of inertia affects the torque required, and the torque required is a function of acceleration and inertia.If you find that your load inertia is larger that 10 times the motor inertia you may find it desireable to trade some speed performance for accuracy at the final position. In this case to make the tradeoff you reduce the velocity gain and increase the Integral gain.

Slow response due to Load inertia.

In a system where the load inertia is larger than the factory setting allows for, it may be possible to increase the system response time by allowing the overshoot to increase. In this case increase the Velocity gain, increase the proportional gain and decrease the Integral gain.

Position Errors Due to Friction

Significant friction in the load may cause the end-of-move position to be unacceptably in error. In this case you can trade off system response for final positional accuracy. To do this increase the integral gain, increase the derivative gain and if necessary decrease proportional or velocity gains.

Shaft and Coupling Vibration

If the load is coupled to the shaft through a non-rigid coupler, it is possible for the shaft and coupler to oscillate at a frequency greater than would be possible for the system as a whole. In this case it may be possible to trade system response for system stability. To do this increase the integral and derivative gains while decreasing velocity or proportional gains.

Inadequate Response Time (Frequency Response)

Some systems may involve very little inertia, but need the torque for very high acceleration. In this case it may be desireable to narrow the range of values that the system can handle in order to optimize the move profile for a light load. To do this increase the proportional and velocity gains while decreasing the integral term.

General tuning considerations.

You should remember that all of the terms are interactive and it may take considerable experimentation to find the exact combination of values to get the best performance in your application.
In a very general sense the velocity term should be set first, followed by proportional then integral and finally the differential terms.

5. MAINTENANCE AND TROUBLESHOOTING

5.1. Motor Maintenance

All mechanical parts of the motor should be inspected regularly to ensure that no bolts or couplings have worked loose during normal operation. This can prevent some minor problems from developing into anything more serious.

5.2. Diagnostic LED's

5.2.1. POWER

-- This LED will be green under normal operating conditions. If this LED is red it indicates a loss of the low voltage power supply. Check for correct input voltages and for fuses blown. If everything checks out and the drive is still not operating or if fuses blow when power is reapplied, send the unit back for repair.

5.2.2. FAULT

-- This red LED will be off under normal operating conditions. It will be red if the amplifier section of the drive is shutdown. The amplifier will shutdown itself if an over-current, short-circuit or over-temperature condition exists. This LED will also be lit if the amplifier is shutdown by the Remote Power Shutdown input, or if the Average Current Defintion has been exceeded or there is excess following error. If this LED comes on, first try disconnecting the indexer cable. If the LED goes off, it was probably caused by a Remote Power Shutdown. If it stays on, remove power and examine the connections to the motor to verify that no short circuits exist in the wiring or motor, winding to winding or winding to ground. The error code will be displayed on the two digit display or the RSE command can be issued to determine what condition(s) exist. The error condition can be cleared by resetting the drive: either by issuing a Z command, or by pushing both the up and down buttons at the same time, or by cycling power or through the FAULT RESET input on the indexer connector.

5.2.3. DRIVE TEMP

-- This LED is normally off. When lit, it will be red, indicating an overtemperature condition in the drive. This error will cause the FAULT LED to light as well. If an overtemperature fault occurs, power the unit down and allow it to cool for at least 30 minutes before powering back up. If the Fault is not cleared after 30 minutes (assuming the drive is not in a higher ambient than usual) contact your local Compumotor Field Applications Engineer.

5.2.4. MOTOR TEMP

-- This LED is normally off. When lit, it will be red, indicating an overtemperature condition in the motor. An Overtemperatur Fault in the motor is derived by the microprocessor based on the average current being sent to the motor. Ambient temperature is not taken into consideration. If this type of fault occurs, check the peak current setting. If the motor is not operating near the top of it's performance curve (i.e. Speed/Torque curve), lower the peak current setting. This may be necessary if the fault is recurring.

6. SPECIFICATIONS

System dependent:

DESCRIPTION	VALUE	UNITS
Driver Operating Temperature	0 to +50	degrees Celsius.
Motor Operating Temperature	125	degrees Celsius, max.
Storage Temperature	-40 to +85	degrees Celsius.
Humidity	0 to 95	percent, non-condensing.

