



# FLEX “KAT”<sup>®</sup> ALL POSITION, VARIABLE SPEED TRAVEL CARRIAGE

*(USING GULLCO’S GSP-2100 CONTROL)*

**FOR MODELS:**

**GK-200-FL**

**GK-200-FM**

**GK-200-FH**



## PARTS LIST & OPERATING INSTRUCTIONS

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## **SAFETY INSTRUCTIONS**

Although the Gullco "KAT"® carriage is manufactured for safe and dependable operation, it is impossible to anticipate those combinations of circumstances, which could result in an accident. An operator of the "KAT"® carriage is cautioned to always practice "**Safety First**" during each phase of operation, setup and maintenance.

Read and understand the whole operation manual (including the supplementary GSP-2100 control manual, "GD-075") before operating or performing service of this equipment. Become familiar with the machines operation, applications and limitations. Keep the operation manual in a clean and readily available location.

This equipment is normally used to automate / semi-automate welding or cutting processes. These processes usually have any combination of the following; bright and hot arcs, flying sparks, fumes, ultraviolet and infrared radiated energy, hot work-pieces, compressed gases, etc... The onus is on the operator of this equipment to know, understand and follow all the safety precautions associated with the process being used.

A careless operator invites troubles, and failure to follow safety practices may cause serious injury or even death. Important safety precautions are given in the following:

### **Electrical Shock Prevention**

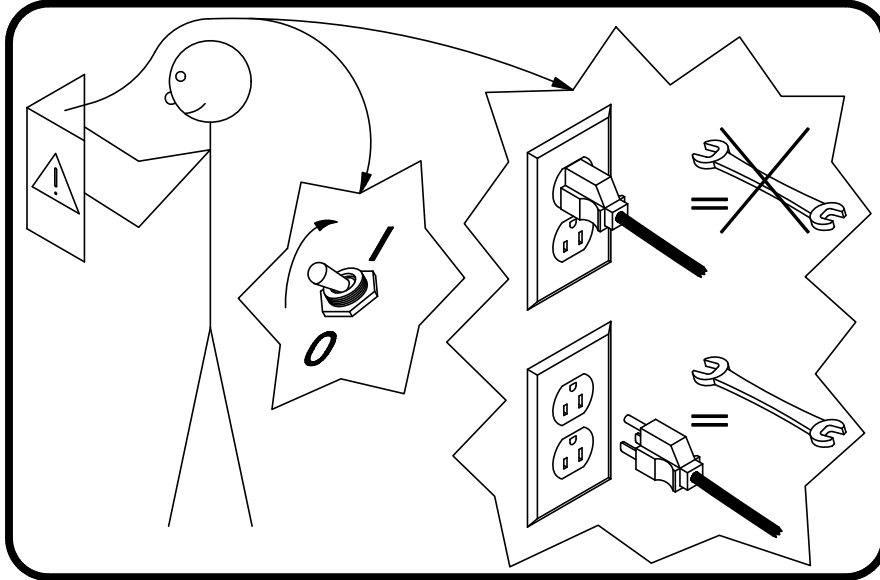
- Do not use this equipment in damp or wet locations.
- Do not expose this equipment to rain.
- Never carry this equipment by the cables or pull the cables to disconnect from the receptacle.
- Keep all cables from heat, oil and sharp edges.
- Inspect all cables periodically and replace if damaged.
- Inspect the secureness of all cables periodically and repair if loose.
- Disconnect the power cord when not in use.
- Disconnect the power cord **positively** to prevent electrical shock before repair and service of the equipment.

### **Bodily Injury Prevention**

- Do not wear loose clothing, jewellery and loose, long hair, which may get caught into automatic systems or moving parts.
- Ensure that the track is **well** secured when installed in any other position than flat on a surface.
- The track must have a method of safety backup from falling when elevated, i.e., chained at the ends, welded to work-piece, etc.
- Keep lifting handle dry, clean and free from oil and grease.
- Keep hands away from the underside of the "KAT"® carriage when there is the slightest possibility of motion.
- Wherever possible, avoid (or at least protect against) objects protruding from the moving equipment, posing possible pinch-points.
- There should only ever be one (1) operator working at the machine at any given time.
- The Flex track is made from spring steel. Therefore extreme caution should be exercised with respect to the hazards of injury due to whipping.
- Protective gloves should be worn when handling the Flex Track to prevent injury from sharp edges.

## SAFETY PRECAUTIONS

The following cautionary/warning label is attached to each “KAT”<sup>®</sup> carriage:-



The above label pictorially represents the following:

*“Warning:-*

*Read the manual before turning the unit on and before performing service.  
Also, positively disconnect the unit from all power supplies before servicing!”*

## IMPORTANT

### READ THIS BEFORE OPERATING THE “KAT”<sup>®</sup> CARRIAGE

Ensure that an adequate and well-maintained weld return path is provided with good electrical contact. Failure to do so may result in the welding current passing through the carriage and damaging the wiring and electrical components.

Important information regarding safety and operation of the “GSP-2100” motor control used in the “KAT”<sup>®</sup> carriage is contained in a supplemental manual attached at the end of this manual. It is equally important to read, understand and apply the information contained within the manual. The manual (GD-075) has a title “Technical Information For The Gullco “GSP-2100” Micro-Processor Based, 24 Volt DC Motor Control”, and it’s pages are numbered with a prefix of “T-“.

**ALL THE SAFE PRACTICES AND PRECAUTIONS MAY NOT BE GIVEN IN WRITING. SOME ARE BASED ON COMMON SENSE, BUT OTHERS MAY REQUIRE TECHNICAL BACKGROUND TO EXPLAIN.**



## FLEX “KAT”® CARRIAGE

This parts list covers the operation and maintenance requirements of the following Gullco Flex “KAT”® all position, variable speed travel carriages:

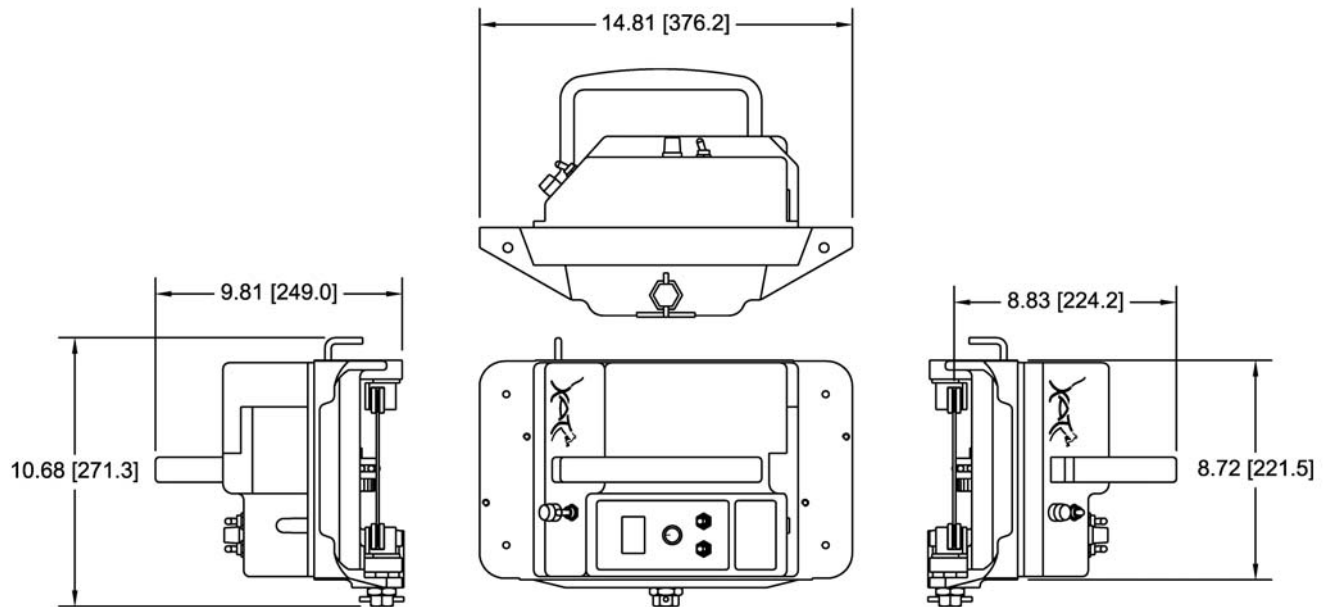
**GK-200-FL, GK-200-FM and GK-200-FH**

### SPECIFICATIONS

<b>MODEL</b>	<b>SPEED RANGE</b>
GK-200-FL	0.8 – 25.8 in/min [2 – 65.4 cm/min]
GK-200-FM	1.5 – 51.5 in/min [3.9 – 131 cm/min]
GK-200-FH	4.2 – 139.1 in/min [10.6 – 353 cm/min]

- Weight of “KAT”® carriage:** 29 Lbs. [13 Kg.]
- Vertical load capacity:** 100 lbs. [45 Kg.]
- Drive motor:** 24 VDC permanent magnet gear motor.
- Supply voltage:** Either 42, 115 or 230 VAC, single phase, 50/60 Hz., 200 watts.
- Complies with:** C.S.A. (File # LR 35006-7) & CE Certification.
- U.S. Patent:** U.S. Patent # 5070792.

### GENERAL DIMENSIONS



## **GENERAL DESCRIPTION**

The Gullco Flex “KAT”® is a heavy duty, all position travel carriage. It is an electrically powered self-propelled carriage that travels in a forward or reverse direction, at precisely controlled speeds, along a special track. The self-aligning wheel system of the carriage grips the top and bottom of the track, enabling it to travel along any plane. The adjustable wheel assembly keeps the carriage snug to the track, while allowing it to be easily mounted and removed from the track at any point. The positive drive of the “KAT”® is obtained from a uniquely designed sprocket that engages with slots in the track, driven by a low voltage permanent magnet motor and gear-head power unit assembly. Safety is greatly enhanced by the use of Gullco’s low voltage (24 V), highly advanced control / power supply system that is available in three line voltage inputs, i.e. 42, 115 and 230 VAC, single phase, 50/60 Hz, or any unregulated 24 VDC power supply at 220 watts of power. The motor and the control operate on 24 VDC, supplied by a power supply located within the casing of the “KAT”® carriage. Therefore, all operator interface devices (except the power on/off isolation switch) are subjected to signal level voltages only. The microprocessor pulse width modulation motor control offers operator interface of forward, stop, reverse and infinitely variable control of the speed, within the range of the model, as well as an L.E.D. display indicating travel speed in either in/min. or cm/min. The travel speed is electronically controlled using an optical tachometer located on the back of the gear-motor. Through the use of this, closed loop, feedback circuitry, the motor control can obtain accurate and constant speed control of the “KAT”® carriage when running in any plane, regardless of the load (within the rating of the equipment).



## **INTENDED / FORESEEN USAGE**

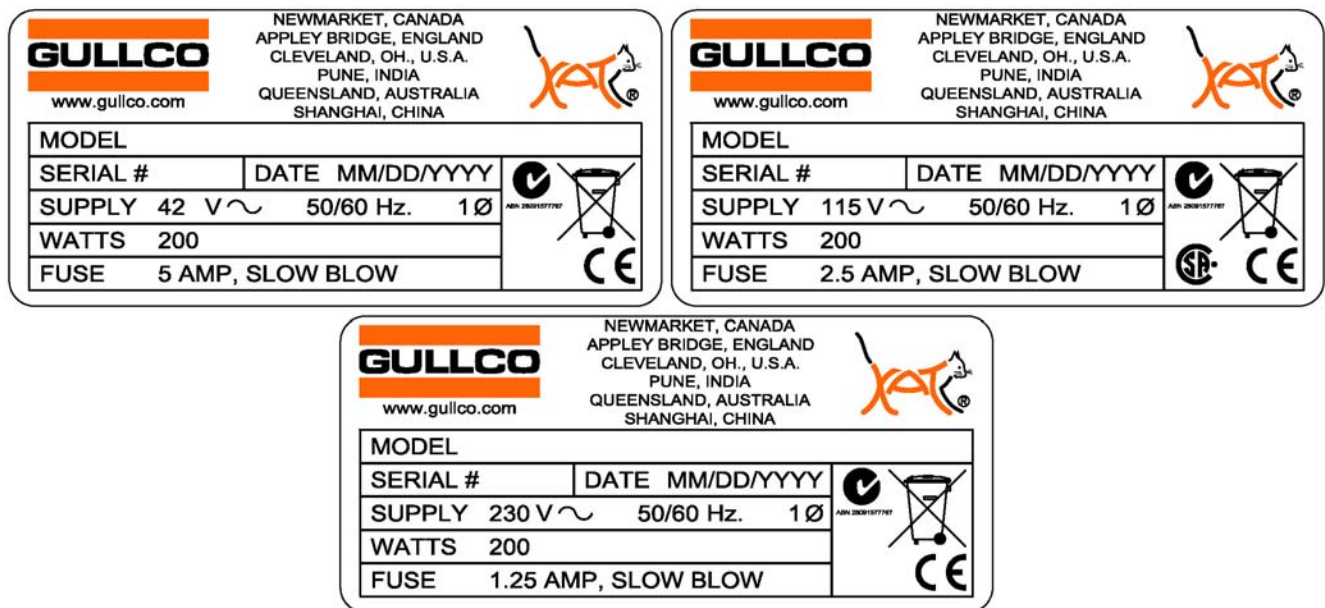
The Gullco Flex “KAT”® carriage is used throughout the world to automate and improve the quality and efficiency of single or multiple “head” welding / cutting operations. Welding guns or cutting torches are readily mounted on the “KAT”® carriage. Its flexible track is positioned so that the “KAT”® will move the gun or torch along the desired path, then securely held in place using magnetic or vacuum activated mounting devices. With the use of Gullco’s Flex “KAT”® carriage, welding guns or cutting torches can operate with precise motion from start to finish regardless of the number of passes or the work pieces involved, Improving the quality, efficiency and repeatability of the process. Detrimental factors such as poor or awkward accessibility, operator fatigue, or inconsistent workmanship are eliminated. Required quality levels are consistently attained and productivity and profitability increased.

## INSTALLATION

### ELECTRICAL CONNECTION

**WARNING!** Ensure proper AC earth grounding of the Gullco “KAT”® carriage and all auxiliary equipment (where applicable), before applying power. Failure to do so may invalidate the Gullco Warranty.

