Digiplan

Electronic Motion Control

HFC Series Drive

User Guide

Parker

HFC Series Drive
User Guide

This user guide applies to the HFC and HFC100 DC Servo Drives

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Part No: 1600.039.04 6th August 1991

IMPORTANT INFORMATION FOR USERS

Installation and Operation of Digiplan Equipment

It is important that Digiplan motion control equipment is installed and operated in such a way that all applicable safety requirements are met. It is your responsibility as a user to ensure that you identify the relevant safety standards and comply with them; failure to do so may result in damage to equipment and personal injury. In particular, you should study the contents of this user guide carefully before installing or operating the equipment.

Under no circumstances will the suppliers of the equipment be liable for any incidental, consequential or special damages of any kind whatsoever, including but not limited to lost profits arising from or in any way connected with the use of the equipment or this user guide.

⚠ SAFETY WARNING

High-performance motion control equipment is capable of producing rapid movement and very high forces. Unexpected motion may occur especially during the development of controller programs. ***KEEP WELL CLEAR*** of any machinery driven by stepper or servo motors. Never touch it while it is in operation.

High voltages exist within enclosed units, on rack system backplanes (motherboards) and on transformer terminals. Keep clear of these areas when power is applied to the equipment.

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How To Use This User Guide

This user guide is designed to help you install, develop, and maintain your system. Each chapter begins with a list of specific objectives that should be met after you have read the chapter. This section is intended to help you find and use the information in this user guide.

Assumptions

This user guide assumes that you have a fundamental understanding of the following:

- Basic electronics concepts (voltage, switches, current, resistors, etc.)
- Basic motion control concepts (torque, velocity, distance, etc.)

With this basic level of understanding, you will be able to effectively use this guide to install, develop, and maintain your system.

Contents of This User Guide

This user guide contains the following information:

Chapter 1: Introduction

This chapter provides a description of the product and a brief account of its specific features.

Chapter 2: Getting Started

This chapter contains a detailed list of items you should have received with your HFC Series system shipment. It will help you become familiar with the system and ensure that each component functions properly. In this chapter, you will perform a preliminary configuration of the system.

Chapter 3: Installation

This chapter provides instructions for you to properly mount the system and make all electrical connections. Upon completion of this chapter, your system should be completely configured, installed, tested, and ready to perform basic operations.

Chapter 4: Tuning the Drive

The procedures in this chapter will help you tune the system to meet your application's needs.

Chapter 5: Hardware Reference

This chapter contains information on system electrical and performance specifications.

Chapter 6: Maintenance & Trouble-shooting

This chapter describes recommended system maintenance and troubleshooting procedures. It also provides methods for isolating and resolving hardware problems.

Installation Process Overview

To ensure trouble-free operation, you should pay special attention to the following:

- The environment in which the HFC Series system will operate

- The system layout and mounting
- The wiring and grounding practices used

These recommendations are intended to help you easily and safely integrate the HFC Series system into your equipment.

Installation Recommendations

Before you attempt to install this product, you should complete the following steps:

1. Review this entire user guide. Become familiar with its contents so that you can quickly find the information you need.
2. Develop a basic understanding of all system components, their functions, and interretationships.
3. Complete the basic system configuration and wiring instructions provided in Chapter 2, Getting Started. *This is a preliminary configuration, not a permanent installation, intended to be set up in a bench-top environment.*
4. Perform as many basic functions as you can with the preliminary configuration. You can perform this task only if you have reviewed the entire user guide. You should try to simulate the task(s) that you expect to perform when you permanently install your system. **However, do not attach a load at this time.** This will give you a realistic preview of what to expect from the complete configuration.
5. After you have tested all of the system's functions and used or become familiar with all of the features, carefully read Chapter 3, Installation.
6. After you have read Chapter 3 and clearly understand what must be done to properly install the system, you should begin the installation process. Proceed in a linear manner; do not deviate from the sequence or installation methods provided.
7. Before you begin to customize your system, check all of the system functions and features to ensure that you have completed the installation process correctly.

The successful completion of these steps will prevent subsequent performance problems and allow you to isolate and resolve any potential system difficulties before they affect your system's operation.

Developing Your Application

Before you attempt to develop and implement your application, you should consider the following:

- Recognize and clarify your application's requirements. Clearly define what you expect the system to do.

- Follow the guidelines and instructions outlined in this user guide. Do not skip any steps or procedures. Proper installation and implementation can be ensured only if all procedures are completed in the proper sequence.

Conventions

To help you understand and use this user guide effectively, the conventions used are explained in this section.

Warnings & Cautions

Warning and caution notes alert you to possible dangers that may occur if you do not follow instructions correctly. Situations that may cause bodily injury are presented as warnings. Situations that may cause system damage are presented as cautions. Refer to the examples shown below.

WARNING

Do not touch the motor immediately after it has been in use for an extended period of time. The unit will be hot.

CAUTION

System damage will occur if you power up the system improperly.

Direction

Throughout this user guide, you will find references to clockwise (CW, +) and counter-clockwise (CCW, -) rotation. The direction of rotation is determined while facing the flange-end of the motor.

Related Publications

The following publications may be helpful resources:

- *Digiplan or Compumotor Motion Control Catalogue*
- Schram, Peter (editor). *The National Electric Code Handbook (Third Edition).* Quincy, MA: National Fire Protection Association

Chapter 1. INTRODUCTION

Chapter Objective

The information in this chapter will enable you to understand the product's basic functions & features.

Product Description

The HFC is a high-performance pulse-width modulated DC servo drive designed to operate a wide range of permanent-magnet servo motors. As described below, the HFC Series consists of the standard HFC and the HFC100.