Motor dependent:
(See torque speed curves)

Physical Description

Drive Height: 11.5 INCHES (241.3mm)
Drive Width: 5.17 INCHES (125.47mm)
Drive Depth: 6.73 INCHES (171mm)

Drive Weight: 20 lbs (14.6kg)

Environmental

Operating Temp.: 32°F to 122°F (0°C to 50°C) With adequate air flow
Humidity: 0-95%, non-condensing.

Electrical

Input power:

Voltage: 100-130 VAC, single phase. 10 Amp service
Frequency: 47-66 Hz.

Output power: (to motor)
Voltage: 184 VDC peak 170 VDC nominal
Frequency: 20 kHZ PWM

6.1. Inputs and Outputs

Indexer: 25 pin D connector, female

1 **STEP+** Input. Optically isolated current loop input. 15 mA, 500 nS pulse, minimum; 1 MHz maximum. Rising edge of current pulse causes one step.

14 **STEP-** Input. Return for Step+.

2 **DIRECTION+** Input. Optically isolated current loop input. 20 mA nominal. Must be held active at least 10 microseconds prior to rising current edge of STEP+.

15 **DIRECTION-** Input. Return for direction.

16 **RPS+** Input. Optically isolated current loop input. 20 mA nominal. Presence of current on RPS (Remote Power Shutdown) causes current to be removed from the motor phase outputs.

17 **RPS-** Input. Return for RPS+.

10 **SLIP FAULT+** Output. 20 mA nominal current output. Presence of current indicates that the motor is not within the user definable deadband range.

22 **SLIP FAULT-** Output. Return for SLIP FAULT+.

9 **DRIVE FAULT+** Output. 20 mA nominal current output. Presence of current indicates a drive fault condition. (Shorted outputs, overtemperature, etc...)

21 **DRIVE FAULT-** Output. Return for DRIVE FAULT+.

7 **FAULT RESET+** Input. Optically isolated current loop input. 20 mA maximum. Presence of current clears a DRIVE FAULT or an ERROR.

19 **FAULT RESET-** Input. Return for FAULT RESET+.

12 **COMMON** Low voltage power supply common.

RS-232: 25 pin D connector

2 **RECEIVE DATA** Input. RS-232 characters are received on this input. Conforms to IEEE standards for RS-232 communication.

3 **TRANSMIT DATA** Output. Characters received are echoed on this output. Conforms to IEEE specifications for RS-232 communication.

7 **COMMON** Output. This is the signal common for TRANSMIT and RECEIVE signals.

Auxiliary: 4 pin Entrelec Connector

1 **DRIVE FAULT+** Output. 20 mA nominal current output. Presence of current indicates a drive fault condition. (Shorted outputs, overtemperature, etc...)

2 **DRIVE FAULT-** Output. Return for DRIVE FAULT+.

APPENDIX A

CONNECTOR LISTING

A. Motor Connections

The KQ-Drive is supplied with a preassembled motor cable with an MS type connector on the motor end, and 3 leads with ring terminals on the drive end. This cable should be attached to both the motor and the drive before the AC power is connected. The motor connections on the KQ-Series drive are made to a screw terminal block on the front panel.

The standard cable supplied with the KQ-Drive is 25 feet in length. If you need a longer length cable it may be purchased from Compumotor in lengths up to 50 feet. If you wish to make up your own cable, 12 gauge or larger stranded wire should be used for lengths up to 50 feet. Lengths above 50 feet are not recommended.

B. Resolver Connections

A preassembled 50 foot cable is supplied for connecting the resolver to the Drive. This cable has an MS style connector on the motor/resolver end and a 9-pin D type connector on the drive end.

The MS type connector should be connected to the motor mounted resolver connector and securely tightened. The 9-pin D connector should be connected to the mating resolver connector on the Drive and secured with the two captive mounting screws.