**WARNING!** Before connecting the “KAT”® carriage to a power source (receptacle, outlet, etc..) be sure that the voltage supplied is the same as that specified on the product label of the carriage. If in doubt, DO NOT PLUG IN THE “KAT”® CARRIAGE. Copies of the possible product labels are shown below:



As the colours of the wires in the mains lead of this equipment may not correspond with the coloured markings identifying the terminals in your plug, proceed as follows:

- The Green & Yellow or Green wire must be connected to the terminal in the plug which is allocated for “Earth” / “Ground”.
- The Blue or White wire must be connected to the terminal that is allocated for “Neutral”.
- The Brown or Black wire must be connected to the terminal that is allocated for “Live”.

### MECHANICAL INSTALLATION

**WARNING!** Check to ensure that no parts have become loose during transportation.

The “KAT”® carriage is equipped with a handle for portability. The weight of the carriage is evenly distributed around the handle, however, if the “KAT”® carriage has had other equipment attached to it, uneven weight distribution may present a hazard when lifting. Therefore we recommend care and consideration should be given to removing uneven loads and /or any additions that may make the total weight of the equipment too heavy or awkward to be comfortably lifted.

The drive engagement lever is the 90° lever that extends out of the side of the carriage lower housing. This lever engages the drive sprocket with the flex track and must always be disengaged when fitting or removing the “KAT”® carriage from the ends of the track. It also permits free wheeling for rapid positioning. To engage the drive, push lever in towards the carriage body and turn in an anti-clockwise direction. To disengage drive, push lever in towards the carriage body and turn in a clockwise direction.

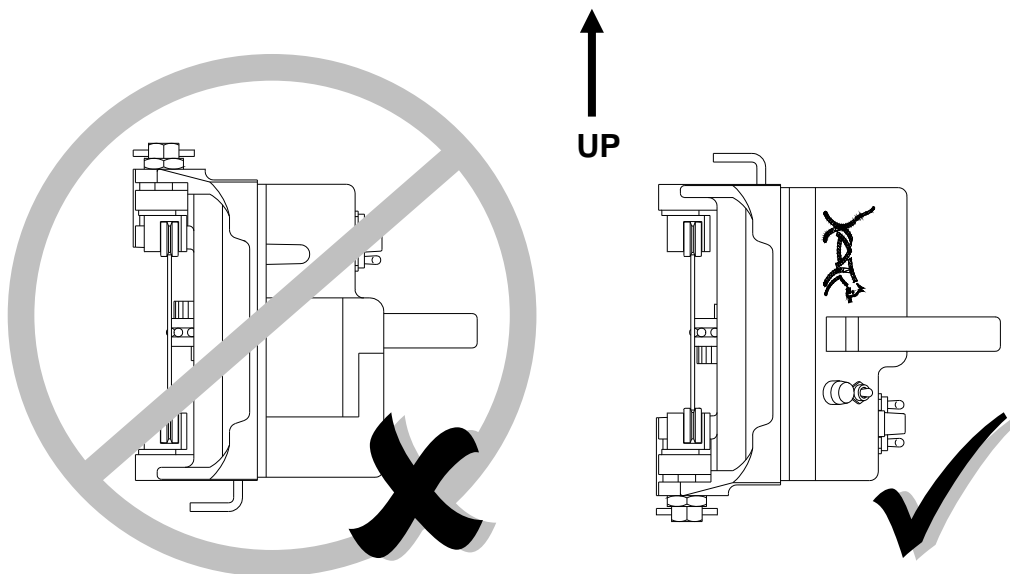
**WARNING!** Never disengage the drive, when there is a possibility that this action may result in the equipment falling to the ground due to load.

The wheel adjustment screw moves the pivoted adjustable wheel assembly relative to the track and is used to facilitate the fitting of the carriage anywhere along the track length. To fit the carriage, slacken the lock nut (item # 3 – drawing # GK-192-F-020-2B) and turn the adjusting screw (item # 2 – drawing # GK-192-F-020-2B) anti-clockwise to withdraw the wheels to their fullest extent. Fit the carriage to the track making sure that the fixed wheel assemblies are engaged on the track, then turn the adjusting screw clockwise until all wheels fit snugly on the track. The “KAT”® carriage should be free to move along the track, but there should be no play between the wheels and the track. Tighten up the lock nut. To remove the carriage from the track, perform a reverse operation to that described above.

**NOTE:** Over-tightening of the wheel assemblies will result in overloading the drive system as well as causing a possible 'jerky' downward motion.

**NOTE:** If the carriage is being removed or fitted over the end of a length of track, then it is not necessary to withdraw the wheel bracket assembly.

**NOTE:** If it is necessary that the carriage is to be mounted to track in the plane shown by the following sketch, always mount the “KAT”® with the fixed wheels on the top, as shown.





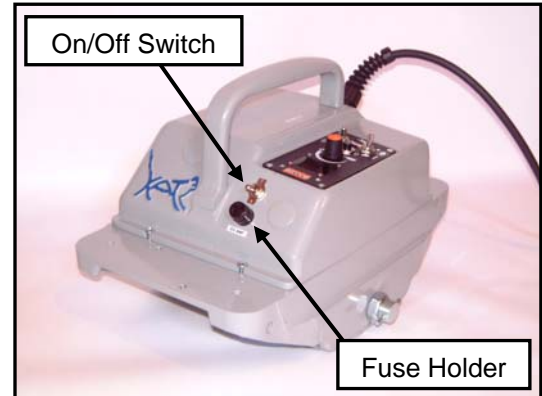
## OPERATION

### Local Control Devices

The power On/Off switch is used to disconnect the power to the rest of the control circuitry.

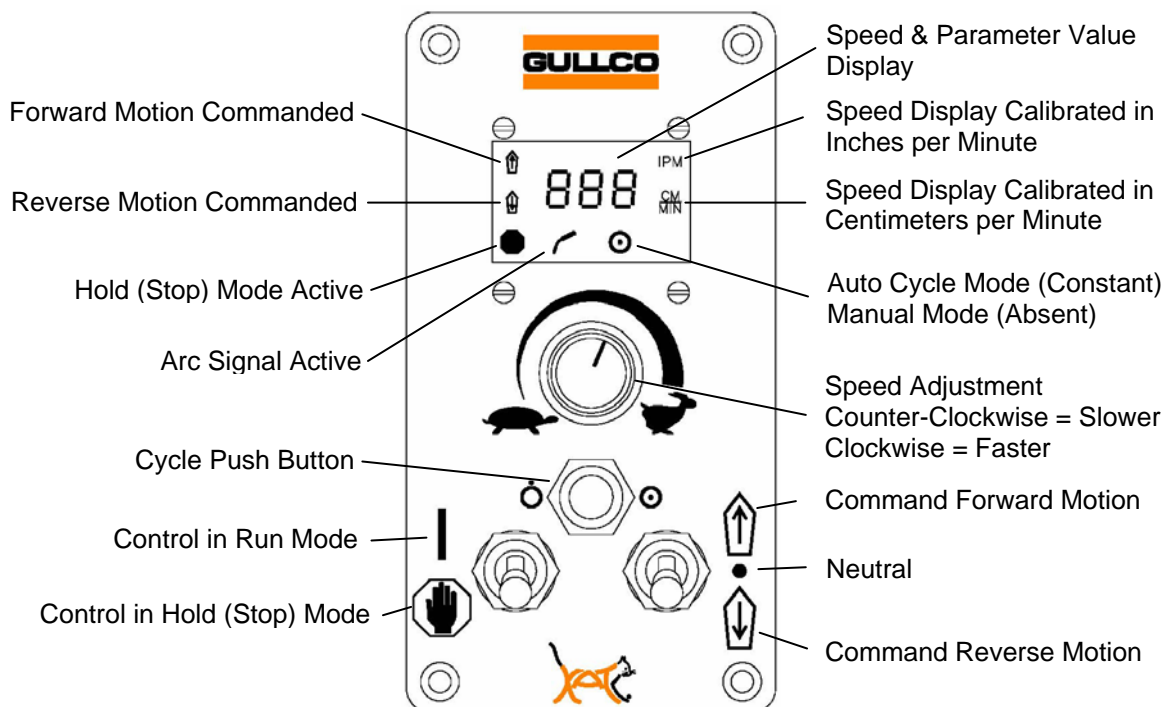
I = on, O = off.

**WARNING!** The motor control must not be continually started and stopped by the removal and reapplying of power to the control. Turning the power off to the control will not provide instant braking and continued use will damage the control. Allow ten (10) seconds after the removal of power before reapplying the power to the motor control.



The fuse holder allows accessibility to the main fuse by pushing the cap in towards the main body and twisting in a counter-clockwise direction.

### GSP-2100 Control Overview



Externally, the Gullco GSP-2100 control has switching for Forward/Neutral/Reverse, Run/Stop, Manual/Auto & program variable increment/decrement (where applicable), as well as a rotary encoder for speed control.

Please refer to the supplemental manual (GD-075) "Technical Information For The Gullco "GSP-2100" Micro-Processor Based, 24 Volt DC Motor Control" (the pages are numbered with a prefix of "T-"), attached at the end of this manual, for additional, more comprehensive details than those provided in the following overview.

The Run/Stop Switch is a two (2) position toggle switch located on the GSP control. Refer to the "Manual Operation" and "Automatic Operation" sections later in this manual for further details of this switch.



= "STOP" - This over-rides all other controls and when activated will apply regenerative braking to the motor to bring it to a dead stop, and will disallow any further operation of the motor while ever it is in this state. This position will also reset an error code once the fault has been rectified. The Run/Stop switch needs to be in this position to change between automatic and manual modes and also to alter any of the program variable parameters.



= "RUN" - This removes the "STOP" command and allows the control to assume an operational status.

**WARNING!** Avoid repeatedly starting and stopping the carriage in quick, short succession, as this will reduce the life expectancy of the control and the motor.

The direction selection switch allows the operator to set the travel direction. It is also used as the method to change the values/settings of the program variables. This is a three (3) position switch with the center position being "Neutral" (no direction chosen). Refer to the "Manual Operation" and "Automatic Operation" sections later in this manual for further details of this switch.



= "FORWARD" - When the switch is in this position, the control will drive the motor in the Forward direction, while in manual mode and when so permitted. It is also used as the method of adjustment for the program variables when used in conjunction with the speed adjustment knob.



= "NEUTRAL" - When the switch is in this position, the control will not drive the motor in either direction while in manual mode.



= "REVERSE" - When the switch is in this position, the control will drive the motor in the Reverse direction, while in manual mode and when so permitted. It is also used as the method of adjustment for the program variables when used in conjunction with the speed adjustment knob.

**WARNING!** Avoid changing the travel direction without making sure that the carriage comes to a complete stop first. Failure to comply may cause an overload.

**WARNING!** Avoid repeatedly starting and stopping the carriage in quick, short succession, as this will reduce the life expectancy of the control and the motor.

The ten-turn speed adjustment knob on the control is used to change the travel speed of the carriage. Adjusting the speed control may be performed when stationary or when in motion. The travel speed may be preset, prior to any motion, by placing the Run/Stop switch to the Stop position and the Forward/Neutral/Reverse switch in the Neutral position. Then, by rotating the Variable Speed Control knob, the travel speed can be pre-set to the required value, as indicated in the L.E.D. display.



= "VARIABLE SPEED CONTROL" - By turning the ten (10) turn rotary encoder knob in a clockwise direction, the motor speed will be increased. When rotated in the counter-clockwise direction, the motor speed will decrease. The Variable Speed Control adjustment is used to set the travel speed of the "KAT"<sup>®</sup> carriage in both manual mode and automatic mode.

The Cycle Push Button is a momentary device, which allows the operator to toggle between automatic and manual modes. The Cycle Push Button is also used to increment/decrement the values/settings of the program variables (refer to the section "Programming The Automatic Cycle Parameters/Variables" later in this manual for further details of this function).



= "AUTOMATIC MODE" ("PRESET CYCLE ENABLED") - Only by depressing the Cycle Push Button continually for one second while the Fwd/Neut/Rev switch is in the Reverse position, and while the control is in "Hold" (Stop) mode, may the Manual Mode be toggled to the Automatic Mode (pre-set cycle routine enabled), as indicated by the constant illumination of the Auto Cycle Mode L.E.D. The Cycle Push Button is also used to enter and exit parameter/variable menu.



= "MANUAL MODE" ("PRESET CYCLE DISABLED") - Only by depressing the Cycle Push Button continually for one second while the Fwd/Neut/Rev switch is in the Reverse position, and while the control is in "Hold" (Stop) mode, may the Automatic Mode be toggled to the Manual Mode (pre-set cycle routine disabled), as indicated by the non-illumination of the Auto Cycle Mode L.E.D. The Cycle Push Button is also used to enter and exit parameter/variable menu.

### **The L.E.D. Display**

The GSP control has an L.E.D. display, which when factory installed on a "KAT"<sup>®</sup> carriage, will be calibrated to display the travel speed in one of two units of measure, either;

1. Calibration in inches per minute (IPM L.E.D. will be illuminated and the closed loop tach feed back system is required) or;
2. Calibration in centimetres per minute (CM/MIN L.E.D. will be illuminated and the closed loop tach feed back system is required).

Whenever the control is in Stop (hold) mode and there is no Forward or Reverse direction commanded (Neutral), the speed display will indicate the preset speed.

For more information regarding the calibration scale selection, using the Motor Control Variables, Rotary Switch, refer to the supplemental manual (GD-075) "Technical Information For The Gullco "GSP-2100" Micro-Processor Based, 24 Volt DC Motor Control" (the pages are numbered with a prefix of "T-"), attached at the end of this manual.

The display also shows the travel direction accessed as well as the status of the “Hold” (Stop) command. Arc Signal activation and Program/Cycle mode L.E.D.’s are also provided.



The Forward and Reverse L.E.D.’s indicate the motor direction commanded.