Standard HFC

The standard HFC comprises a power chassis with a fan-cooled heatsink, power supply, built-in transformer, regenerative power dump, and an appropriate number of drive cards (up to five drives – as ordered). The low-voltage supplies are derived from the built-in transformer, and the motor supply is derived from the external transformer. To meet the requirements of multi-axis systems using mixed motor sizes, a dual-voltage chassis is available which permits one or more axes to run at a lower supply voltage.

HFC100

For single-axis applications, the alternative HFC100 is available. It comprises a power chassis, power supply, built-in transformer, and one drive card.

Product Features

Features of the HFC Series drives are summarized as follows:

- 12A continuous current; 24A peak current
- Motor speed up to 6,000 RPM (motor dependent)
- Protection:
  - Short circuits (phase-to-phase and phase-to-ground)
  - Over-temperature
  - Over-voltage
  - Under-voltage
- Auto-foldback circuit reduces current by ≈40% when drive is operated at peak current (usually 24A) for ≥2 seconds
- Diagnostic LEDs on each drive and power supply card
- ±10V control signal input provides easy interface to a new controller or an existing servo controller
- Differential amplifier on the velocity command input improves electrical noise immunity
- User outputs and inputs:

  - Current output monitor
  - Fault/disable output monitor
  - Reset input
  - Axis disable input
  - Auxiliary input
  - End-of-travel limit switch inputs
  - Remote gain programming
- Drive card potentiometer adjustments:
  - Time constant
  - Current limit
  - Signal gain
  - Tachometer gain
  - Balance
  - Auxiliary gain

Options

- Dual-voltage chassis (standard HFC only)
- Single-axis (HFC100) or up to five axis chassis (HFC)
- High wattage dump resistor*

* The dump resistor option can be retro-fitted using a kit available from the manufacturer. For more information, contact an application engineer on one of the numbers given at the front of this user guide.

Theory of Operation

The external analogue servo controller sends analogue input signals to the HFC servo drive, and these signals control the servo motor's velocity. The tachometer provides velocity feedback to the drive so that it can adjust (*servo*) the current to maintain the programmed velocity. Figure 1-1 is a typical functional block diagram of the system's processes.

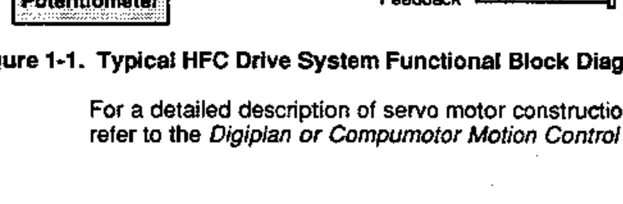


Figure 1-1. Typical HFC Drive System Functional Block Diagram

For a detailed description of servo motor construction and operation, refer to the *Digiplan or Compumotor Motion Control Catalogue.*

Chapter 2. GETTING STARTED

Chapter Objectives

The information in this chapter will enable you to do the following:

- Verify that each component of your system has been delivered safely
- Become familiar with system components and their interrelationships
- Establish the basic system configuration
- Ensure that each component functions properly

What You Should Have

Upon receipt, you should inspect your HFC Series system shipment for obvious damage to its shipping container. Report any damage to the shipping company as soon as possible. The manufacturer cannot be held responsible for damage incurred in shipment. The items listed in Table 2-1 should be present and in good condition. To verify that you have the proper drive model, check the model number listed on the drive serial plate.

Ship Kit Table

HFC Part Description	Sales Code	Part Number
Power supply card	HFC/PS	1259.073
HFC drive card (up to 5 for HFC chassis)	HFC/AX	1259.155
Chassis	HFC/CH	1259.193
Transformer (1, as ordered):		
Model TO73	TO73	2050.006.05
Model TO92	TO92	2050.036.04
HFC Series User Guide	----------	1600.039.04
Pkg. of connector hardware	--------	--------

Table 2-1. HFC Drive Ship Kit

HFC100 Part Description	Sales Code	Part Number
HFC100	HFC100	1340.049
Transformer (1, as ordered):		
Model TO73	TO73	2050.006.05
Model TO92	TO92	2050.036.04
HFC Series User Guide	--------	1600.039.04
Pkg. of connector hardware	--------	--------

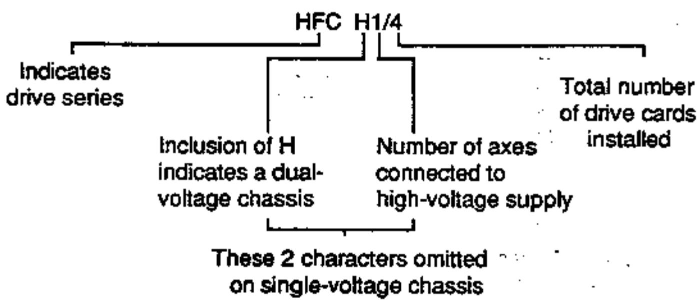
Table 2-2. HFC100 Series Drive Ship Kit

The HFC systems are shipped configured as follows:

- Power supply and drive card(s) pre-installed in the chassis
- Package of connector hardware included in the ship kit
- Transformers can be ordered pre-wired in the USA

Variant Information

The standard HFC chassis can have various configurations of axes of high- or low-voltage. To verify that the chassis is configured as ordered, inspect the serial tag (located on the base plate near the fan) for the following information:



Bench Test

This section provides procedures to help you configure and test your HFC Drive system. This bench test is designed to test one axis. You must repeat this test for each drive card in the chassis. *This is a temporary bench-top configuration.* Detailed permanent installation instructions are provided in Chapter 3, Installation.