KQ RESOLVER CABLE

Resolver	Wire color	MS	MS	Wire Color	9 PIN D
R1	red/white	A	A	white	4
R2	yellow/white	B	B	brown	9
S4	blue	C	C	blue	3
S2	yellow	D	D	green	6
S1	red	E	E	red	1
S3	Black	F	F	Black	7
		G	G	Shield	5

Connector is MS3102A 14S-6S for KQ Motors

C. Line Power Connections

AC power is connected to the screw terminal connector on the front panel. The 120 V.A.C. single phase should be connected with a 12 gauge stranded wire. The wires should be connected to the screw terminals as follows:

120 VAC single-phase power, (100 V.low line, 130 V. high line)
10 Amp Service

Terminal	NAME	Wire color
LINE	120 VAC LINE	Black (blue)
NEUT	120 VAC NEUTRAL	White (brown)
EARTH GND	EARTH GROUND	Green (green/yellow)

AUXILIARY 4 Pin Entrelec

1 DRIVE FAULT+ (N.O.)
2 DRIVE FAULT- (COM.)

INDEXER 25-pin 'D' connector, female.

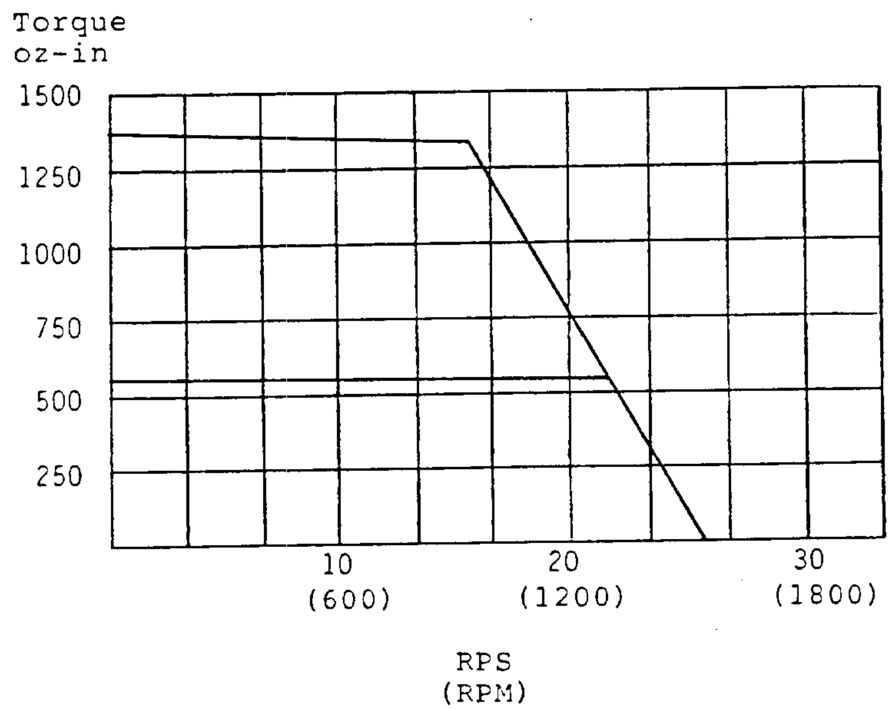
1 -- STEP+
2 -- DIRECTION+
3 -- n.c.
4 -- n.c.
5 -- SHIELD
6 -- n.c.
7 -- FAULT RESET+
8 -- n.c.
9 -- DRIVE FAULT+
10 -- SLIP FAULT+
11 -- n.c.
12 -- RESERVED
13 -- n.c.
14 -- STEP-
15 -- DIRECTION-
16 -- REMOTE POWER SHUTDOWN+
17 -- REMOTE POWER SHUTDOWN-
18 -- n.c.
19 -- FAULT RESET-
20 -- n.c.
21 -- DRIVE FAULT-
22 -- SLIP FAULT-
23 -- n.c.
24 -- n.c.
25 -- n.c.

RS-232 25-pin D connector, female.

1	-- N.C.
2	-- RECEIVE
3	-- TRANSMIT
4	-- N.C.
5	-- N.C.
6	-- N.C.
7	-- GROUND
8-25	-- N.C.

APPENDIX B
TORQUE SPEED CURVES

KQ-530



*Torque ratings have a +/- 10% tolerance.

APPENDIX C

SUMMARY OF ERROR CONDITIONS

The following summaries list all the abnormal conditions one may encounter with the KQ-Drive. Under each condition is a list of the indicators for that condition.