The “Hold” (stop) L.E.D. will illuminate whenever there is a “Hold” (stop) command present. This could be any combination of either the Run/Stop switch being in the Stop position, or a “Hold” (stop) command being activated through one of the interface ports, or a part of the automatic cycle. When the “Hold” (stop) L.E.D. flashes on and off, it is indicating that the control is looking for a reset before allowing any functionality. To reset this condition, initiate a “Hold” (stop) command through the Run/Stop switch or one of the interface ports. See the section regarding error codes in the supplemental manual (GD-075) “Technical Information For The Gullco “GSP-2100” Micro-Processor Based, 24 Volt DC Motor Control” (the pages are numbered with a prefix of “T-“), attached at the end of this manual for more details.



The Arc Signal L.E.D. is used as an indication that the product/application specific micro-processor chip has activated the output ports “CN81” and “CN83”. When the optional Gullco auxiliary relay module is connected to the “CN81” port, the relay energizes, providing an isolated signal activating the welding/cutting equipment as part of the automatic cycle. When the “CN81” port is de-activated, the relay is de-energized, instructing the welding/cutting equipment to stop and the Arc Signal L.E.D. is extinguished.



The Auto Cycle Mode L.E.D. is used to indicate whether the control is in automatic cycle mode (Preset Cycle routine enabled), or in manual mode (Preset Cycle routine disabled). When the L.E.D. is constantly illuminated the automatic mode is enabled. When the L.E.D. is not illuminated the control is in manual mode.

The various L.E.D.’s may also be used to help identify various program variable parameters and their selected settings, when the Program Variable or Motor Control Variable selector switches are accessed.

## **Manual Operation**

To toggle between automatic mode (Aut) and manual mode (Hnd), place the Run/Stop switch in the Stop position and the Fwd/Neut/Rev switch in the Rev position and press and hold the Cycle Push Button until the desired mode is displayed (Aut or Hnd).

In manual mode (Hnd) the Auto Cycle Mode L.E.D. located in the lower right hand corner of the display will be extinguished.

Manual mode only permits manual motion of the “KAT”® carriage. The Forward/Neutral/Reverse switch selects which direction the “KAT”® will travel. The Speed Adjustment knob sets the linear travel speed. When the Run/Stop switch is placed in the Run position, the “KAT”® carriage will travel in the direction and speed set by the Forward/Neutral/Reverse switch and the Speed Adjustment knob. Travel motion will cease if; the Run/Stop switch is placed in the Stop position; the Forward/Neutral/Reverse switch is placed in the Neutral position; the speed is set to zero; or the optional travel limit switch is activated in the relevant direction (when installed).

## **Automatic Operation**

To toggle between automatic mode (Aut) and manual mode (Hnd), place the Run/Stop switch in the Stop position and the Fwd/Neut/Rev switch in the Rev position and press and hold the Cycle Push Button until the desired mode is displayed (Aut or Hnd).

When the control is in automatic mode (Hnd) the Auto Cycle Mode L.E.D. located in the lower right hand corner of the display will be constantly illuminated.

In automatic mode (Aut), the activation and subsequent procedure of an automatic cycle are described below:

1. The automatic cycle is initiated by placing the Forward/Neutral/Reverse switch in either the Forward or Reverse position and the Run/Stop switch in the Run position. The cycle then proceeds to section 2.
2. Momentarily looks at the Forward/Neutral/Reverse direction switch and the optional limit switch signals.
  - a. If the switch is in the Forward position and the optional forward limit switch is activated, the cycle aborts, resets and displays “End”.
  - b. If the switch is in the Reverse position and the optional reverse limit switch is activated, the cycle aborts, resets and displays “End”.
  - c. Otherwise the cycle proceeds to section 3.
3. Momentarily looks at the Forward/Neutral/Reverse direction switch and the Weld Direction parameter. The setting of the Forward/Neutral/Reverse switch is ignored from this point onward, until it is placed in the Neutral position or the Run/Stop switch is placed in the Stop position.
  - a. If the switch is set to the opposite direction as the Weld Direction parameter, then the “KAT”® carriage will start to travel at full speed in the direction set by the switch until either; the Run/Stop switch is placed in the Stop position; the

Forward/Neutral/Reverse direction switch is placed in the Neutral position; or the relevant optional travel limit switch is activated, at which point the travel will immediately stop and the cycle is then completed and “End” is displayed.

- b. If the switch is set to the same direction as the Weld Direction parameter, or if the Weld Direction parameter is set to both Forward & Reverse, then the cycle proceeds to section 4.
4. The optional Arc Signal Relay (GK-191-P-071) is energized and the Travel Motion Delay is initiated. The cycle then proceeds to section 5.
5. Upon completion of the Travel Motion Delay, the “KAT”® carriage starts to travel in the direction set by the Forward/Neutral/Reverse switch (detected and recorded at the onset of the cycle), at the speed set by the potentiometer. The cycle then proceeds to section 6.
6. When the Run/Stop switch is placed in the Stop position, or the Forward/Neutral/Reverse switch is placed in the Neutral position, or if the relevant forward or reverse optional limit switch is activated, then the travel motion will cease, and the Crater Fill Delay will commence. The cycle then proceeds to section 7.
7. Upon completion of the Crater Fill Delay (maintaining the Arc Signal after the weld motion has ceased, thereby filling the weld crater), The optional Arc Signal Relay is de-energized. The cycle then proceeds to section 8.
8. If the cycle was stopped via:
  - a. The Run/Stop switch or the Forward/Neutral/Reverse switch, the cycle is now completed and “End” is displayed.
  - b. If the cycle was stopped via the relevant forward or reverse optional limit switch and either the Automatic Return To Home parameter is set to Off; or the Weld Direction parameter is set to both Forward & Reverse, the cycle is now completed and “End” is displayed.
  - c. If the cycle was stopped via the relevant forward or reverse optional limit switch and the Automatic Return To Home parameter is set to On (and the Weld Direction parameter is not set to both Forward & Reverse), and the opposite limit switch to the Weld Direction is detected and not activated, then the Post Weld Delay timing cycle is initiated and the cycle proceeds as per section 9.
9. Upon completion of the Post Weld Delay (keeping the carriage stationary to allow time for any burn-back or post flow welding functions), the cycle will continue as per section 10.
10. The carriage will travel in the opposite direction to that of the Weld Direction parameter, at full speed, until the activation of the home limit switch (the optional limit switch in the opposite direction to that of the Weld Direction parameter). The cycle then proceeds to section 11.
11. Upon the activation of the home limit switch the carriage return travel will immediately stop and the cycle is then completed and “End” is displayed.

The Automatic Return To Home parameter setting is ignored if the Weld Direction parameter is set to both Forward & Reverse, or if optional travel limit switches are not detected on power-up.

If the Run/Stop switch is placed in the Stop position, or the Forward/Neutral/Reverse switch is placed in the Neutral position at any time during an automatic cycle, the carriage travel will stop immediately, and upon completion of the crater fill delay the Arc Signal will reset (if applicable).

### **Special consideration for the Auxiliary “Hold” (Stop) Signal in Automatic Mode:**

The Auxiliary “Hold” (Stop) Port - “CN12” - of the control allows an external device to place the control in the “Hold” (stop) mode. While-ever the device activates the “Hold” (stop) signal (closes the circuit between pins 1 & 2 of CN12) the carriage travel is immediately inhibited (both manual and automatic modes) and upon completion of the Crater Fill Delay the Arc Signal will reset, if applicable (automatic mode).

If the external device activates the auxiliary “Hold” (stop) signal for more than one second during an automatic cycle, the “Hold” (stop) mode is activated as described above. However, when the signal is deactivated (released), and if neither the Run/Stop switch had been placed in the Stop position nor the Forward/Neutral/Reverse switch placed in the Neutral position, the control will commence a new automatic cycle. **It is important to realise that under these circumstances, even though the auxiliary “Hold” (stop) signal may have been applied while the automatic cycle was performing an Automatic Return To Home routine, when the signal is deactivated (released), the cycle will start anew (arc signal activation, followed by carriage travel in the direction set by the Forward/Neutral/Reverse switch).**

If the external device activates the auxiliary “Hold” (stop) signal for less than one second during an automatic cycle, the automatic cycle performs a controlled shut down and resets (as though the Run/Stop switch has been placed in the Stop position).

## Programming The Automatic Cycle Parameters/Variables

Cycle Push Button



The Cycle Push Button is used to enter the programmable parameters menu that allows the operator to change their values and settings and so define how the automatic cycle will function. The Cycle Push Button is located between and above the Run/Stop switch and the Forward/Neutral/Reverse switch of the GSP control.

To make changes to the program variables, turn the power turned on and place the Run/Stop switch in the Stop position and the Fwd/Neut/Rev switch in the Neutral position, then press and hold the cycle push button (approximately 5 seconds) until the control acknowledges programming mode has been entered by displaying the first parameter screen "P1". By rotating the speed adjustment knob clockwise the operator can navigate to the next parameter "P2". Clockwise rotation will increment the program variable number while counter clockwise rotation will decrement the program variable.

Once the desired parameter has been selected the display screen will automatically alternate between the parameter number (P#) and the programmable parameter/variable that is assigned to it. Changes made by placing the Fwd/Neut/Rev toggle switch in either Fwd or Rev and then rotating the speed adjustment knob to change the value of the parameter. For numeric values, clockwise rotation will increase while counter clockwise rotation will decrease the value.

To exit programming mode, push and hold the Cycle Push Button until the control acknowledges it has exited programming mode by returning the main screen.



## **Description of Programmable Parameters/Variables**

The following describes the Program Variable settings for the GSP-2100 motor control while implementing the stored “-1” program.

Position	Details:
0	Normal Operating Position - The control needs to be in this position to allow normal operation of the unit (top-dead-center).
P. 1	Travel Motion Delay - Sets a delay after the activation of the optional Arc Signal Relay, prior to starting the weld travel, to allow for such things as shielding gas preflow and to allow the arc to establish before starting the welding/cutting motion. The variable value range is from 00.0 to 09.9 seconds, in increments of 00.1 seconds.
P. 2	Crater Fill Delay - Sets a delay after the cessation of welding/cutting travel prior to de-energizing the optional Arc Signal Relay, allowing the welding/cutting signal to remain active after the motion has stopped. The variable value range is from 00.0 to 09.9 seconds, in increments of 00.1 seconds.
P. 3	Post Weld Delay - Sets a delay after the Crater Fill Delay (above) prior to allowing the Automatic Return To Home routine to start. This is to allow the equipment to remain stationary over the end of the weld/cut for such things as burnback or postflow to occur. The variable value range is from 00.0 to 09.9 seconds, in increments of 00.1 seconds.
P. 4	Weld Direction - Allows the operator to select the direction(s) in which the automatic welding/cutting routines are to occur in. The variable options are Forward; Reverse; or Forward & Reverse.
P. 5	Automatic Return To Home - When this parameter is set to On and optional limit switches are used to terminate the welding/cutting cycle, the control will complete both the Crater Fill Delay and the Post Weld Delay, then drive the carriage at full speed back to the home limit switch (opposite direction to the Weld Direction parameter). If there are no optional limit switches attached, or the Weld Direction parameter is set to both Forward & Reverse, then this parameter is ignored. The variable options are either On or Off.
P. 6 to P. 10	Reserved for future use.

**Factory Settings:**

The following table shows the settings/values of the Programmable Parameter/Variables as supplied from the factory:

Switch Position	Parameter	Value
P. 1	Travel Motion Delay	00.3 (seconds)
P. 2	Crater Fill Delay	00.5 (seconds)
P. 3	Post Weld Delay	01.0 (seconds)
P. 4	Weld Direction	Forward
P. 5	Automatic Return To Home	Off
P. 6	Future Use	- - -
P. 7	Future Use	- - -
P. 8	Future Use	- - -
P. 9	Future Use	- - -
P. 10	Future Use	- - -

The standard equipment and functionality as described in this manual is suitable for a large percentage of simple welding and cutting procedures, however, Gullco has many different product/application modules, attachments and programs to accommodate more complex applications requiring features above those provided here. Please consult your local Gullco dealer to discuss your specific application.

## **MAINTENANCE**

The Flex “KAT”® carriage is a heavy duty, robust piece of equipment, and under normal conditions, it will give you years of trouble free service, if it is operated within the limits of its expected use and if the following maintenance points are adhered to:

Clean all excess dust and spatter from the carriage regularly. Pay particular attention to the drive gear and wheel assemblies. Occasionally lubricate the wheel assemblies and the drive gear. A dry lubricant is preferred, but even light machine oil will help.

## **INSPECTION**

At least once per year, the equipment should be taken out of service, stripped down and all moving parts should be cleaned, greased and inspected for wear and damage. All cables must be inspected for breaks and abrasion and must be well secured. All damaged and worn parts should be replaced. All fastening devices should be inspected for tightness.

The tachometer feed-back encoder sensor assembly located on the back of the motor, should be inspected for dirt accumulation and cleaned where necessary (an optional flex lower housing dust cover is available to reduce the opening of the lower housing, thereby reducing the amount of dirt contamination to the encoder). It is common for the armature shaft of a fatiguing motor to develop excessive axial float. This float sometimes causes the tachometer feed-back sensor wheel to rub on one of the encoder sensor faces, causing damage and failure. Check that the sensor disk is located centrally within the slot of the encoder sensor when the armature shaft is pressed in and pulled out. Adjust as necessary. The frequency of this inspection should increase with the accumulated use and or workload of the gear-motor.

**NOTE:** These inspections should be performed with greater frequency if conditions and usage requires.

## **STORAGE**

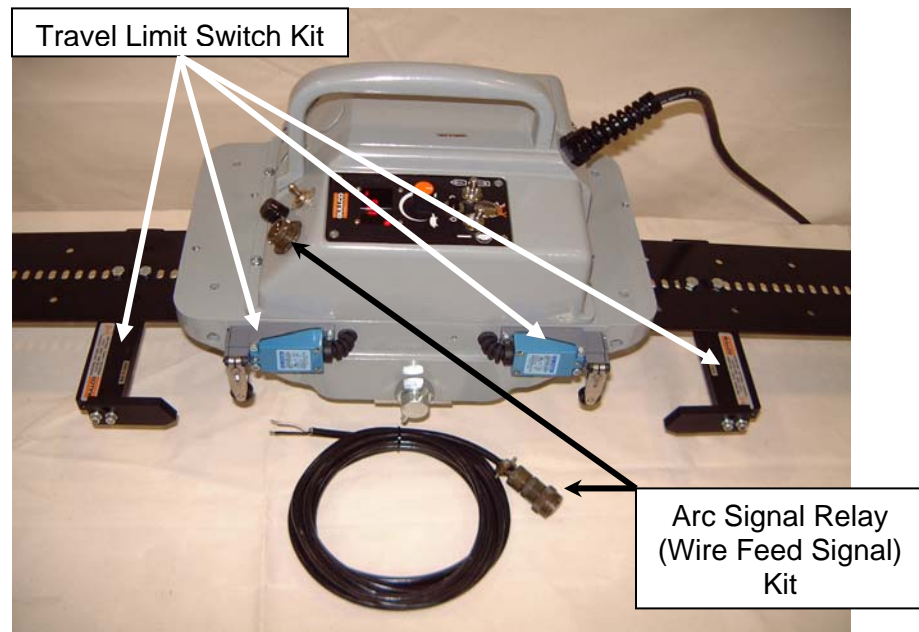
The Flex “KAT”® carriage should be kept in a dry environment with no possibility of impact or damage due to stacking of heavy objects on top of the “KAT”®.

