



### Objective

To answer general information about the 590 chassis or 955 DRV drive.

### Equipment

HA467078 manual, 590 DC drive

HA352494 manual, 955 DRV drive

### Problem: The drive will not spin the motor.

1. Have you verified the wiring connections – page 3-5
2. Do you have a jumper from B3 to A6?
3. Is the RUN led on the control board ON or Blinking?
4. Is the drive going into Current Limit?
5. Can you spin the shaft of the motor using your hand?
6. What type of device is controlling the speed input? (potentiometer, load cell, dancer, PLC)
7. What type of speed feedback is connected to the drive? (armature volts, tach, encoder)
8. Do you have voltage present on the field terminals?
9. Using the keypad under Diagnostics verify the following while the drive is enabled to run:

Speed Feedback	_____%	At Current Limit	True / False
Speed Demand	_____%	Start	True / False
Current Demand	_____%	ANIN 1 (A2)	_____%
Current Fbk	_____%	ANIN 2 (A3)	_____%
Drive Start	True / False	ANIN 3 (A4)	_____%
Drive Enable	True / False	ANIN 5 (A6)	_____%

If you have questions, please call the Product Support Group at (704) 588-3246.

*This procedure is to be used only with the 590xC/xx/061 control board that has Plug-in calibration switches. Use application note 4209 if calibrating a control board with a Built-in resistor calibration card (smt).*

**Armature Current**

Parallel combination of R1 - R4 on the back board. Leave the armature current calibration slots blank on the plug-in calibration card.

$$R_{IA} = \frac{2200}{(I_A - 1)} \quad \text{ohms}$$

**Field Current**

Parallel combination of R10 & R11 on the plug-in calibration card.

$$R_{10} // R_{11} = \frac{4000}{I_F} \quad \text{ohms}$$

For stack controllers with Option 43, high field current option,

$$R_{10} // R_{11} = \frac{20000}{I_F} \quad \text{ohms}$$

When the field is in voltage control mode, use the appropriate formula from above and assume the field current to be 0.2 A.

**Armature Voltage**

Series combination of R8 & R9 on the plug-in calibration card.

$$R_8 + R_9 = \frac{(\text{Armature Volts} - 100)}{10} \quad \text{Kohms}$$

**Tach Feedback**

Series combination of R6 & R7 on the plug-in calibration card.

For tach feedback voltage (at Max speed) up to 200VDC:

$$R_6 + R_7 = (\text{Tach Volts} - 10) \quad \text{Kohms}$$

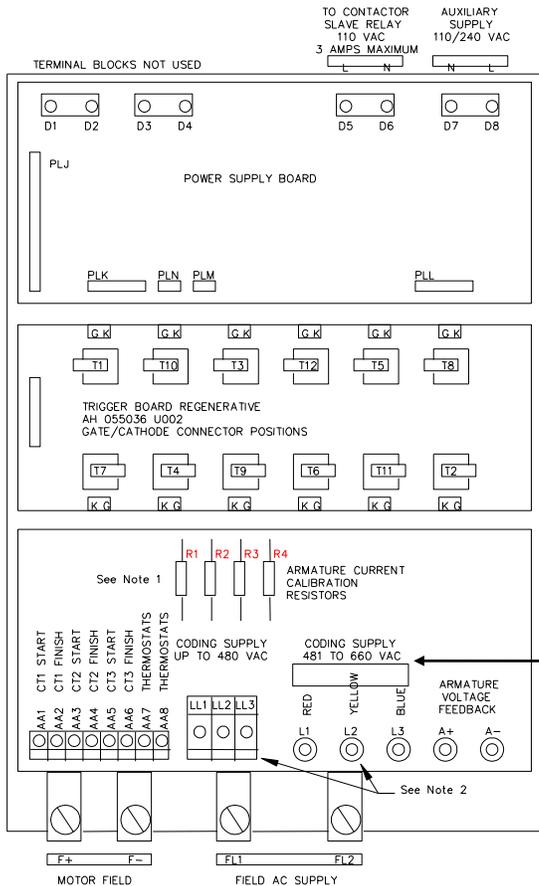
If tach volts at max speed exceeds 200VDC: Set **R<sub>6</sub> = 120K** and **R<sub>7</sub> = 68K**. Also, an external series resistor **R<sub>E</sub>** is required at terminal B2, its value given by the formula:

$$R_E = \frac{(\text{Tach Volts} - 200)}{5} \quad \text{Kohms}$$

Power dissipation of **R<sub>E</sub>** is given by:

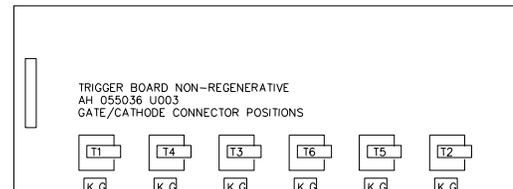
$$W = \frac{(\text{Tach Volts} - 200) \times 5}{1000} \text{ Watts}$$

**Armature current calibration resistors are to be installed on the back board, as shown below. Do not install any armature current calibration resistors on the plug-in calibration card.**



**Header Functions**

- PLJ Control door signals
- PLK Current transformers
- PLL Field thyristor firing
- PLM Armature sense
- PLN Stack heatsink trip



**Armature current calibration resistors**

1. If any resistor value > 5 ohms use a 0.5 W resistor  
For resistors 2.5 to 5 ohms use a 1 W resistor  
For resistors 1.25 to 2.5 ohms use a 2 W resistor  
For resistors 0.75 to 1.25 ohms use a 3 W resistor
2. Terminals LL1, LL2, LL3 are rated to 480VAC. For higher line voltages, from 481 to 660VAC, use terminals L1, L2, L3.

- **All 590DRV models are factory calibrated at the full load currents of their respective HP ratings.**
- **All 590 controller models are factory calibrated at the full current rating of their respective stacks. The User should recalibrate the controller to match the motor armature current rating. See previous page for procedure.**
- **All external stack drives are shipped with the field in 'Voltage Control' mode and calibrated at 0.2 amps. If Current control mode is desired, the User must calibrate the controller to match the rated field current of the motor. See previous page for procedure.**

*This procedure is to be used only with the 590xC/xx/061 control board that has built-in calibration switches. Use application note 4208 if calibrating a control board with a plug-in resistor calibration card.*

### Armature Current

For armature currents less than 799 amps, dial the setting directly into the switches SW1, SW2, SW3. Calibrate a 720 amp drive by setting SW1, SW2, SW3, to 7, 2, 0, respectively.

If armature current is greater than or equal to 800 amps, dial in 700 amps on the IA CAL rotary switches on the control board, by setting SW1, SW2, SW3, to 7, 0, 0, respectively. Then additional current may be added by inserting resistors R1 through R4 on the suppression board, according to the following formula. See sketch overleaf for resistor locations.

$$R_{IA} = \frac{2200}{(I_A - 699)} \text{ ohms} \quad \text{Resistor wattage guidelines are covered overleaf.}$$

If armature current is 2000 amps,  $R_{IA} = 2200/(2000-699) = 1.691$  ohms.

**Hint:** Use a standard 1.5 ohm resistor yielding 1467 amps, and set the switches to 533 amps, to total 2000 amps.

### Field Current

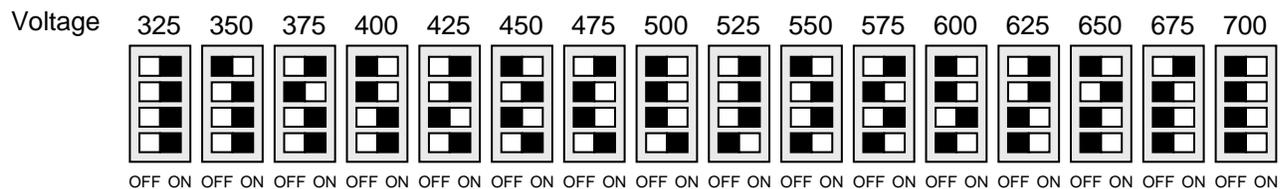
Dial in exactly **75%** of the motor field current using the IF rotary calibration switches, SW4, SW5, SW6 which represent the tens, units and decimal place. If the field current is 20.8amps, set SW4, SW5, SW6 to 1, 5, 6 respectively for 15.6A.