Operation Error Conditions

SLIP FAULT:
- Indexer SLIP FAULT output = ACTIVE

SHUTDOWN:
- Indexer FAULT OUTPUT - ACTIVE
- DRIVE FAULT LED - ON

ERRORS AND FAULTS:
- Indexer FAULT OUTPUT - ACTIVE
- Auxiliary FAULT OUTPUT - ACTIVE
- FAULT LED - ON
- "RSE" messages --
  - #11_amplifier_overheating___
  - #16_amplifer_off___
  - #17_indexer_shutdown___
  - #19_amplifier_overcurrent___
  - #20_exessive_position_error___
  - #22_excessive_average_current___
  - #23_drive_enable_plug_not_inserted___
  - #24_regen_overheating___
  - #30_failed_CRC_in_EEPROM___
  - #60_rs232_command___
  - #61_indexer_incoming_pulses___
  - #62_excessive_peak_current
  - #70_resolver_disconnect

Hardware Error Conditions

POWER/FUSES:
- STATUS LED - OFF

CONTROLLER:
- Indexer FAULT OUTPUT - ACTIVE
- Auxiliary FAULT OUTPUT - ACTIVE
- FAULT LED - ON

APPENDIX D

****

SERVO COMMAND SUMARY

E	Enable the RS-232.	25
SV	Save new values.	
SAVE		25
F	Exit the RS-232 mode and return to front panel control.	26
OFF		
ST0	Turns the power amplifier off.	26
ON		
ST1	Turns the power amplifier on.	26
RFS	Returns the drive to Factory Settings.	26
DFS	Display all of the servo status flags	26
RSE	Reports Servo Errors.	27
Z	Resets the drive.	27
RV	Software Revision level reported.	28
KILL		
K	STOP POWERING THE MOTOR	
STOP		
S		28
CMTR	Configure/report Motor Type	29
CMR	Configure Motor Resolution definition/report	29
CCA	Configure Current, Average, limit-Definition/report.	31
CCP	Configure Current Peak definition/report.	31
CDB	Configure DeadBand definition/report.	32
CPE	Configure Position Error definition/report	32
CVG	Configure Velocity Gain definition/report	34
CDG	Configure Differential Gain definition/report	34
CIG	Configure Integral Gain definition/ report.	34
CPG	Configure Proportional Gain Definition/report.	34
CVM	Configure Velocity Maximum. Definition/report	35
CDM	Configure Differential Maximum Definition/report	35
CIM	Configure Integral Maximum Definition/report.	35
CPM	Configure Proportional Maximum Definition/report.	35
DCA	periodically Displays/reports Current (average) in Amperes.	37

APPENDIX E

MOTOR MAINTENANCE

CAUTION: When disassembling for maintenance, use clean bench free of steel parts or chips. Permanent magnetic field will attract loose parts.

BRUSHES: Brushes should be inspected periodically to insure uninterrupted service. Length of new brush is 1.25 inch[1]. Life depends on speed as well as load. Suggested inspection hours for motors are as follows when used on DC supply under continuous full load conditions.

SUGGESTED BRUSH INSPECTION INTERVALS

Duty	Moderate	Heavy	Extra Heavy
Hours	2000	1000	500

Sealed Brush Design Motor is equipped with two brushes accessible by removing the terminal cover and rear bell assembly. Refer to figure 2 and 3. To remove brush, pull brush spring away from brush and slightly loosen terminal stud. Teplace with new brush and tighten terminal stud.

Before replacing end bell assembly, "cock" brush springs by pulling back brushes (see figure 4). Be sure wave washer is in bearing bore before replacing bell. Partially insert bell and "uncock" brushes by pushing down on brush end until they snap against commutator. Tighten the two tie bolts holding the end bell in position being sure the key is in the same shell notch as originally assembled. Using the opposite shell notch will cause the motor to run in the reverse direction.

Inspection Plate Design Remove protective covers. lift insulator guard. Lift brush spring from end of brush. Remove "stab-on" connection and withdraw brush.

COMMUTATOR When replacing brushes, check commutator for wear. If commutator is worn down more than 1/32 inch on the diameter or is pitted, turning and undercutting is recommended. Usually three sets of brushes can be used for one commutator turning.

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[1] Brush length for brush access design is 1.03 inch.