## **SHIPPING**

When shipping the “KAT”® carriage, the drive engagement lever must be in the disengaged position and packing placed under the belly of the lower casting, in between the wheel assemblies but not resting on the drive gear.

## ACCESSORIES

GK-191-P-071 Arc Signal Relay Kit	A modular kit, typically used to provide an isolated relay signal (generated by the GSP control during automated welding/cutting cycles), to the trigger input of the welding/cutting equipment.
GK-192-F-045 Flex "KAT"® Carriage Travel Limit Switches	Forward and reverse travel limit switches mounted to the "KAT"® carriage, complete with wiring and two adjustable track mounted actuators.
GK-190-068 Lower Housing Dust Cover	A cover which is installed to the lower housing, reducing the drive opening to minimize dust & smoke pollutions to the interior of the "KAT"® carriage.



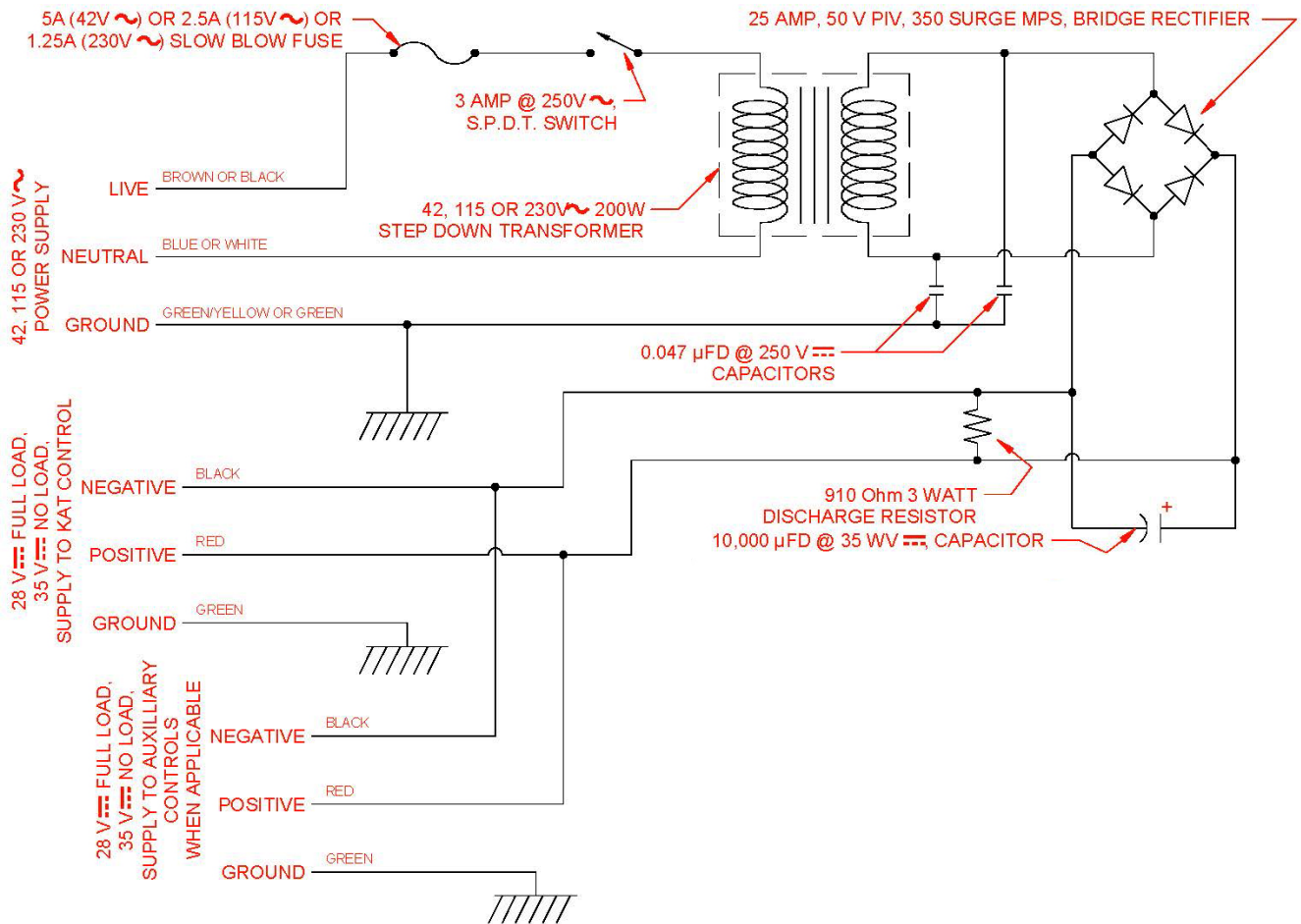
### Other Accessories:

The Flex "KAT"® carriage is drilled to facilitate the mounting of rack boxes and rack box riser brackets, cable support brackets, as well as links for towing idler carriages. Many other accessories such as remote controls, oscillation, seam tracking, auto indexing, auto stitch welding, and automatic overlaying are also available for fitting to the "KAT"® all position, variable speed travel carriage.

Visit Gullco's web site, "[www.gullco.com](http://www.gullco.com)" to see, or request, more product and application information.

# "KAT"® CARRIAGE POWER SUPPLY SCHEMATIC

DRAWING NUMBER: GK-191-P-029



## FLEX "KAT"® LOWER HOUSING ASSEMBLY, PARTS BREAKDOWN

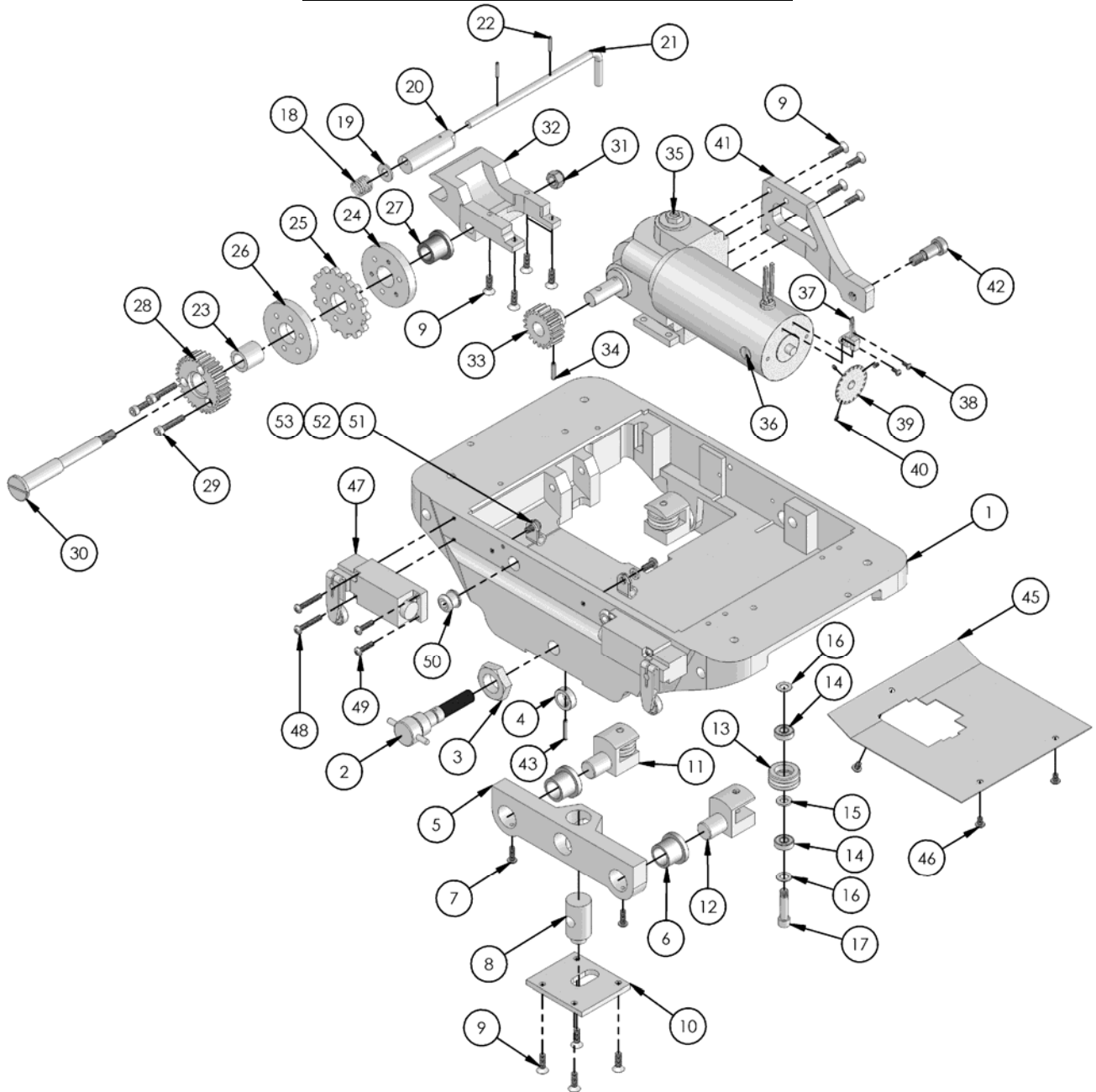
**DRAWING NUMBER: GK-192-F-020-2B**

ITEM	PART NUMBER	DESCRIPTION	QTY
1	GK-171-005	"KAT" LOWER HOUSING	1
2	GK-171-012	WHEEL ADJUSTMENT SCREW	1
3	GK-110-062	LOCK NUT	1
4	GK-171-102	RETAINING RING	1
5	GK-171-007	ADJUSTABLE WHEEL HOUSING	1
6	GK-165-009	WHEEL SHAFT BEARING	4
7	GK-112-050	8-32 x 1/2" ROUND HEAD SCREW	4
8	GK-171-008	WHEEL HOUSING PIVOT PIN	1
9	GK-105-050	10-32 x 5/8" FLAT HEAD LOCKING SCREW	12
10	GK-171-482	RETAINING PLATE	1
11	GK-192-F-065	FLEX WHEEL ASSEMBLY (ITEMS 12 TO 17)	4
12	GK-192-F-006	FLEX WHEEL YOKE	4
13	GK-192-F-007	FLEX WHEEL	4
14	GK-192-F-005	FLEX WHEEL BEARING	8
15	GK-192-F-009	BEARING SPACER	4
16	GK-111-066	FLAT WASHER, 1/4" ID x 1/2" OD	8
17	GK-192-F-035	FLEX WHEEL BOLT	4
18	GK-116-003	CAM SHAFT SPRING	1
19	GK-111-051	PLAIN WASHER, 1/4"	1
20	GK-165-015	CAM	1
21	GK-171-013	CAM SHAFT LEVER	1
22	GK-117-004	3/32" x 9/16" SPRING PIN	2
	GK-192-F-028	POWER UNIT ASSEMBLY (8 PCS ITEM 9 & ITEMS 23 TO 42)	1
	GK-192-F-008-1	FLEX CAM FORK ASSEMBLY (ITEMS 23 TO 32)	1
	GK-192-F-021	FLEX SPROCKET DRIVE GEAR ASSEMBLY (ITEMS 23 TO 29)	1
23	GK-118-060	IDLER GEAR BEARING	1
24	GK-192-F-004	DRIVE HUB (WITH BOSS)	1
25	GK-192-F-017	DRIVE SPROCKET	1
26	GK-192-F-003	DRIVE HUB (FLAT)	1
27	GK-118-052	IDLER GEAR BUSHING	1
28	GK-192-F-015	TRANSFER GEAR	1
29	GK-107-080	SOCKET HEAD CAP SCREW, 10-32 x 1"	3
30	GK-192-F-167	SHOULDER SCREW	1
31	GK-135-050	LOCK NUT, 5/16"-18	1
32	GK-192-F-008	CAM FORK	1
33	GK-192-F-012	FLEX MOTOR DRIVE PINION	1
34	GK-117-031	SPRING PIN 1/8" x 5/8"	1
35	GK-192-F-271	GEARHEAD & MOTOR ASSEMBLY, 0.8-25.8 ipm [2-65.4 cm/min.] (C/W ITEM 36)	1
	GK-192-F-133	GEARHEAD & MOTOR ASSEMBLY, 1.5-51.5 ipm [3.9-131 cm/min.] (C/W ITEM 36)	
	GK-192-F-131	GEARHEAD & MOTOR ASSEMBLY, 4.2-139 ipm [10.6-353 cm/min.] (C/W ITEM 36)	
36	GK-171-068-4	MOTOR BRUSHES (INCLUDED WITH ITEM 35)	2
37	GK-191-P-035	SENSOR, INCLUDING WIRING AND CONNECTOR	1
38	GK-112-060	ROUND HEAD SCREW, 4-40 x 1/4"	2
39	GK-191-P-038	SENSOR WHEEL	1
40	GK-106-063	SET SCREW, 4-40 x 3/16"	3
41	GK-171-011	MOTOR MOUNTING PLATE	1
42	GK-104-051	SHOULDER SCREW, 3/8" x 5/8"	1
43	GK-117-008	1/8" x 3/4" SPRING PIN	1
44	GL-190-019	"PUSH TO TURN" - NAMEPLATE (NOT SHOWN ON DRAWING)	1
45	GK-190-068	DUST COVER (OPTIONAL)	1
46	GK-112-089	8-32 x 1/4" ROUND HEAD SCREW (OPTIONAL)	3

SPECIFY "KAT"® MODEL NUMBER AND SERIAL NUMBER WHEN ORDERING PARTS.