1. Connect The Motor

> **WARNING**
>
> **Ensure that AC power is disconnected before attempting to connect or disconnect the motor. High voltages are present on the connectors.**

Check motor inductance and if necessary add an additional series inductor to meet the minimum requirement of 0.5mH.

Connect the motor leads to connector PL4 (see Figure 2-1). Use a wire size appropriate to the continuous rated motor current. If you plan to operate the drive at full current, use 12 AWG (3mm^2) wire.

On a dual-voltage chassis, the high-voltage drive cards are connected to the supply capacitor via red and black cables. The low-voltage drive cards are connected via blue and orange cables.

CAUTION

Be sure to properly connect the motor to the HFC Drive. Incorrect connections can cause damage to the drive and the motor.

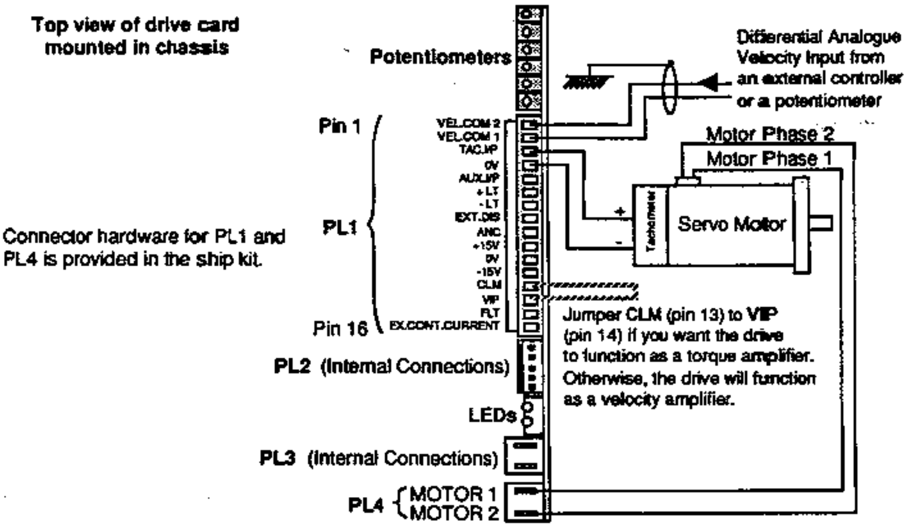


Figure 2-1. Drive Connections for Bench Test

2. Select The Amplifier Mode

The drive is shipped to you set up as a velocity amplifier. As a *velocity amplifier*, the drive uses the tachometer feedback to monitor the velocity of the motor. The velocity of the motor will be proportional to the input voltage (or Velocity command).

Some applications and/or controllers require the drive to be configured as a *torque amplifier*. This can be accomplished by connecting the current clamp input (PL1 pin 13) to the velocity amp input (PL1 pin 14) as shown in Figure 2-1. **The tachometer is no longer needed**, and torque, instead of velocity, is now proportional to the input voltage. When the drive is configured as a torque amplifier, the SIG GAIN potentiometer controls the relationship between input voltage and output torque.

3. Connect The Tachometer

Connect the tachometer's positive lead to TAC.I/P (PL1 pin 3) and connect the negative lead to 0V (PL1 pin 4) as shown in Figure 2-1. The nominal input range is ±10V (max. is ±60V) with an impedance of 20kΩ. To ensure stability, you should couple the tachometer rigidly to the motor.

4. Connect The Controller

Figure 2-1 is a generalized illustration of the differential analogue input connections to the drive. If you are using an analogue controller, refer to the analogue controller's user guide for pinouts. **Use a minimum wire size of 24 AWG (7/0.2mm) for connections.** The nominal input range is ±10V (max. voltage is 24V) with an impedance of 20kΩ. This is a differential input which avoids problems associated with inputs referenced to 0V.

As an example, Figure 2-2 shows connections between a four-axis HFC and the Model 4400 Series Controller.

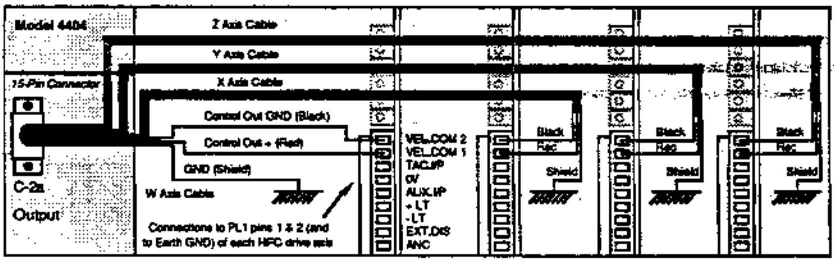


Figure 2-2. Connecting the Model 4404 Servo Controller

As an alternative to an analogue controller, you can use a simple potentiometer. Figure 2-3 illustrates two possible sources: one from the on-board ±15V supply, and the other from an external ±10V supply.

One of the input pair connections should be connected to ground (Figure 2-3 shows examples). Connecting the VEL.COM 1 input to ground and applying the signal to VEL.COM 2 allows a signal of +10V to -10V (+10V = full speed CW; -10V = full speed CCW). The direction of rotation is reversed if you ground the VEL.COM 2 input and apply signal to the VEL.COM 1 input.