BEARINGS Ball bearings are lubricated for life. Shielded or sealed bearings may be used depending on the application. Under good conditions, bearings will give over 20,000 hours of service. The bearing in the front end bell (shaft end) is held in place with Locktite. Use wheel puller to remove front end bell and bearing from shaft. If the bearing cannot be properly removed, replace both bearing and end bell. After pressing the new bearing on the shaft, Locktite the outer race in the end bell. If a new face mount end bell is used (56C or 48C), pilot and face runout should be checked after the motor is assembled. Normal pilot and face runout is .004" T.I.R.

Rear bearing floats in rear end bell.

ARMATURE REMOVAL

1) Loose nuts
2) Withdraw tie bolts
3) Remove rear end bell assembly and wave washer
4) Hold shell assembly securely (do not squeez excessibely in vice) and grasp shaft and/or front end bell and withdraw briskly
5) To insert armature, be careful to avoid pinching fingers and scarring commuttor or wires against housing magnets. Insert commutator end first and use edge of bearing to guide start of insertion (see figure 5)

MAGNETS Material is oriented barium ferrite (ceramic). Avoid dropping or shart blows. There is not deterioration in magnetic properties with age. Demagnetizing will occur only with severe overvoltage (about 150% normal). If demagnetizing occurs, speed will increase slightly. Magnet and shell assembly can be remagnetized at the factory. Magnets can be purchased only as part of a nagnet and shell assembly.