For stack controllers with **Option 43**, high field current option, dial in exactly **15%** of the motor field current, using the same procedure.

When in field voltage control mode, set the switches to 0.2

### Armature Voltage

Armature voltage calibration is done on the DIP switch VA CAL, according to the following sketch.



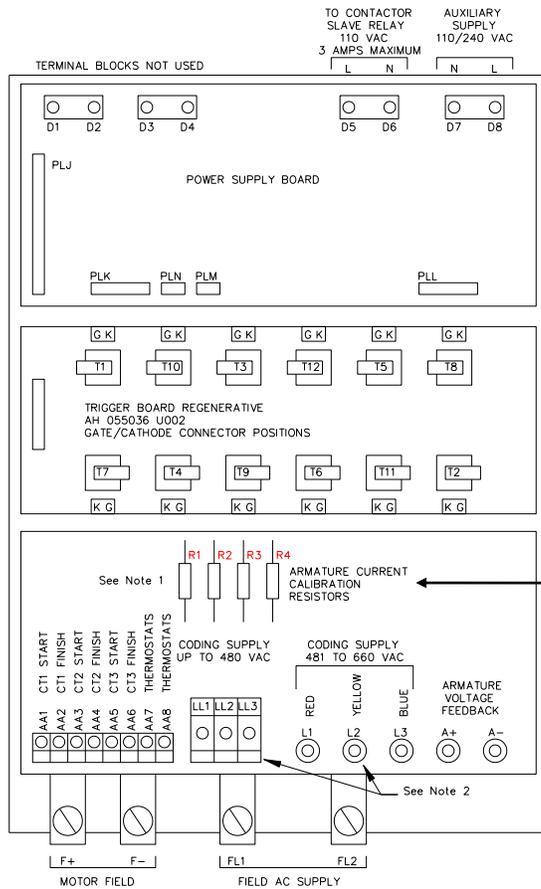
**NOTE:** For 230V external stack drives, use control board part number 590DC/xx/000.

Follow the armature voltage calibration procedure from the drive instruction manual.

For armature current, field current and tach feedback calibration, follow this procedure.

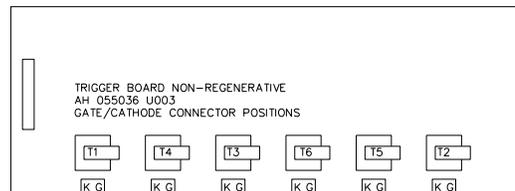
### Tach Feedback

Use the optional analog tach feedback card AH38587U001 and set the on-board switches for the maximum tach voltage expected. See the drive manual for setup procedure.



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## Objective

To manually tune the 590 drive.

Note. The default values for the field and speed loops will typically be stable; however, some motors and loads require manual tuning.

## Equipment

590 DC drive (> v4.2), Oscilloscope.

## Current Loop for Large Motors

The autotune procedure may not produce satisfactory results with large motors with long armature time constants. The first stage of the autotune measures the point at which the current becomes continuous. Continuous current is when the current pulses join and the current does not get to zero between pulses.

With large armature time constants, this may occur at less than 10% of full load current so the measurement may be less accurate. The adaptive current control compensates for the inherent reduction in gain when the current is discontinuous by using a predictive algorithm.

If the measured discontinuous value is too high, the higher gain may cause instability when the current goes continuous. Reducing the discontinuous value below the actual value can increase stability (at the expense of slower response).

Note. The discontinuous value should not be set above the actual value.

## When to manually tune?

?? When the discontinuous autotune value is less than 10%.

?? When the motor rating is over 500HP.

?? When the motor rating is greater than 200HP with greater than 2:1 field range.

?? When the motor is old.