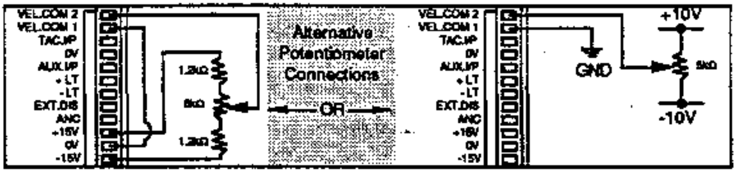


Figure 2-3. Analogue Potentiometer Input

5. Connect The Motor Supply

The motor supply must be derived from an isolating transformer. The required motor supply voltage will depend on the application. The isolating transformer must be rated for the total loading. This depends on the duty cycle, but would be typically 250 - 400VA **per axis**. *If you intend to power the rack from a three-phase power source, we recommend that you first consult an Applications Engineer on one of the numbers given at the front of this user guide.*

Normally, the HFC system is shipped with the TO73 or TO92 transformer with optional motor supplies of 61VAC and 40VAC (86VDC and 57VDC respectively).

Use 16 AWG (1.3mm²) cables to wire the transformer primary for 120VAC or 240VAC input. Refer to Figure 2-4 for 120VAC and 240VAC primary wiring configurations. You should install an in-line fuse in the AC line circuit (see Figure 2-4). The fuse must be suitably rated for the AC supply and the transformer loading.

Before **connecting the AC motor supply leads from the transformer, measure their voltage(s) to ensure they do not exceed 63VAC at the nominal AC input voltage.**

When using one transformer to power more than one drive chassis, you must use a separate secondary winding for each chassis.

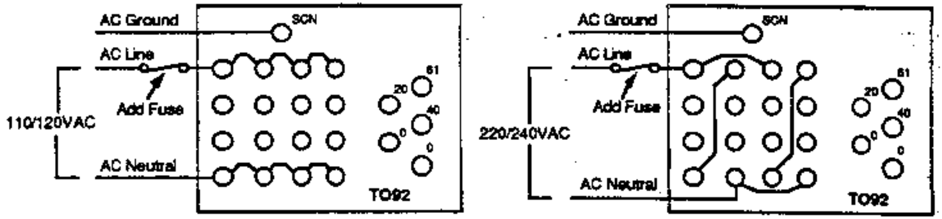


Figure 2-4. Transformer Primary Wiring Configuration for 120VAC or 240VAC Input

> **CAUTION**
>
> **Do not apply power to the HFC chassis until you reach the appropriate point in the test procedure discussed at the end of this chapter.**

Standard HFC Motor Supply Connections

Connect the transformer secondary to the large screw terminal connector attached to the heatsink behind the fan unit. Figure 2-5 illustrates the four optional connections for single- and dual-voltage operation.

You can operate any dual-voltage chassis from a single AC supply (see box B of Figure 2-5). When operating in this way, you must jumper the positive terminals of the two large supply capacitors using two lengths of 12 AWG (3mm^2) wire. Push-on connector hardware is provided in the ship kit. The negative terminals are already jumpered together.

> **WARNING**
>
> **Do not attempt to use a single-tapped secondary winding to provide both supplies on a dual-voltage chassis.**

> **CAUTION**
>
> **When using a dual-voltage chassis, the supply to the high-voltage connections must ALWAYS be equal to or greater than the supply to the low-voltage connections. Failure to comply with this requirement will result in damage to the unit. This applies at all times, even under fault conditions. Therefore, you should install a fuse on the input to the transformer to ensure that the LV supply is removed in the event of operation of the HV supply protection.**

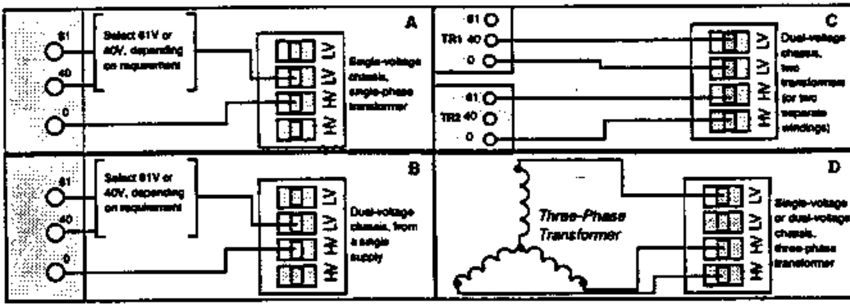


Figure 2-5. Optional Motor Supply Connections to the Standard HFC

HFC100 Motor Supply Connections

Connect the transformer secondary to connector TB2, located above the large capacitor on the AC Input Card (see Figure 2-6). Push-on connectors are provided in the ship kit.

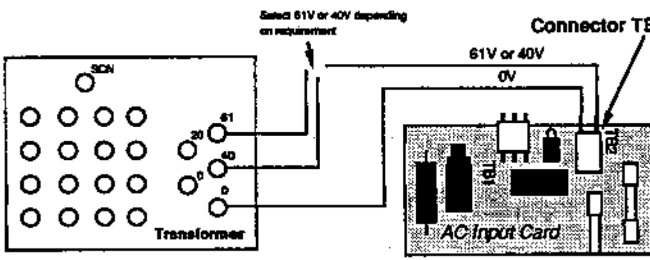


Figure 2-6. Motor Supply Connections to the HFC100

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6. Connect The AC Input Power

HFC chassis drives are factory-set to operate from either 110/120VAC or 220/240VAC depending on the local supply. If you need to change the supply voltage range, you must change the voltage selector link located near the bottom right corner of the power supply PCA card (see Figure 2-7). To access the voltage selector on the standard HFC chassis, you must first remove the back panel by loosening the retaining bolts and pulling the panel up and away from the chassis.