# FLEX "KAT"® LOWER HOUSING ASSEMBLY, PARTS BREAKDOWN

**DRAWING NUMBER: GK-192-F-020-2B**



THE FOLLOWING ITEMS ONLY APPLY TO CARRIAGES THAT HAVE BEEN FITTED WITH OPTIONAL LIMIT SWITCHES			
ITEM	PART NUMBER	DESCRIPTION	QTY
47	GK-191-P-059	LIMIT SWITCH	2
48	GK-112-063	ROUND HEAD SCREW 8-32 x 1"	4
49	GK-112-052	ROUND HEAD SCREW, 8-32 x 5/8"	4
50	GK-151-003	RUBBER GROMMET	2
51	GK-156-041	CABLE CLAMP	2
52	GK-111-068	FLAT WASHER, #10	2
53	GK-112-094	ROUND HEAD SCREW, 10-32 x 7/16"	2
54	GK-191-P-070-C	WIRING HARNESS (FWD/REV) NOT SHOWN ON DRAWING	1

## PARTS BREAK DOWN FOR A "KAT"® UPPER HOUSING ASSEMBLY

**DRAWING NUMBER: GK-191-P-330**

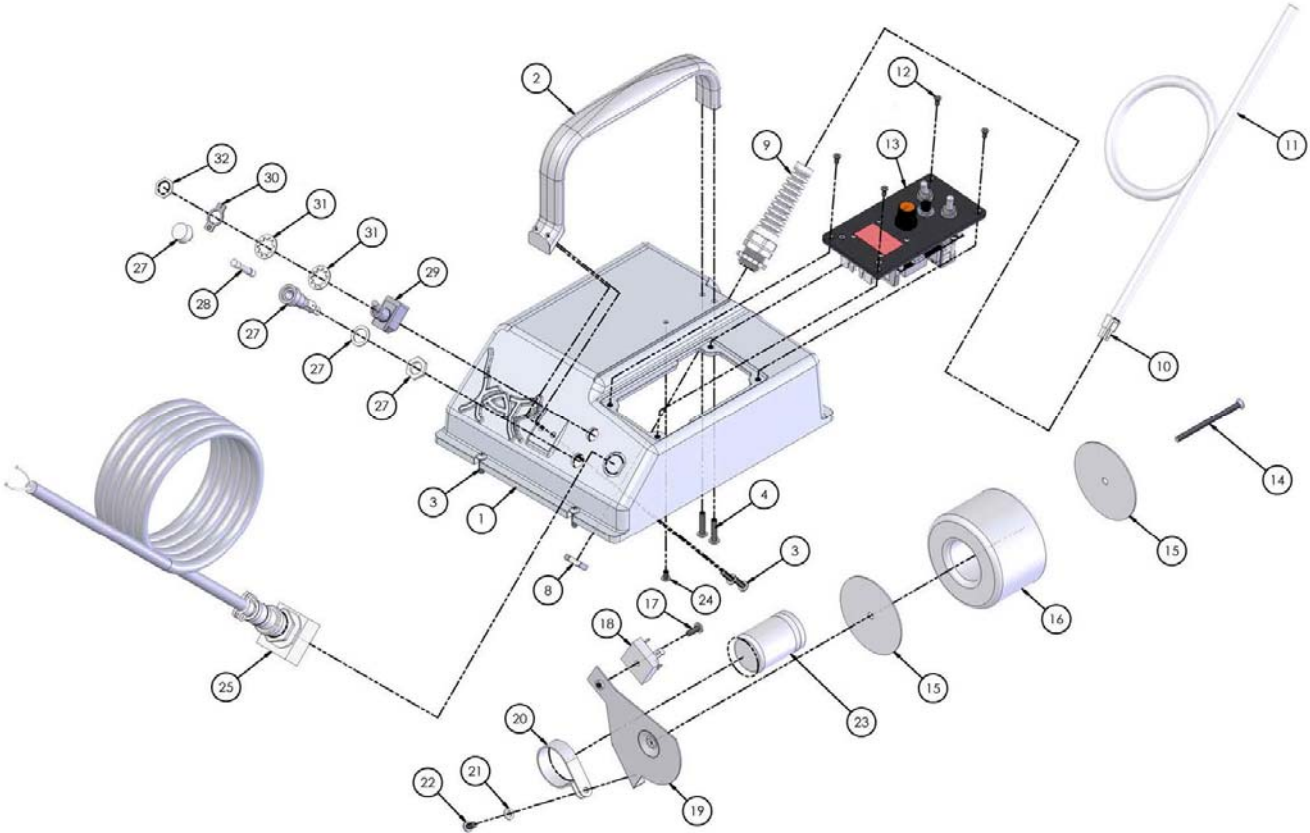
ITEM	PART NO.	DESCRIPTION	QTY.
1	GK-191-P-006-B	UPPER HOUSING	1
2	GK-171-029-B	HANDLE - MACHINED	1
3	GK-112-069	#10-32UNF x 5/8 RND HEAD SCREW	6
4	GK-112-068	#10-32UNF x 7/8 RND HEAD SCREW	2
8	GK-148-017	STRAIN RELIEF LOCK NUT	1
9	GK-148-015	PIGTAIL STRAIN RELIEF	1
10	GK-156-047	CONNECTOR	1
11	GK-171-032	POWER CORD (SPECIFY VOLTAGE) (NOT ALWAYS SUPPLIED WITH PLUG)	1
12	GK-141-014	6-32 x 5/16" FHS	4
13	GSP-2100	GSP-2100 MOTOR CONTROL ASSEMBLY	1
	GK-191-P-039	ELECTRICAL ASSEMBLY (ITEMS 14-23 & ITEMS 33-35)	1
14	GK-141-019	#10-32UNC x 3 FHMS	1
15	GK-191-P-218	TRANSFORMER MOUNTING PAD	2
16	GK-191-P-019-A	TRANSFORMER, 42 V INPUT	1
	GK-191-P-019-B	TRANSFORMER, 115 V INPUT	
	GK-191-P-019-C	TRANSFORMER, 230 V INPUT	
17	GK-112-054	#10-32UNF x 1/2 RND HEAD SCREW	1
18	GK-191-P-020	BRIDGE RECTIFIER	1
19	GK-191-P-021	TRANSFORMER MOUNTING BRACKET	1
20	GK-191-P-063	CAPACITOR CLIP	1
21	GK-111-068	WASHER #10 BOLT x 3/8 OD x 0.050	1
22	GK-112-065	#10-32UNF x 3/8 RND HEAD SCREW	1
23	GK-191-P-062	CAPACITOR	1
24	GK-112-089	#8-32UNC x 1/4 RND HEAD SCREW	1
25	GK-191-P-071	OPTIONAL ARC SIGNAL RELAY KIT	
27	GK-165-134	FUSE HOLDER ASSEMBLY	1
28	GK-165-098	SLOW BLOW FUSE, 42 V INPUT USE 5 AMP	1
	GK-165-099	SLOW BLOW FUSE, 115 V INPUT USE 2.5 AMP	
	GK-165-097	SLOW BLOW FUSE, 230 V INPUT USE 1.25 AMP	
29	GK-191-P-022	POWER ON/OFF SWITCH	1
30	GK-191-P-050	ON/OFF NAME PLATE	1
31	GK-129-014	INTERNAL TOOTH LOCK WASHER	2
32	GK-191-P-056	ON/OFF SWITCH NUT	1
33	GK-191-P-103	DISCHARGE RESISTOR & CAP. WIRING HARNESS (NOT SHOWN ON DRAWING)	1
34	GK-191-P-127	HIGH FREQUENCY CAPACITOR HARNESS (NOT SHOWN ON DRAWING)	1
35	GK-191-P-140	CAPACITOR TO "KAT" CONTROL HARNESS (NOT SHOWN ON DRAWING)	1
36	GK-191-P-128	LINE CORD CONNECTION HARNESS (NOT SHOWN ON DRAWING)	1

SPECIFY "KAT"® MODEL NUMBER AND SERIAL NUMBER WHEN ORDERING PARTS.



**PARTS BREAK DOWN FOR A "KAT"® UPPER HOUSING ASSEMBLY**

**DRAWING NUMBER: GK-191-P-330**



## **REVISIONS LIST**

### September, 2002

Overall First Release.

### November, 2004

Front Page Updated India details and added Gullco International Shanghai – Limited.

Overall Increased line weights of graphics.

Revision List Added “Additional Notes”.

### May, 2006

Pgs 20 & 21 Updated Flex KAT® Lower Housing Assembly Parts Breakdown.

Page 5 Updated product label.

### July, 2007

Front Page Updated Gullco contact details.

### July, 2007

Page 20 Item 4 in bill of materials was change to GK-171-102 from GK-119-053

### June, 2011

Front Page Contact details updated.

Page 20 Part number for GK-192-F-021 was GK-192-F-013.

### March, 2014

Overall Updated for the GSP-2100 control, replaces GSP-2000/2001/2010 controls

## **ADDITIONAL NOTES**

Specifications and products are subject to change without notice.

KAT, Moggy, Sam, KATBAK & KBM are registered trademarks of Gullco International Enterprises Ltd.

Only use genuine/authorized replacement parts.



# TECHNICAL INFORMATION FOR THE GULLCO “GSP-2100” MICROPROCESSOR BASED, 24 VOLT DC MOTOR CONTROL

**MODEL:  
GSP-2100**



## PARTS LIST & OPERATING INSTRUCTIONS

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## **IMPORTANT**

### **READ THIS BEFORE OPERATING THE “GSP-2100” CONTROL**

Read and understand the operation manual before operating or performing service of this equipment. Become familiar with the machines operation, applications and limitations. Keep the operation manual in a clean and readily available location.

The components used in these controls are Electrostatic Discharge Sensitive. Suitable ESD precautions must be adhered to when handling the control. Failure to comply may result in immediate or latent failure.

The motor control must not be continually started and stopped by the removal and reapplying of power to the control. Turning the power off to the control will not provide regenerative braking and continued use will damage the control.

Allow ten (10) seconds after the removal of power before reapplying the power to the "GSP" control.

The “Current Limit” (motor overload protection) on this product is typically factory pre-set to 10 Amps (unless specifically requested at time of order). If a specific application requires that this be changed, please refer to the section which describes the “Motor Control Variable Adjustments”, later in this manual.

The "GSP-2100" control has built in safety logic that reduces the risk of injury, damage and faulty operation. When the “GSP-2100” control recognizes a potential problem, its LED's display an error code and the unit will not allow any motor output until the fault has been cleared and the control has been reset (application of the hold command and pushing the cycle push button, or depending on the circumstances, powering down & waiting 10 seconds before powering back up). The Error Table on the following page lists the generic errors and their displayed error codes. Certain product/application specific programs may have other error codes, specific to that unit, which are not listed in this manual. Refer to the manual for the specific equipment/program for further details.

## Error Table

Error Code	Reason for Error
Er.1	The “GSP” control was set to run when; electrical power was initially supplied to the control (powered-up); or upon exiting either the Program Variable or Motor Control Variable settings. To prevent unexpected motion generated from the “GSP” control, the motor output is disabled and the error code displayed until the control is placed in “Hold” (stop) mode & pushing the cycle push button, resetting the error.
Er.2	As port “CN12” is usually used to provide an external “Hold” (stop) command, wiring should run from pin 1 of this port, up to the external device and then back to pin 3, thereby closing the circuit between pins 1 and 3 whenever connected. Each time the “GSP” control is powered-up, it checks the status of pins 1 & 3 of “CN12” and if closed circuit, the control will continue to monitor their status as well as the status of pin 2 with respect to pin 1 (if pin 1 & 3 were open circuit on power-up, the control ignores all signals for port “CN12”). Once the “GSP” control has recognized a device was connected to “CN12” but is no longer connected (i.e. pins 1 & 3 change from closed circuit to open circuit), the motor output is disabled and the error code displayed. Rectifying the fault and resetting the “GSP” control by placing the control in “Hold” (stop) mode & pushing the cycle push button will clear the error. <b>Note: turning the power to the “GSP” control off, waiting ten (10) seconds then re-applying the power will clear the error, but if the circuit between pin 1 &amp; 3 remains open, all signals coming into “CN12” will be ignored (failing to recognize external “Hold” commands).</b>
Er.3	The current draw of the motor exceeded the amperage set by the “Current Limit” variable of the “GSP” control. Rectify the fault causing the excessive current draw, or increase the value of the “Current Limit” variable – <b>only if it is set too low</b> . Then reset the “GSP” control by either powering-down the control, or by placing the control in “Hold” (stop) mode & pushing the cycle push button, to clear the error.
Er.4	As port “CN13” is usually used to interface normally closed travel limit switches, a closed circuit between pins 1 and 2 indicate a non-activated reverse travel limit switch and a closed circuit between pins 1 and 4 indicate a non-activated forward travel limit switch (a third limit switch is sometimes connected between pins 1 and 3). Each time the “GSP” control is powered-up, it checks the status of pins 2 & 4 of “CN13” with respect to pin 1 and if at least one is closed circuit, the control will continue to monitor their status (as well as the status of pin 3 where relevant) with respect to pin 1 (if both pins 2 & 4 were open circuit to pin 1 on power-up, the control ignores all signals for port “CN13”). Once the “GSP” control has recognized limit switches were connected to “CN13” but are no longer connected (i.e. pin 1 is no longer in a closed circuit with either pin 2 or 4), the motor output is disabled and the error code displayed. Rectifying the fault and resetting the “GSP” control by placing the control in “Hold” (stop) mode & pushing the cycle push button will clear the error. <b>Note: turning the power to the “GSP” control off, waiting ten (10) seconds then re-applying the power will clear the error, but if the circuit remains open between pin 1 &amp; 2 as well as pin 1 &amp; 4, all signals coming into “CN13” will be ignored (failing to recognize limit switch signals).</b>
Er.5	If, an automatic cycle is requested, but the “GSP” control does not recognize the correct connection of a closed-loop tachometer speed sensor, the motor output (and automatic cycle) will be disabled and the error code displayed. Rectifying the fault and resetting the “GSP” control by placing the control in “Hold” (stop) mode & pushing the cycle push button will clear the error. Note: the motor control will still enable manual operation, but the motor control will only operate in open loop mode (speed will only be calibrated as a percentage and susceptible to speed variations due to loading).