## Procedure

### Current Loop Tuning

**Warning!** The internal test oscillator bypasses the current limit and speed loop. The motor may rotate due to residual or series fields. High currents should only be applied for short periods to a stationary motor.

1. Change PASSWORD to the superuser password 1311. When you are finished with this procedure the password should be set back to its original value (0x0000 is default).
2. Disable the field, with a series field the motor shaft may have to be locked.
3. Monitor the armature current waveform on the test pin with an oscilloscope.
4. Enable the test oscillator in the RESERVED menu by setting SEL. INT/CUR/SPD to 0.  
Note: TOGGLE REF 1 and TOGGLE REF 2 are the current demands, and TOGGLE PERIOD sets the oscillator period (default 160\*2.7mS at 60Hz).
5. Set TOGGLE REF 1 to 5% and TOGGLE REF 2 to 0%.
6. Start the drive and adjust TOGGLE REF 1 until the current is just continuous.

If you have questions, please call the Product Support Group at (704) 588-3246.

7. Enter the current value from step 5 as the discontinuous value in “CURRENT LOOP”.  
Note: Large motors with a low continuous current value, set the discontinuous value in the Current loop to less than the actual value for safety; for example, 80%.
8. Set TOGGLE REF 1 to 5% above the discontinuous value and TOGGLE REF 2 to 20% above TOGGLE REF 1.
9. Start the drive and adjust the Current Loop Proportional and Integral gains to optimize the response. Increase the I gain to give a fast rise with not more than 10% overshoot, then increase the P gain to produce critical damping (practically no overshoot).  
Note: If the I gain is too high, the response will be underdamped (excessive overshoot with long oscillatory settling). If the I gain is too low, the response will be overdamped (long exponential rise). With the I gain optimally set, if the P gain is too low the response will be underdamped. If the P gain is too high, the response will become underdamped with a tendency to instability.
10. Check the current loop response at higher currents, in the reverse direction and from one direction to the other (regenerative drives only).
11. Set the SEL. INT/CUR/SPD back to 2 and SAVE PARAMETERS.  
Note: Some large motors are very unstable in speed control at low load due to the adaptation in discontinuous current. Reducing the adaptive gain by changing the Disc Adapt Pot and the HF C/O Disc Gain in the Reserved Menu can improve the stability. Reduce both parameters to the same value; for example, to 1000. Recheck the current loop performance in the discontinuous region.

### Field Control Tuning

The Field control has two control loops, the field current loop and the back emf loop for field weakening.

Note. The 590L V4 surface mount board has a hardware problem causing the field current feedback to be unstable which degrades the field control performance. This can be rectified, if necessary, by adding a 150pF capacitor across R37.

1. Monitor the field current with an oscilloscope. TP4 on the 590D (rectified) or on the Cal Board connector pin J (unrectified).
2. Step the field current by switching from “Quench” to ”Standby” (0 to 50%) or “Start” from Standby (50 to 100%).
3. Adjust the Field Prop Gain and Int. Gain for rise time and overshoot (similar to the Current Loop above).
4. Save Parameters.

### Field Weakening Loop

5. Check the field current loop response before tuning the field-weakening loop.
6. Monitor Armature Volts with an oscilloscope on TP3 on the 590D or on the Cal Board connector pin I.
7. Start the drive and increase the speed into the field-weakening region.

If you have questions, please call the Product Support Group at (704) 588-3246.

8. If the Armature volts are unstable, decrease the EMF Gain or increase the EMF lead and lag. Preferably the EMF gain should not be reduced below 0.20, as this will affect the steady state voltage.
9. The EMF lag and lead should be maintained in the ratio of 20:1. With larger motors they should be increased together as required (maximum lead 10, lag 200).
  
10. Apply small step speed changes, 5-10%, and check stability of the armature volts. Adjust the EMF gain and EMF lead and lag as above to achieve optimum response.
11. BEMF Lead and Lag are provided to limit armature voltage overshoot where the acceleration rate exceeds the rate at which the field can be reduced due to the long field time constant. BEMF gain is the ratio of Lead/Lag and at 1 has no effect.
12. Accelerate the motor at the specified rate through the field range. If the voltage overshoot is excessive, increase both the BEMF Lead and Lag, with the ratio of lead/lag = 2, until the overshoot is acceptable. The ratio can be varied but too much (above about 2.5) will cause instability. Increasing the Lead and Lag together increases the time constant.