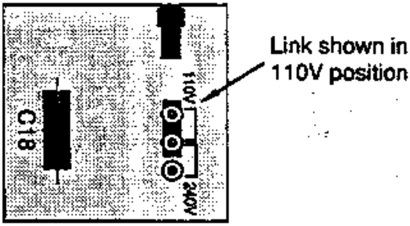


Figure 2-7. 110VAC or 240VAC Input Settings (HFC Chassis only)

Described below are procedures for connecting the AC supply to the standard HFC and the HFC100. **Be sure to use a minimum wire size of 20 AWG (16/0.2 mm).**

> **CAUTION**
>
> **Do not apply power to the HFC chassis until you reach the appropriate point in the test procedure discussed at the end of this chapter.**

Standard HFC AC Connections

AC supply connections are made directly to the side-by-side connectors, PL6 and PL7, located in the middle of the power supply PCA card. Push-on connectors are provided in the HFC ship kit. Connect AC line to PL6 pin 1, AC neutral to PL6 pin 2, and earth ground to PL7 pin 1 (see Figure 2-8).

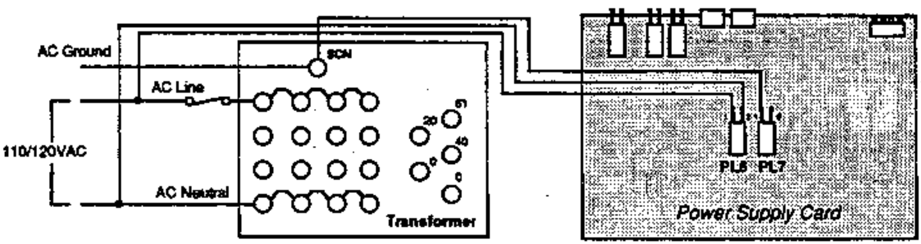


Figure 2-8. Standard HFC AC Input Connections (110/120VAC Source)

HFC100 AC Connections

NOTE: The AC input voltage to the HFC100 is **110/120VAC only.** When operating from a 220/240VAC source, the 110V supply is derived from the primary of the motor-supply transformer as shown in Figure 2-9. When operating from a 110/120VAC source, make the connections directly to the AC supply in parallel with those to the transformer.

AC supply connections are made directly to connector TB1, located above the large capacitor on the AC input card (see Figure 2-9). The AC input card is attached to the side of the chassis between the drive card and the power supply card. Connector hardware is provided in the ship kit.

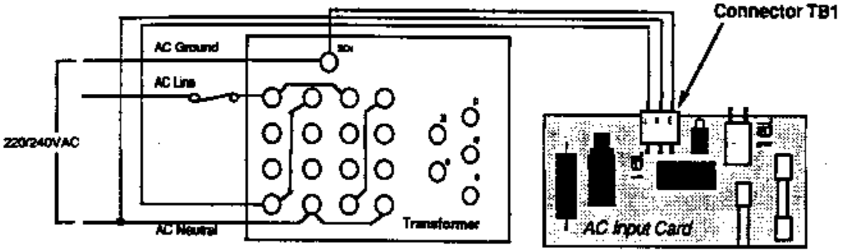


Figure 2-9. HFC100 AC Input Connections (220/240VAC Source)

7. Test The System

Before you begin the test, make sure the motor is held securely in place.

Use the following procedure to test the functionality of the HFC Drive system and to verify proper system connections:

1. Make sure the motor shaft is free to rotate.
2. Apply power by plugging the transformer AC input cable into your power source. The green LED on each supply capacitor (Standard HFC), or the green LED on the AC input card (HFC100) should be illuminated. All other LEDs on the drive card(s) and the power supply card should be off.
3. Apply a differential velocity analogue input to the drive. The motor should rotate proportional to the velocity input.

   A positive input signal on VEL1 with respect to VEL2 will result in a positive voltage on MOTOR 1 with respect to MOTOR 2, and this should result in a negative tachometer voltage on TACHO with respect to TACHO 0V. (Normally, this should result in clockwise shaft rotation.)

If the motor does not move (and you are sure the motor and power connections are correct) or if any red or yellow LEDs illuminate, refer to Chapter 6 for troubleshooting procedures.

4. Stop the motor by reducing the velocity input to zero.
5. Unplug the transformer power cable from the power source. You should now be ready to proceed to Chapter 3.

Chapter 3. INSTALLATION

Chapter Objectives

The information in this chapter will enable you to do the following:

- Mount all system components properly
- Connect all electrical system inputs and outputs properly
- Ensure that the complete system is installed properly
- Perform basic system operations

You must complete all steps in Chapter 2, Getting Started, before proceeding with the steps in this chapter.

Installation Precautions

To help ensure personal safety and long life of system components, pay special attention to the following installation precautions:

- **Never connect or disconnect the motor or other inputs and outputs with power applied to the chassis.**
- **Never use this drive with motors that have an inductance lower than 0.5mH.**
- To reduce the effect of radiated electrical noise, run the motor leads and the supply leads as twisted pairs, or as screened (shielded) cable. Also, keep the motor and power leads away from the signal leads.
- Make sure the drive is operated in room temperatures between 0° and 50°C (32° to 122°F). Use a cooling fan if you run the HFC100 drive at high duty cycles.