Er.6	If the GSP control does not receive encoder feedback after energizing the motor for two (2) seconds, the control realises that either the motor is stalled or the encoder circuit is not working, in which case the motor output is disabled and the error code displayed.
Er.7	Power supply problem – power supply (transformer) has a malfunction possibly due to low or high input voltage. Note: Whenever the control is powered down by the operator, Er .7 will be displayed.
Er. 55	Software not compatible -If any of the control boards (display, keypad, motor driver) are replaced with incompatible revision this error will be displayed.
Er. 60	Display Error – the control display has encountered a problem.
Er. 70	Keypad Error – the control keypad has encountered a problem.

## GENERAL SPECIFICATIONS

The GSP-2100 microprocessor based motor control is a 24 vdc, full "H"-Bridge, pulse width modulation control with regenerative braking. It is designed to run 24 vdc motors and requires a 24 to 38 vdc no-load supply (30 to 38 vdc is usually required for Gullco products to meet specifications), usually derived from a full bridge rectified 22-24 vac source. The required wattage of the supply depends upon the size of the motor. This control can operate any motor with a capacity of up to 250 Watts (1/3 horse power).

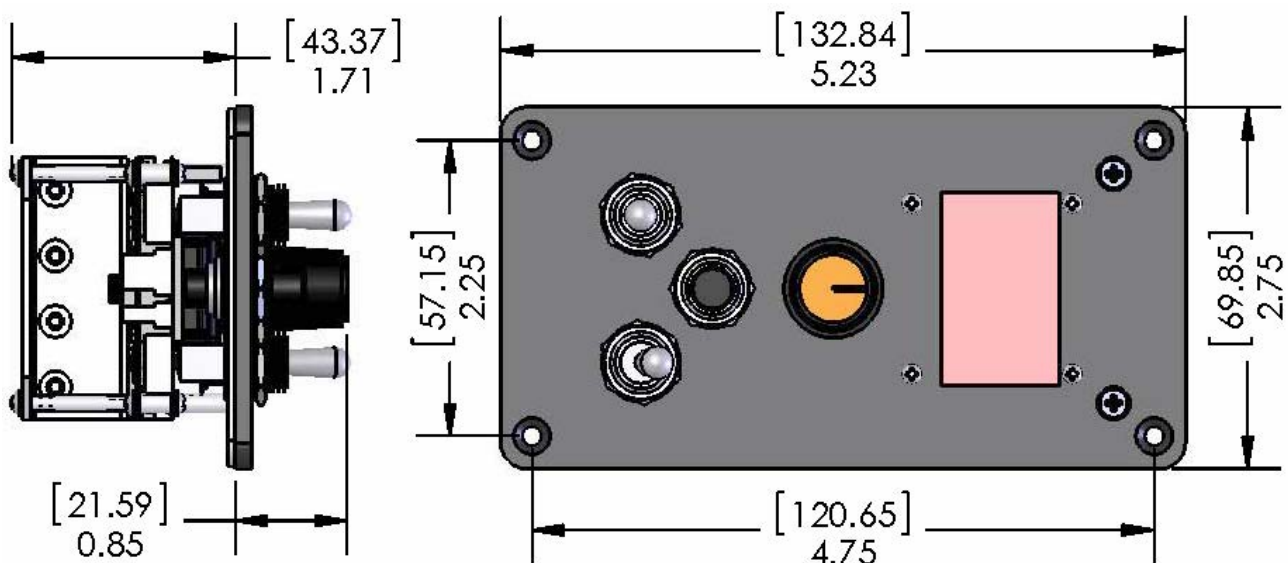
The control can either operate with, or without, a closed loop tach feedback system attached to the armature of the motor. A tach feedback is normally recommended as it allows the motor control to constantly monitor and correct the speed of the motor providing accurate speed control regardless of any variance in loading. A tach feedback system is also necessary for some automatic cycles to function, or when using engineering units (counting of tach feedback pulses, used to measure the distance travelled). Open loop (i.e. no tach feedback) may be acceptable for manual motor operation in situations where; the motor sensor is temporarily damaged; the motor sensor is susceptible to failure due to an exceptionally harsh environment; or where accurate calibrated speed is not required and the loading of the motor is constant.

Various input and output ports are provided which are either optically coupled or transistor outputs. These ports are described in detail later in this manual.

An L.E.D. display is provided to indicate the status of the control. This display is described in detail later in this manual.

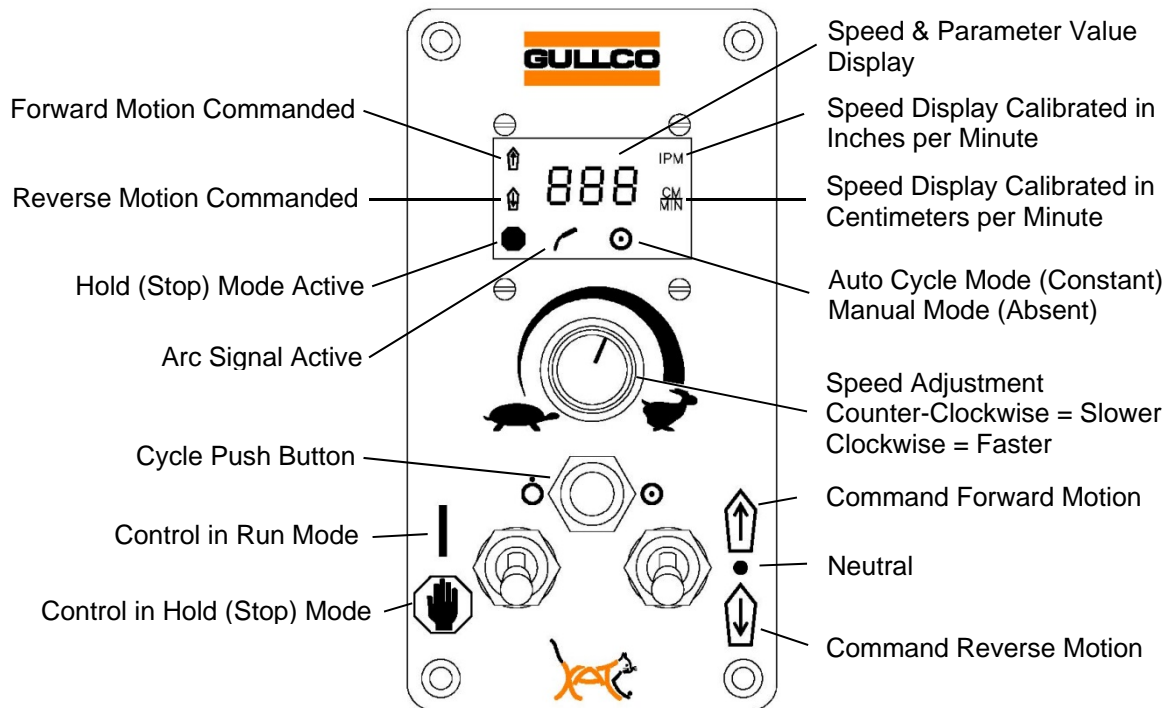
A varied selection of programs allows the control to behave in specific ways that are suited with the motorized equipment and process that the controls are being applied to. Typically, each program allows full manual operation of the motor and usually provides; automatic cycle routines; programming ability for the operator to set and fine tune the automatic cycles to that desired; and external interfacing. Refer to the manual for the specific product/micro-processor chip for details.

## GENERAL DIMENSIONS





## “GSP” CONTROL PANEL LAY-OUT



## OPERATION

### Local Control Devices

Externally, the Gullco GSP-2100 control has switching for Forward/Neutral/Reverse & Run/Stop, Manual/Auto as well as a rotary encoder for speed control.



= “STOP” - This over-rides all other controls and when activated will apply regenerative braking to the motor to bring it to a dead stop, and will disallow any further operation of the motor while ever it is in this state. The Run/Stop switch needs to be in this position to change between automatic and manual modes (where applicable) and also to alter any of the program variable parameters (where applicable).



= “RUN” - This removes the “STOP” command and allows the control to assume an operational status.



= “FORWARD” - When the switch is in this position, the control will drive the motor in the Forward direction, while in manual mode and when so permitted. It is also used as the method of adjustment for the program variables when used in conjunction with the speed adjustment knob.



= “NEUTRAL” - When the switch is in this position, the control will not drive the motor in either direction while in manual mode.



= "REVERSE" - When the switch is in this position, the control will drive the motor in the Reverse direction, while in manual mode and when so permitted. It is also used as the method of adjustment for the program variables when used in conjunction with the speed adjustment knob.



= "VARIABLE SPEED CONTROL" - By turning the multi turn rotary encoder knob in a clockwise direction, the motor speed will be increased. When rotated in the counter-clockwise direction, the motor speed will decrease. The Variable Speed Control adjustment is normally used to set the manual speed of the motor and the welding/cutting speed of the motor commanded in an automatic cycle.



= "PRESET CYCLE ENABLED" - Only by depressing the Cycle Push Button continually for one second while the Fwd/Neut/Rev switch is in the Reverse position, and while the control is in "Hold" (Stop) mode, may the preset cycle routine be toggled from disabled to enabled (as indicated by the constant illumination of the Auto Cycle Mode L.E.D.). The Cycle Push Button is also used to enter and exit parameter/variables menu.



= "PRESET CYCLE DISABLED" - Only by depressing the Cycle Push Button continually for one second while the Fwd/Neut/Rev switch is in the Reverse position, and while the control is in "Hold" (Stop) mode, may the preset cycle routine be toggled from enabled to disabled (as indicated by the non-illumination of the Auto Cycle Mode L.E.D.). The Cycle Push Button is also used to enter and exit parameter/variables menu.

### **The L.E.D. Display**

The control has an L.E.D. display that indicates the travel speed in one of four possible calibration scales. The calibration scale selection is made using the Motor Control Variables, Rotary Switch, described later in this manual. The four possible calibration scales are as follows:

1. Calibration in inches per minute (IPM L.E.D. will be illuminated and the closed loop tach feedback system is required);
2. Calibration in centimetres per minute (CM/MIN L.E.D. will be illuminated and the closed loop tach feedback system is required);
3. Calibration in other units such as degrees per minute (no L.E.D. will be illuminated and the closed loop tach feedback system is required, or;
4. Calibration in percentages of full speed obtainable (0 to 100% pulse width duty cycle) (no L.E.D. will be illuminated and automatically selected when no closed loop tach feedback is recognized).

Whenever the control is in Stop (hold) mode and there is no Forward or Reverse direction commanded (Neutral), the speed display will indicate the preset speed.

The display also shows the travel direction accessed as well as the status of the “Hold” (Stop) command. Weld activation signal and Program/Cycle mode L.E.D.’s are also provided.



The Forward and Reverse L.E.D.’s indicate the motor direction commanded.



The “Hold” (stop) L.E.D. will illuminate whenever there is a “Hold” (stop) command present. This could be any combination of either the Run/Stop switch being in the Stop position, or a “Hold” (stop) command being activated through one of the interface ports, or a part of the automatic cycle. When the “Hold” (stop) L.E.D. flashes on and off, it is indicating that the control is looking for a reset before allowing any functionality. To reset this condition, initiate a “Hold” (stop) command through the Run/Stop switch or one of the interface ports. See the section regarding error codes, earlier in the manual for more details.



The Arc Signal L.E.D. is typically used as an indication that the product/application specific program has activated the output ports “CN81” & “CN83” (The “-2” program activates “CN82” & “CN84”). When a Gullco auxiliary relay module (optional on most equipment) is connected to the “CN81” (or “CN82”) port the relay energizes, providing an isolated signal activating the welding/cutting equipment. When the “CN81” port is de-activated, the relay is de-energized, instructing the welding/cutting equipment to stop and the Arc Signal L.E.D. is extinguished.



The Pre-set Cycle L.E.D. is used to indicate whether the Preset Cycle routine is enabled (automatic cycle mode) or disabled (manual mode). When the L.E.D. is constantly illuminated the Preset Cycle is enabled (automatic cycle mode). When the L.E.D. is not illuminated the Preset Cycle is disabled (manual mode).

### **Local Control Operation**

The following provides some basic operational procedures that are typical on the GSP-2100 control. It is important to note that depending upon the product/application specific program, some of the following information may vary or not be applicable.

**SPEED PRESET** - The travel speed may be preset, prior to any motion, by placing the Run/Stop switch to the Stop position and the Forward/Neutral/Reverse switch in the Neutral position. Then, by rotating the Variable Speed Control knob, the travel speed can be pre-set to the required value, as indicated in the L.E.D. display.

**MANUAL MODE** – To place the control in manual mode (disable the preset cycle), with the power on, place the Run/Stop switch in the Stop position and Fwd/Neut/Rev switch in the Reverse position. Then continually press the Cycle Push Button until the display shows “Hnd” (the Pre-set Cycle L.E.D. will be extinguished). While the control is in manual mode, the motor may usually be operated by placing the Forward/Neutral/Reverse switch in the desired travel direction, and placing the Run/Stop switch in the Run position. Normally, if there are no other external “Hold” (stop) signals or activated limit switch signals etc., the motor will run in the direction selected at the speed set by the Variable Speed Control Knob. The speed may be adjusted at any time and the manual motion may be stopped by placing either the Run/Stop switch in the Stop position or by placing the Forward/Neutral/Reverse switch in the Neutral position.

**AUTOMATIC MODE** - To place the control in automatic mode (enable the preset cycle), with the power on, place the Run/Stop switch in the Stop position and Fwd/Neut/Rev switch in the Reverse

position. Then continually press the Cycle Push Button until the display shows "Aut" (the Pre-set Cycle L.E.D. will be illuminated). While the control is in automatic mode, the automatic cycle is usually initiated by placing the Forward/Neutral/Reverse switch in the desired travel direction (if applicable), and placing the Run/Stop switch in the Run position. When the automatic cycle has completed, the display will show "End" and the "Hold" (stop) L.E.D. will flash, indicating the need to reset the Autocycle by placing the Run/Stop switch in the Stop position before another automatic cycle may be initiated. The automatic cycle may be aborted at any time by placing the Run/Stop switch in the Stop position. The welding/cutting speed may usually be adjusted at any time during an automatic cycle.