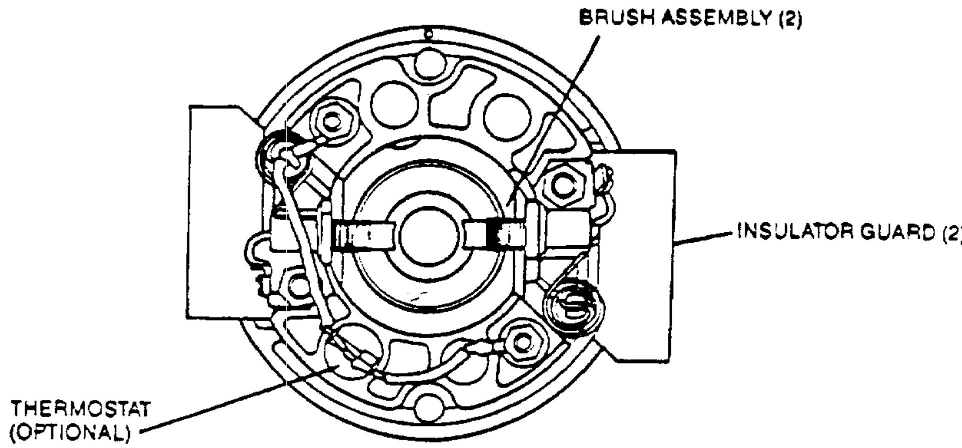


FIGURE 2

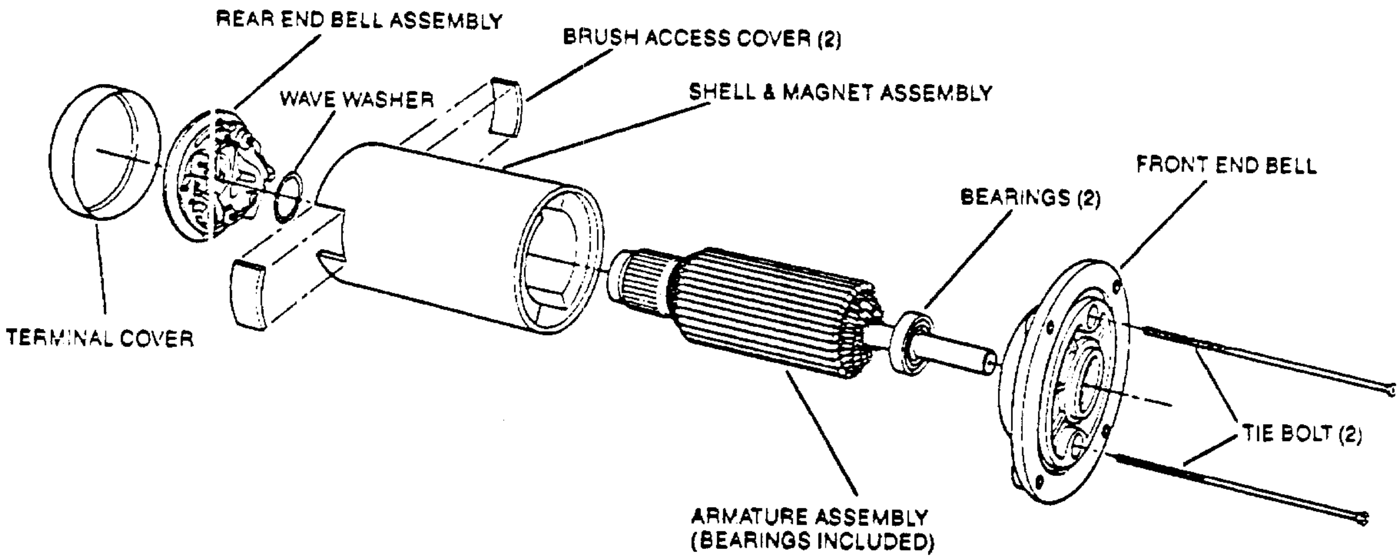
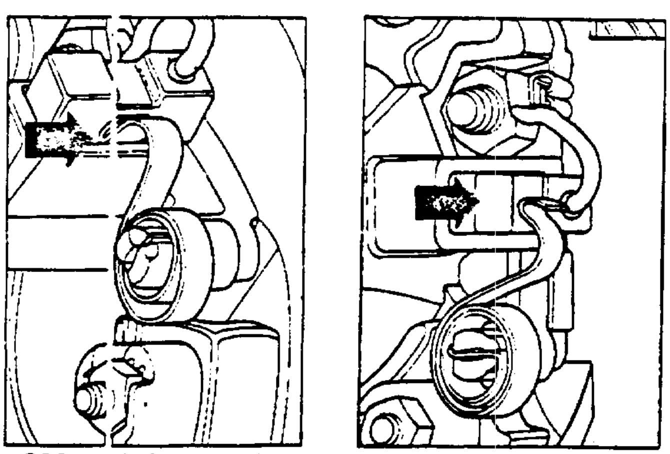


FIGURE 3
EXPLODED VIEW—TENV WITH BRUSH ACCESS



COCKED FOR INSERTION NORMAL

FIGURE 4 BRUSH COCKING PROCEDURE

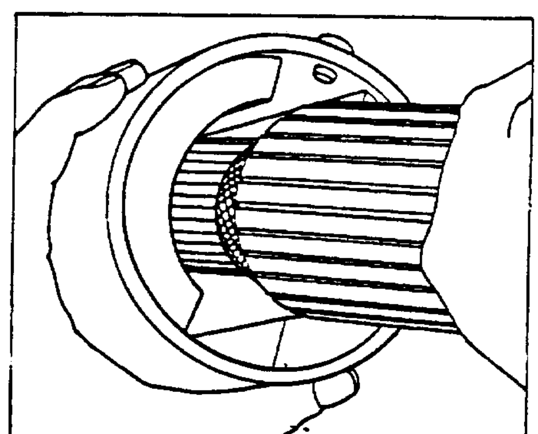


FIGURE 5 ARMATURE INSERTION PROCEDURE

WARRANTY

Your K Drive is warranted against manufacturing defects for one year from the date of purchase. Should you have questions about operating the Drive, your Parker Compumotor representatives and distributors stand ready to support your individual needs. Call Parker Compumotor Corporation at the number listed below to get the name, address and phone number of the Parker Compumotor representative nearest you.

Should return of your K Drive be required to effect repairs or upgrades, do the following:

1. Get the serial number and the model number of the defective unit, and a purchase order number to cover repair costs in the event the unit is determined to be out of warranty by Parker Compumotor upon inspection.

2. Call Parker Compumotor for a Return Material Authorization Number (RMA) at 800-358-9068 except in California. In California, call 800-345-2084.

3. Your RMA number MUST be clearly written on the shipping label and all paperwork so that your defective unit will be properly handled once it reaches our shipping department. Failure to do so may result in the equipment being returned for proper identification.

4. Ship the unit to: Parker Compumotor Corporation
1179 N. McDowell Blvd.
Petaluma, CA 94952
Attn: RMA # xxxxxxx