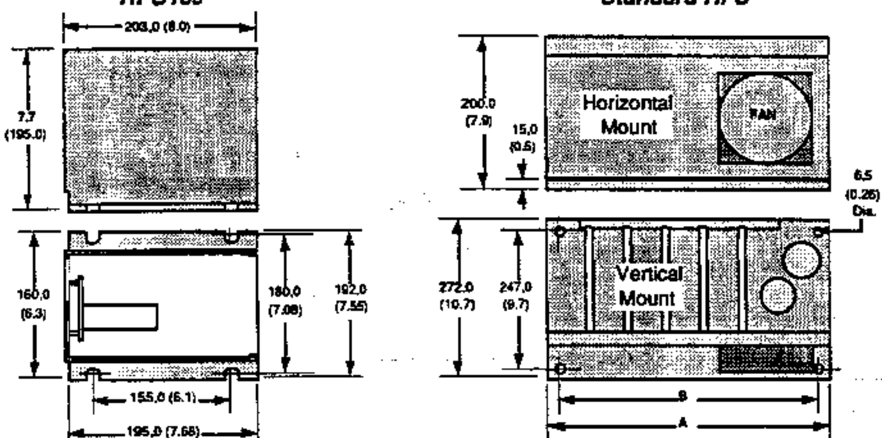
System Mounting

Consider environmental factors such as atmospheric contamination and excess heat **before** you install and operate your HFC Drive system.

Chassis Mounting

It is recommended to install the chassis in an enclosure to protect it against atmospheric contaminants such as oil, moisture, and dirt. The National Electrical Manufacturers Association (NEMA) has established standards that define the degree of protection that electrical enclosures provide. The enclosure should conform to NEMA Type 12 standards if the intended environment is indoors, industrial, and contains airborne contaminants.

The standard HFC can be mounted vertically (with the fan on the bottom) or horizontally. The HFC100 may be mounted in any position. Figure 3-1 illustrates the mounting options and dimensions of the standard HFC and HFC100 chassis.



Model	A	B
HFC/2/3/4	330,0 (13.0)	311,0 (12.2)
HFC/5	364,0 (14.3)	345,0 (13.6)

Figure 3-1. Chassis Dimensions and Mounting Options

Transformer Mounting

The transformers used with the HFC system (model TO73 or TO192) may be mounted in the cabinet or, if you are not using a cabinet, close to the HFC system. Ensure that the transformer is located where it does not have excessively long leads and does not interfere with the HFC system operation and electrical connections.

The Model TO73 transformer weighs 15.2Kgs (33.5lbs), and its critical dimensions are 140mmW x 165mmL x 222.5mmH (5.51" x 6.5" x 8.76"). The Model TO92 transformer weighs 8.0Kgs (18.0lbs), and its critical dimensions are 126mmW x 136mmL x 145mmH (4.96" x 5.35" x 5.71"). Figure 3-2 illustrates the mounting holes on each transformer model.

WARNING

Do not mount the transformer where it is likely to be touched by personnel. Touching the wiring studs while the transformer is energized can inflict a lethal shock.

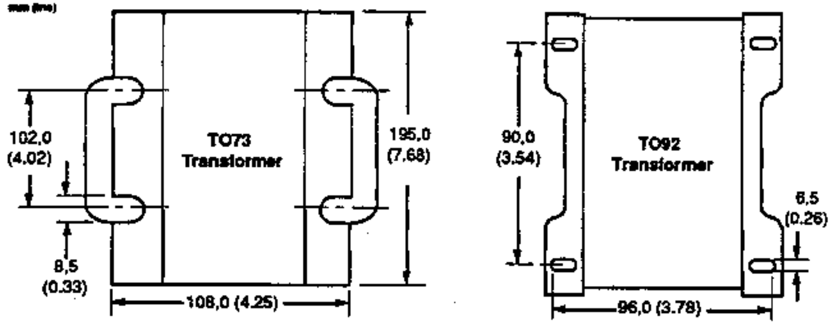


Figure 3-2. TO73 and TO92 Mounting Details

System Connections

This section covers procedures for HFC system I/O connections. Refer to Chapter 2, Getting Started, for the following system connections:

- Motor (do not couple the load yet)
- Tachometer
- Controller (or potentiometer)
- Transformer and AC input

Wiring Guidelines

Proper grounding of electrical equipment is essential to ensure the safety of personnel. You can reduce the effects of electrical noise due to electromagnetic interference (EMI) by grounding. A good source of information on grounding requirements is the National Electrical Code published by the National Fire Protection Association of Boston, Massachusetts.

In general, all components and enclosures must be connected to earth ground to provide a low impedance path for ground fault or noise-induced currents. All earth ground connections must be continuous and permanent.

I/O Connections

I/O connections should be made with a minimum wire size of 24 AWG (7/0.2mm), using the crimp terminals provided in the ship kit. A suitable crimping tool is Molex part no. 11-01-0026 (HTR-2445-A). Shielded cables are recommended for all I/O inputs. **Make sure to ground the shield at one end only.**

Figure 3-3 below is an overall I/O connection diagram.

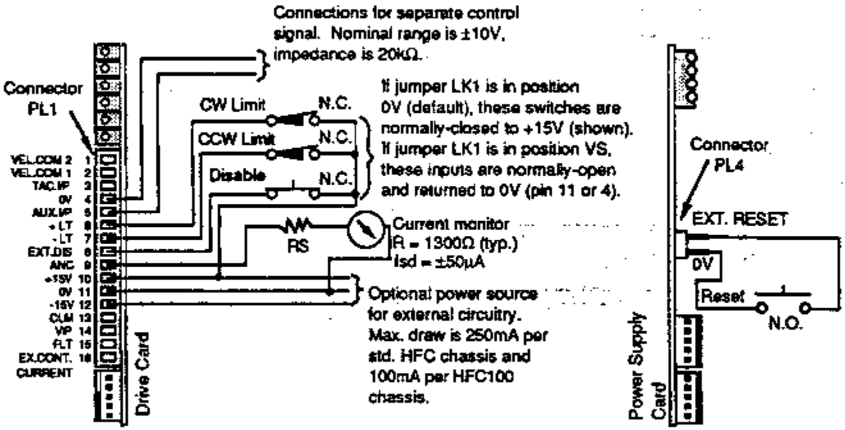


Figure 3-3. I/O Connections

Auxiliary Input

You may connect a separate control signal input to this terminal (PL1 pin 5) reference to 0V (pin 4). The nominal input range is ±10V and the input impedance is 20kΩ.