## **PROGRAM VARIABLE ADJUSTMENTS**

Program Variables are adjustable parameters available to the operator that determine the functionality, and allow fine-tuning, of the automatic cycle operation. **Note:- Not all GSP-2100 product/application specific programs provide program variables - refer to the manual for the specific machine or specific program for further details.**

The Cycle Push Button is used to enter the programmable parameters menu that allows the operator to change their values and settings and so define how the automatic cycle will function. The Cycle Push Button is located between and above the Run/Stop switch and the Forward/Neutral/Reverse switch of the GSP control.

To make changes to the program variables, turn the power turned on and place the Run/Stop switch in the Stop position and the Fwd/Neut/Rev switch in the Neutral position, then press and hold the cycle push button (approximately 5 seconds) until the control acknowledges programming mode has been entered by displaying the first parameter screen "P1". By rotating the speed adjustment knob clockwise the operator can navigate to the next parameter "P2". Clockwise rotation will increment the program variable number while counter clockwise rotation will decrement the program variable.

Once the desired parameter has been selected the display screen will automatically alternate between the parameter number (P#) and the programmable parameter/variable that is assigned to it. Changes are made by placing the Fwd/Neut/Rev toggle switch in either Fwd or Rev and then rotating the speed adjustment knob to change the value of the parameter. For numeric values, clockwise rotation will increase while counter clockwise rotation will decrease the value.

To exit programming mode, push and hold the Cycle Push Button until the control acknowledges it has exited programming mode by returning the main screen.

The values/settings of the variables are stored on the product/application specific program. If the program is changed, the values/settings of the variables will need to be re-entered.

## **MOTOR CONTROL VARIABLE ADJUSTMENTS**

Motor Control Variables are adjustable parameters that affect the core operation of the motor control and its relationship with the motor. These variables are generic, regardless which product/application specific program is selected.

The Cycle Push Button is used to enter the motor control variable adjustments menu that allows the operator to change their values and settings. The Cycle Push Button is located between and above the Run/Stop switch and the Forward/Neutral/Reverse switch of the GSP control.

To make changes to the program variables, with the power turned off place the Run/Stop switch in the Stop position and the Fwd/Neut/Rev switch in the Neutral position, then press and hold the cycle push button, then power up the control. Continue to press and hold the cycle push button while the control boots up (approximately 5 seconds). The control will acknowledge programming mode has been entered by displaying the first parameter screen "A1". By rotating the speed adjustment knob clockwise the operator can navigate to the next parameter "A2". Clockwise rotation will increment the program variable number while counter clockwise rotation will decrement the program variable.

Once the desired parameter has been selected the display screen will automatically alternate between the parameter number (A#) and the programmable parameter/variable that is assigned to it. Changes are made by placing the Fwd/Neut/Rev toggle switch in either Fwd or Rev and then rotating the speed adjustment knob to change the value of the parameter. For numeric values, clockwise rotation will increase while counter clockwise rotation will decrease the value.

To exit programming mode, push and hold the Cycle Push Button until the control acknowledges it has exited programming mode by returning the main screen.

The values/settings of the variables are stored on the product/application specific program. If the program is changed, the values/settings of the variables will need to be re-entered.

### **Descriptions of the Motor Control Variable parameter settings:**

The following describes the settings.

- A. 1 Current Limit – This sets the maximum current draw that the motor control will allow before activating an error code and ceasing operation. The variable value range is from 00.0 to 15.0 Amps, in increments of 1.0 amperes.
- A. 2 Speed Calibration, 2 Most Significant Digits – This sets the first two digits of the maximum speed (regardless of decimal place). The variable value range is from 00 to 99, in increments of 1.
- A. 3 Speed Calibration, 2 Middle Digits – This sets the second two digits of the maximum speed (regardless of decimal place). The variable value range is from 00 to 99, in increments of 1.
- A. 4 Speed Calibration, 2 Least Significant Digits – This sets the last two digits of the maximum speed (regardless of decimal place). The variable value range is from 00 to 99, in increments of 01.

- A. 5 Speed Calibration, Decimal Place – This sets the decimal place location for the speed display. The variable settings range between no decimal places and two decimal places.
- A. 6 Calibration Units – This sets the units of calibration for the speed display. The variable settings offer either; inches per minute (Inc); or centimetres per minute (CEn); or non-specific (rAd). When the closed loop tach feedback is connected and; if the inches per minute option is selected the IPM L.E.D. will illuminate; or if the centimetres per minute option is selected the CM/MIN L.E.D. will illuminate; or if the non-specific option is selected neither the IPM nor the CM/MIN L.E.D.'s will illuminate.
- A. 7 Braking – This sets the level of motor braking from instant braking to a variable degree of pulsed graduated braking. The variable value range is from a reference value of 000 to 010 in increments of 1. A reference value of 0 provides instant braking whereas a reference value of 10 provides the slowest, softest pulse braking.
- A. 8 Response Gain – This sets the speed correction response rate. By having the motor speed correction rate at a slow response, the motor takes longer to accelerate to speed and reacts to motor speed variances slower. By having a fast response, the motor will accelerate to speed quickly, sometimes resulting in over shooting of the preset speed, and reacting to motor speed variances instantly, sometimes resulting in slight speed oscillation. The variable value range is from a reference value of 001 to 010 in increments of 1. A reference value of 1 provides the fastest speed correction rate, whereas a reference value of 10 provides the slowest, speed correction response rate.
- A. 9 Maximum Speed Scale – This sets the maximum speed at which the motor control will allow (the speed is capped at this set percentage). The variable value range is from 001 to 100 percent of full speed, in increments of 1%.
- A. 10 Program Select – This allows the operator to set the product/application specific program. Programs will be shown as “-1” for example. Each GSP-2100 control will have a number of preloaded programs to choose from depending on the application. Other programs can be loaded by your local authorized Gullco service representative.

**Note:** Following the A.10 motor control variable parameter, U.1, U.2 & U.3 will follow as the next three parameters. These are for factory diagnostic purposes only and are non-adjustable. They indicate the revision level of software and hardware of the control.

If the specific product/application for which a control is to be used and unless otherwise specified, the Motor Control Variables will be factory pre-set as follows:

Variable/Parameter	A. 1	A. 2	A. 3	A. 4	A. 5	A. 6	A. 7	A. 8	A. 9	A.10
Value/Setting	10.0	10	00	00	---	Inc	001	002	100	-1
Overall Result	The control will allow a current draw of up to 10 amperes. The speed will be calibrated so that full speed will display 100 IPM. The braking will be close to instantaneous. The speed correction response will be medium. 100% of full speed will be available.									

The Gullco “GSP-2100” motor controller needs to have the speed display calibrated to match that of the equipment driven by the motor. This is required so that the speed displayed is equal to that of the motion and also so that the control may calculate engineering units (counting and scaling of tach feedback pulses, used to measure distance travelled). If the product/application specific program utilises engineering units, the calibration of the speed is very important. For this reason, the speed calibration is performed with an accuracy of six digits, even though the speed displayed is only three digits. After the calibration process has been completed, the three least significant digits are not displayed.

As mentioned earlier, the accuracy of the calculated engineering unit output is only as good as the calibration of the control relevant to the actual speed. The following example shows how to calculate the actual full speed of a Gullco “KAT®” carriage.

**Known Factors:**

- Control is running at full speed when receiving 2KHz from tach feedback sensor.
- Sensor wheel on motor armature creates 20 pulses per revolution.
- Gear box ratio = 540:1
- External gear drive = 15 tooth to a 30 tooth, gear ratio.
- Pitch diameter of the 30 tooth final drive gear = 1.875”

**Calculation:**

- 2KHz. = 120,000 pulses per minute.
- 120,000 pulses per minute / 20 pulses per rev = 6000 revs per minute (armature)
- 6000 rpm (armature) / 540 (gearbox ratio) = 11.111111 rpm (output shaft of gear box)
- 11.111111 rpm x 15/30 (external gear ratio) = 5.555556 rpm (final drive gear)
- 1.875” (pitch diameter) x Pi = 5.890486” (circumference)
- 5.555556 rpm x 5.890486” per rev = 32.7249” per minute
- Therefore maximum travel speed = 32.7249 inches per minute

In the above example, the speed calibration values of the Motor Control Variables would be set as follows:

Variable/Parameter	A. 2	A. 3	A. 4	A. 5	A. 6
Value/Setting	32	72	49	-. .	Inc

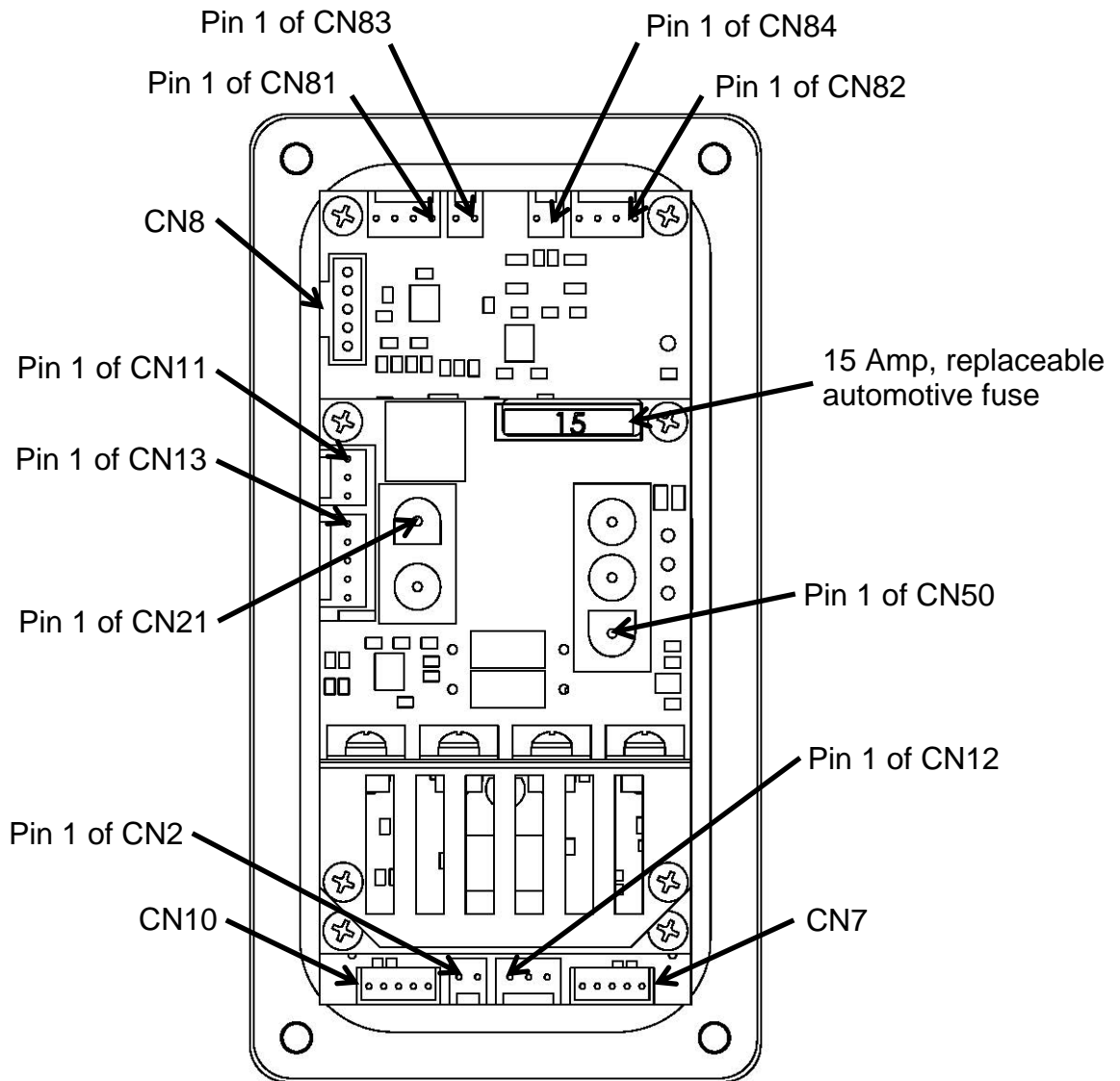
Accurate calculations are preferred, however, a practical test whereby the distance of travel may be timed at full speed and then the distance divided by the time to give a value of full speed. Any inaccuracies in the calibration, all be it small, will magnify through accumulation over distance. For example, if the true full speed of a unit is 18.3125" per minute, and is calibrated to 18.0000" per minute, every time the control thinks that it has travelled 18", it would have, in fact travelled an extra 0.3125". Therefore, there would be a 3.125" [7.94mm] error on 180" [457.2mm] of theoretical travel.

### **STANDARD GULLCO PRODUCT SPEED CALIBRATION TABLE**

PRODUCT	MAXIMUM SPEED	
	IMPERIAL	METRIC
KAT® CARRIAGES		
GK-200-RL	16.3625 "/MIN	41.5607 CM/MIN
GK-200-RM	32.7249 "/MIN	83.1213 CM/MIN
GK-200-RH	88.3573 "/MIN	224.428 CM/MIN
GK-200-RL C/W HI-SPEED GEAR TRAIN	43.6332 "/MIN	110.828 CM/MIN
GK-200-RM C/W HI-SPEED GEAR TRAIN	87.2665 "/MIN	221.657 CM/MIN
GK-200-RH C/W HI-SPEED GEAR TRAIN	235.619 "/MIN	598.473 CM/MIN
GK-200-RL C/W LOW-SPEED GEAR TRAIN	6.98132 "/MIN	17.7325 CM/MIN
GK-200-RM C/W LOW-SPEED GEAR TRAIN	13.9626 "/MIN	35.4654 CM/MIN
GK-200-RH C/W LOW-SPEED GEAR TRAIN	37.6991 "/MIN	95.7557 CM/MIN
GK-200-FL	25.7652 "/MIN	65.4436 CM/MIN
GK-200-FM	51.5304 "/MIN	130.887 CM/MIN
GK-200-FH	139.132 "/MIN	353.395 CM/MIN
MOGGY'S	IMPERIAL	METRIC
GM-03	115.178 "/MIN	292.552 CM/MIN
SAM'S	IMPERIAL	METRIC
GM-02	66.1000 "/MIN	168.000 CM/MIN
KAMEL ROLLS	IMPERIAL	METRIC
KR-1500-035	35.4302 "/MIN	89.9927 CM/MIN
KR-1500-070	70.8604 "/MIN	179.985 CM/MIN
POSITIONERS	REVOLUTIONS PER MINUTE	
GP-250-M & GPP-250-M	4.62962 REV/MIN	
GP-250-H & GPP-250-H	12.5000 REV/MIN	



## "GSP-2100" CIRCUIT BOARD DETAILS



### Control Connection Details

**Note: CN50 & CN21 are Molex 0.093" [2.36mm] series connectors**

#### CN50 - Power Supply Input

- Pin 1 - Optional earth ground
- Pin 2 - common
- Pin 3 - 24 to 38 Vdc supply

### CN21 - Motor Output

Pin 1 - Motor output

Pin 2 - Motor output

Note:

Pins 1 and 2 may be swapped to reverse polarity (only necessary to match the forward and reverse of the motor with those of the control).