Below are sample parameters for a large motor with field range.

Prop Gain	0.3
Int. Gain	0.4
EMF Gain	0.25
EMF Lead	10
EMF Lag	200
BEMF Lead	2000
BEMF Lag	1000

When you have completed this procedure be sure to reset the password back to its original value (0x0000 is default) and do a parameter save.

If you have questions, please call the Product Support Group at (704) 588-3246.

## Objective

Explain the tools for communicating to a 590D controller with Modbus RTU using the KD-485 MODBUS-to-EI ASCII gateway card.

## Equipment

KD485-PROG

590D version XXX or later

Serial Comms card (P1 port)

Gateway software from [www.kksystems.com](http://www.kksystems.com)

## Procedure

Two versions of the gateway program (from KK Systems) are available:

**SYNCHRONOUS (NON-CACHED)** – each Modbus request results in a EI Bisynch request. Block reads are not supported.

**ASYNCHRONOUS (CACHED)** – the KD485 simultaneously communicates on both Modbus and EI Bisynch and maintains cached values of parameters in a table. Modbus block read is supported.

## CONFIGURING

Both program versions are configured in the same way using one of the following methods (see ebi.txt, ebicache.txt and readme.txt).

### Method 1 – MODMAP Tool

The MODMAP tool is used to combine a data table with the executable (ebi.hex or ebicache.hex) which is then downloaded into the KD485.

### Method 2 – Mapping Registers

The mapping registers 1xxx, 2xxx, 3xxx etc. for each parameter is done using a modbus master; for example MODSCAN32, and then saved in flash memory by writing to modbus register 46020 the value 0x55a5 (21925 decimal).

Following files are included in a 'zipped' file that is available from the Product Support Group via e-mail:

EBI.HEX - gateway executable (synchronous version)

EBI.TXT - description of above

EBICACHE.HEX - gateway executable (asynchronous version)

EBICACHE.TXT - description of above

MODMMAP.EXE - utility for creating mapping table

MODMAP.TXT - example input for above utility

README.TXT - description of above

590COMMS.XLS - spreadsheet of 590 parameters with format numbers

If you have questions, please call the Product Support Group at (704) 588-3246.

## KD485-PROG

The KD485-PROG allows any SSD Drives controller equipped with communications capabilities to communicate with a Modbus RTU master. This includes the 590, 584S, 605, and 620 series controllers.

### COMMUNICATIONS

A MODBUS RTU-to-EI-BISYNCH program driver is loaded into this intelligent converter by the user. It allows one or more EI-BISYNCH slaves to appear as a single MODBUS slave. The MODBUS master controls the drives by writing to MODBUS registers within the converter.

### STANDARD FEATURES

- ?? DIN rail mounting
- ?? 7 – 25 VDC supply
- ?? Port 2 is fully isolated
- ?? RS422/485 two- or four-wire interface
- ?? Fully programmable

### CONVERTER TYPES

There are three types of KD485 converters. The following table lists the three types and the typical usage with SSD Drives products.

Part Number	KD485 Port		Drive Comms Port	
	Port 1	Port 2	P1 Port	P3 Port
KD485-PROG	RS232	RS485/422	<input type="checkbox"/>	<input checked="" type="checkbox"/>
KD485-PROG-422-422	RS485/422	RS485/422	<input checked="" type="checkbox"/>	<input type="checkbox"/>
KD485-PROG-232-232*	RS232	RS232	<input type="checkbox"/>	<input type="checkbox"/>

\* This converter is not suitable for usage with standard MODBUS communications configurations.

NOTE. SSD Drives recommends using the P1 Port option for communications due to its more standard terminals and isolation.

If you have questions, please call the Product Support Group at (704) 588-3246.