Limit Switch Inputs

These inputs, +LT and -LT, are intended to be used as end-of-travel emergency stop inputs to prevent the load from travelling beyond the operational travel limits.

You can install normally-open or normally-closed switches, depending on the input polarity setting via jumper LK1 (see *Changing The Input Polarity* below). The default setting (0V) is for using normally-closed switches returned to +15V to ensure that motion is stopped if the limit is tripped or if the limit connection is broken. When the load trips (opens) the limit switch, the motor current is reduced to zero. Use mechanical switches or, if LK1 is in position VS, open-collector outputs. Refer to Figure 3-3 for limit input switch connections.

The +LT input (usually for the CW limit switch) is PL1 pin 6 and inhibits a positive voltage on MOTOR1 (PL4 pin 1) with respect to MOTOR2 (PL4 pin 2). This is equivalent to inhibiting a positive signal on VEL.COM1 (PL1 pin 2) with respect to VEL.COM2 (PL1 pin 1), or a negative signal on the AUX.I/P input (PL1 pin 5) with respect to 0V.

The -LT input (usually for the CCW limit switch) is PL1 pin 7 and inhibits a negative voltage on MOTOR1 with respect to MOTOR2. This is equivalent to inhibiting a negative signal on VEL.COM1 with respect to VEL.COM2, or a positive signal on the AUX.I/P input with respect to 0V.

External Disable

You can enable the relevant axis by opening or closing this input switch between EXT.DIS (PL1 pin 8) and +15V (PL1 pin 10), depending on the position of jumper LK1 (see *Changing The Input Polarity* below). The default position for LK1 is 0V, allowing the use of a normally-closed (*normally-enabled*) switch to +15V (see Figure 3-3). However, if LK1 is in the VS position, the input switch must be normally-open and returned to 0V (PL1 pin 4 or pin 11).

CAUTION

The motor shaft is free to rotate while the drive is disabled, but it should not be rotated at high speed since this may damage the power dump circuitry.

Analogue Current Output

You can use the ANC output (PL1 pin 9) to monitor the motor current. Its voltage is proportional to the motor current. The output level is ±12V for a motor current of ±24A. The output impedance is 2.2kΩ (determined by an internal resistor). This prevents damage in the event of a short to 0V. The simplest form of monitoring is a current meter connected between this pin and logic 0V.

A ±50µA meter could be used with an external series resistor, the value (RS) of which depends on the coil resistance of the meter (see example in Figure 3-3). In this case, a series resistor of 236kΩ will give a full-scale deflection of ±24A.

+/-15VDC Auxiliary Output

For the standard HFC chassis, up to 250mA may be drawn from PL1 pins 10 and 12 to power external circuitry (see Figure 3-3 for connections). **250mA is the total current per chassis, not per drive card.**

For the HFC100 chassis, the maximum current is 100mA.

24VDC Unregulated Output

You can use the 24VDC unregulated output to power custom external circuitry via connector PL14. **Ensure that the maximum current taken from this supply does not exceed 500mA**. Refer to Figure 3-3 for connections.

Current Clamp Input

You can use this input in two ways to externally program the current limit. However, this requires hardware modifications to the drive PCA card. You can obtain this information by contacting an Applications Engineer on one of the numbers given at the front of this user guide.

Velocity Amp Input

By connecting terminal CLM to terminal VIP (PL1 pin 13 to pin 14), you can change the amplifier from a *velocity* amplifier to a *torque* amplifier. The tachometer is no longer needed, and torque, instead of velocity, is then proportional to the input voltage. The SIG GAIN potentiometer is then used to control the relationship between the input voltage and the output torque.

Fault Output/ Input

The fault (FLT) output (PL1 pin 15) is open-collector with an internal 470Ω pull-up resistor to +15V. This output is internally connected to the disable (EXT.DIS) input. When a fault occurs this output goes low and disables the drive. Therefore, on a multi-axis system, you can interconnect the fault outputs to cause all axes to disable if only one axis fault occurs.

Reset Input

You can use the EXT.RESET input (PL4 pin 1 on the power supply card) either to reset the drive in the event of a fault (provided the fault has been located and rectified), or to disable all axes simultaneously. To activate the reset, ground this input to 0V (PL4 pin 2) for a minimum period of one second. Refer to Figure 3-3 for connections.

Changing The Input Polarity

Jumper LK1, located on the drive card, determines whether the limit and external disable inputs (+LT, -LT, and EXT.DIS) are normally pulled up or pulled down. To access LK1 on the standard HFC chassis, you must first remove the back panel by loosening the retaining bolts and pulling the panel up and away from the chassis (see Figure 3-4 for location of LK1 on the card).

LK1 is factory-set to the **0V** position. This means that the inputs are pulled down to 0V, requiring normally-closed switches returned to +15V. This method is *fail-safe* because switch failure, or the breaking of the wire to the switches, will disable the drive.

If LK1 is installed in the **VS** position, then the inputs are pulled up to +15V. Normally-open switches returned to 0V are then required. This method is not *fail-safe* but does allow the **use of open-collector outputs** from a control device.