**Note: CN11 to CN13 & CN81 to CN84 are Molex KK, 0.1" [2.54mm] series connectors, or equivalent spaced headers**

### CN11 - Tach Feed Back Connection

Pin 1 - Common

Pin 2 - Signal

Pin 3 - Sensor detection and current source

**Note: Because the following connectors are effectively inputs/outputs, the particular program of the product/application specific program installed may use these ports for specific signals, other than their common use (described below).**

### CN12 - Auxiliary "Hold" (Stop) Port (Typical)

Pin 1 - Common

Pin 2 - "Hold" (Stop) (digital input active LOW)

Pin 3 - Port active recognition

Note:

When the "GSP" control is initially powered-up, it looks to see if pins 1 & 3 are in a closed circuit, thereby indicating a device/signal using this port. If the control does not see pin 3 connected to common, it assumes that nothing is connected to this port and will not look for the auxiliary "Hold" (stop) signal. **Therefore, any auxiliary "Hold" (stop) device that is connected to the control after it has been powered-up will be ignored.** After the microprocessor has recognised that a device is connected to this port, it will activate the "Hold" (stop) command when pin 1 & 2 are in a closed circuit.

### CN13 - Limit Switch Monitoring Input (Typical)

Pin 1 - Common

Pin 2 - Reverse limit switch

Pin 3 - Center limit switch

Pin 4 - Forward limit switch

Pin 5 - Spare (not used)

Note:

Limit switches are to be wired in the "normally closed" configuration to allow normal use. When the "GSP" control is initially powered-up, it looks to see if either the forward or reverse limit switches are in closed circuit to common. If the control does not see either of pins 2 or 4 connected to common, it assumes that no limit switches are in use and will not look for further signals. **Therefore limit switches that are connected to the control after it has been powered-up will be ignored.** After the microprocessor has recognised that limit switches are being used, it will disable any travel in the relevant direction to that of an open circuit.

### CN2 - Buzzer Output

Pin 1 - Common

Pin 2 - +12VDC

Note:

This output will be energized whenever the arc signal is on. An external buzzer can be connected (not supplied) and used as a warning indicator to others that the equipment is running. This connector may not be populated on some controls

### CN8 – I<sup>2</sup>C Communication

For future use, may not be populated on some controls.

### CN7 & CN10 – Factory Programming ports

These ports are used by the factory for programming and diagnostic purposes.

### Logic Output Ports

#### CN81 - Relay Drive Output (Transistor Output)

Pin 1 - Common

Pin 2 - Spare (not used)

Pin 3 - Transistor collector out

Pin 4 - +12 V

Note:

This port is typically configured to activate whenever the arc signal is called for in the automatic cycle routine.

Pin 3 and Pin 4 are typically used to energize the coil of the optional auxiliary relay module, which is usually connected to the welding/cutting trigger signal.

#### CN83 - Optically Coupled Output Signal

Pin 1 - Emitter

Pin 2 - Collector

Note:

This port is typically configured to activate whenever the arc signal is called for in the automatic cycle routine (activated at the same time as CN81, providing an optically coupled output signal as an alternative to a transistorized output).

#### CN82 - Relay Drive Output (Transistor Output)

Pin 1 - Common  
Pin 2 - Spare (not used)  
Pin 3 - Transistor collector out  
Pin 4 - +12 V

**Note:**

Depending upon the product/application specific micro-processor chip installed, this port, in conjunction with one of Gullco's optional auxiliary relay modules, may be used to activate such things as pneumatic solenoid valves, safety circuits, etc. that may be part of the automatic cycle routine.

Pin 3 and Pin 4 are typically used to energize the coil of an optional auxiliary relay module.

#### CN84 - Optically Coupled Output Signal

Pin 1 - Emitter  
Pin 2 - Collector

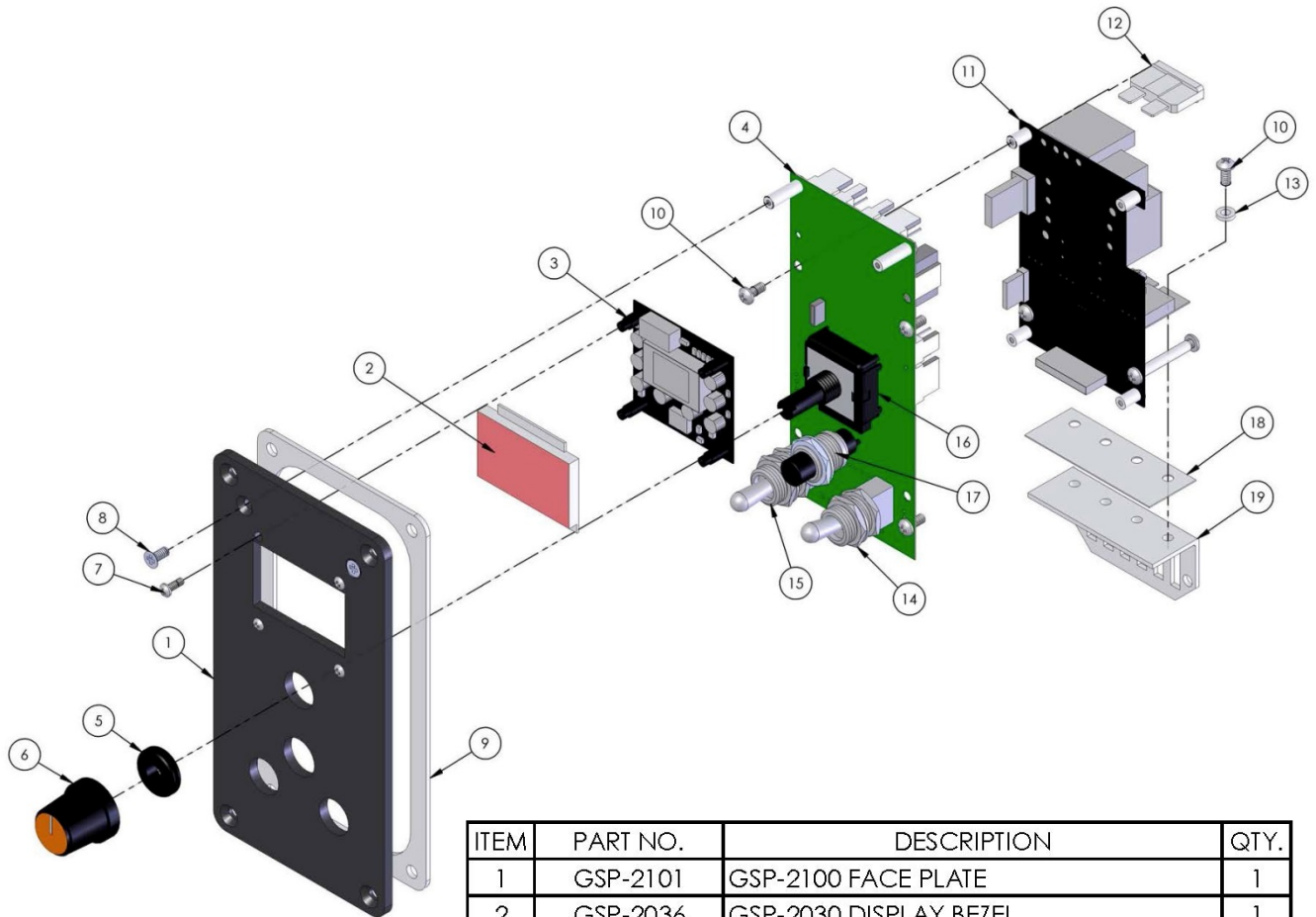
**Note:**

This port is typically configured to activate at the same time as CN82, providing an optically coupled output signal as an alternative to a transistorized output.

**Caution:**

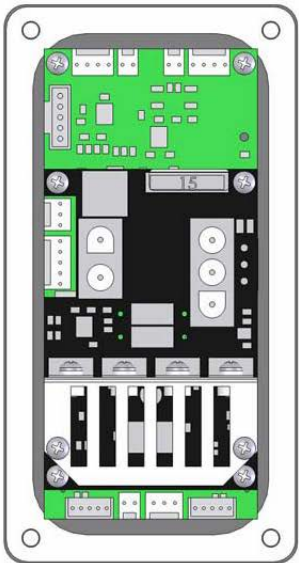
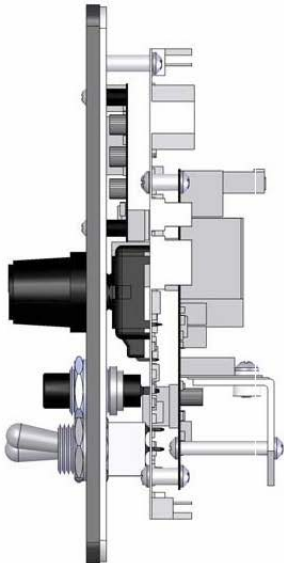
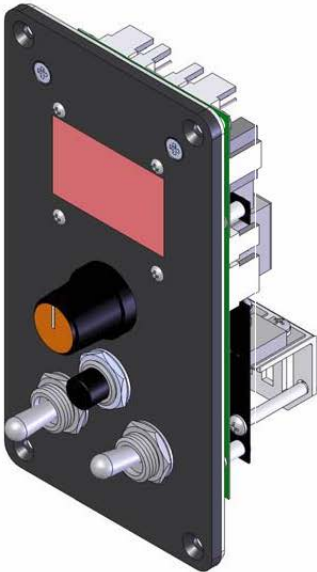
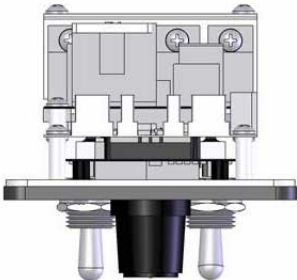
*Even though this control and its input and output ports have been designed to be as non destructible and as isolated and durable as possible, extreme radiated high frequency bombardment **may** cause a malfunction of the control. Gullco recommends that they be consulted in such instances.*

## GSP-2100 CONTROL ASSEMBLY BREAKDOWN



ITEM	PART NO.	DESCRIPTION	QTY.
1	GSP-2101	GSP-2100 FACE PLATE	1
2	GSP-2036	GSP-2030 DISPLAY BEZEL	1
3	GSP-2003	DISPLAY BOARD	1
4	GSP-4003	MOTHER BOARD (KEYPAD BOARD)	1
5	GK-151-004	GROMMET	1
6	GK-191-P-097	SPEED SELECTOR KNOB	1
7	GK-112-091	#2-56UNC x 1/4 RND HEAD SCREW	4
8	GK-141-013	#4-40UNC x 1/4 FHMS	2
9	GSP-2027	GSP FACEPLATE GASKET	1
10	GK-112-060	#4-40UNC x 1/4 RND HEAD SCREW	14
11	GSP-4002	DRIVER BOARD ASSEMBLY	1
12	GSP-2006	15 AMP FUSE	1
13	GK-156-120	GSP FET/HEATSINK BUSHING	4
14	GSP-2007	FORWARD/NEUTRAL/REVERSE SWITCH	1
15	GSP-2008	RUN/STOP SWITCH	1
16	GK-191-P-235	ROTARY SPEED ENCODER	1
17	GK-191-P-236	CYCLE PUSH BUTTON	1
18	GSP-2028	HEATSINK ISOLATION PAD	1
19	GSP-2024	GSP HEAT SINK	1

**GSP-2100 CONTROL ASSEMBLY**



## **REVISIONS LIST**

March, 2014

Overall      Manual release

### **ADDITIONAL NOTES**

Specifications and products are subject to change without notice.  
KAT, Moggy, Sam, KATBAK & KBM are registered trademarks of Gullco International Enterprises Ltd.  
Only use genuine/authorized replacement parts.



**GULLCO**



LINEAR or RADIAL  
HIGH DEPOSIT RATE  
QUICK SETUP TIME

## KAT® OSCILLATOR

- Motorized weld center line adjustment
- Motorized stroke width
- Oscillation speed control
- Store up to 10 welding programs



PORTABLE PLATE EDGE  
BEVELLING MACHINE  
QUICK SETUP TIME

## KBM®

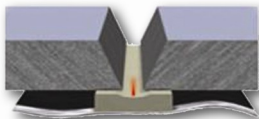
- Produce clean bevels with no thermal distortion
- Bevels angles 22° to 55° (other angles available)
- Hydraulic and Adjustable undercarriages available
- Bevels Mild Steel, Stainless Steel, and Aluminium
- Reduce cost and save time by minimising defects and poor fit up



ONE SIDED WELDING  
X-RAY QUALITY BEADS  
HIGH DEPOSIT RATE

## KATBAK® CERAMIC WELD BACKING

- Eliminate Defects And Rework
- Eliminate Costly Unnecessary Gouging And Grinding
- Sizes 1/4" (6.3 mm) to 2" (51 mm)
- Special Sizes And Configurations Available



PORTABLE AND COMPACT  
INCREASE EFFICIENCY  
MORE ARC ON TIME

## MOGGY® FILLET WELD CARRIAGE

- Single or Dual Torch Models
- Magnet or Non Magnetic Base
- Continuous or Stitch Welding Models
- Fillet, Lap, Butt and Dual Torch Welding