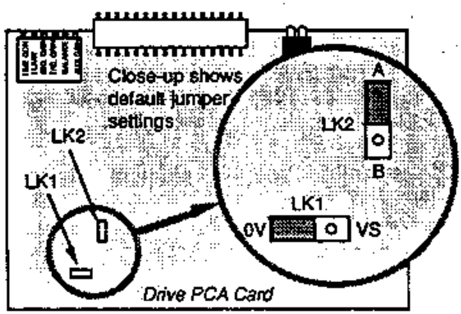


Figure 3-4. Location of Jumpers LK1 and LK2

Changing The Foldback Reset Function

The current foldback circuit allows the drive to deliver the peak current, or whatever current has been programmed via PL1 pin 13 or the current limit control, for a limited period of time. The current will then automatically reduce (or fold back) by approximately 50%. The time taken for foldback to occur depends on the motor current, and is typically 2 seconds at the peak current of 24A. The time will be longer at lower currents.

The setting of jumper LK2 determines how the foldback circuit is reset to make the full motor current available.

With jumper LK2 in position **A** (factory default), the foldback circuit automatically resets itself after the motor current drops below 8A.

With jumper LK2 in position **B**, you must close the reset switch (ground power supply connector PL4 pin 1 to PL4 pin 2) for at least one second to reset the foldback circuit. *Reducing the motor current will not reset the foldback circuit.*

In either case, you can also reset the foldback circuit by cycling power to the drive.

Jumper LK2 is located on the drive card. To access LK2 on the standard HFC chassis, you must first remove the back panel by loosening the retaining bolts and pulling the panel up and away from the chassis (see Figure 3-4 for location of LK2 on the card).

The foldback circuit can also be made to disable the drive upon detecting excessive current. However, this requires hardware modifications to the drive PCA card. For more information, contact an Applications Engineer on one of the numbers given at the front of this user guide.

System Functional Tests

If you performed all the system configuration procedures in Chapter 2 and Chapter 3, your system should be fully configured and ready to perform basic operations.

Before coupling the load to the motor and performing normal operations, return to Chapter 2 and repeat the functional test in the section entitled *7. Test The System.* Pay special attention to the system fault LEDs. If any red LEDs illuminate or if the motor fails to move as expected, refer to Chapter 6.

If you connected any I/O switches, use the following procedures to test for proper operation. The test procedures for limit switches and disable switches assume the use of normally-closed switches returned to +15V.

Test the Limit Switches

To test the limit switches, use the following procedure:

1. Make sure the limit switches are wired properly (see Figure 3-3).
2. Apply a positive input signal on VEL1 with respect to VEL2 to make the motor shaft rotate clockwise.
3. While the shaft is rotating, open the input switch connected to LSW1 (CW limit input). The motor should stop immediately. If the shaft does not stop, remove power, reverse the limit input connections between LSW1 and LSW2, and repeat steps 2 and 3.
4. Apply a negative input signal on VEL1 with respect to VEL2 to make the motor shaft rotate counter-clockwise.
5. While the shaft is rotating, open the input switch connected to LSW2 (CCW limit input). The motor should stop immediately.

Test the Disable Switch

To test the drive disable switch, use the following procedure:

1. Make sure the disable switch is wired properly (see Figure 3-3).
2. Open the disable switch to disable the drive. This is evident by the loss of holding torque on the motor shaft (shaft should be free to rotate by hand).
3. Close the disable switch to enable the drive (check for restored holding torque).

Test the Reset Switch

If you wired a remote reset input (see Figure 3-3 for proper connections), test it now by holding the switch closed for at least 0.5 second (this should simultaneously disable all the drives). The drive(s) will be re-enabled when you release (open) the switch.

Coupling the Load

Special couplings that accommodate different types of misalignments are available. The following are the three types of misalignment. They can exist in any combination.

- Parallel Misalignment. The offset of two mating shaft centre lines, although the centre lines remain parallel to each other
- Angular Misalignment. When two shaft centre lines intersect at an angle other than zero degrees
- End Float. A change in the relative distance between the ends of two shafts

Special couplings are used to accommodate the above misalignments and to transmit the desired torque. Consult the coupling manufacturer's data to ensure that you are using the coupling within its specified torque capacity and misalignment ranges.

Shaft couplings may be divided into three types: single-flex, double-flex, and rigid. Like a hinge, a single-flex coupling accepts angular misalignment only. A double-flex coupling accepts both angular and parallel misalignments. Both single-flex and double-flex, depending on their design, may or may not accept end-play. A rigid coupling cannot compensate for any misalignment.

CAUTION

Do not machine the motor shaft without consulting the motor supplier. Improper shaft machining can destroy the motor bearings.

Single-Flex Coupling

When a single-flex coupling is used, one and only one of the shafts must be free to move in the radial direction without constraint. *Do not use a double-flex coupling in this situation because it will allow too much freedom and the shaft will rotate eccentrically; this will cause large vibrations and immediate failure.*

Double-Flex Coupling

Use a double-flexed coupling whenever two shafts are joined that are fixed in the radial and angular direction (angular misalignment). *Do not use a single-flex coupling with a parallel misalignment; this will bend the shafts, causing excessive bearing loads and premature failure.*

Rigid Coupling

Rigid couplings are generally not recommended. They should be used only if the motor is on some form of floating mounts which allow for alignment compensation.

Coupling Manufacturers

POWERDRIVE PSR LTD
Sydenham Industrial Estate
Leamington Spa
Warwickshire
CV31 1PZ
(0926) 452747

HUNT POWERDRIVES LTD
Harrogate Business Park
Wetherby Road
Harrogate
North Yorkshire HG3 1DH
(0423) 889984

HELI-CAL
901 McCoy Lane
P.O. Box 1460
Santa Maria, CA 93456
(805) 928-3851

ROCOM CORP
5957 Engineer Drive
Huntington Beach, CA 92649
(714) 891-9922

For unusual motor installations contact an Applications Engineer for assistance on one of the numbers given at the front of this user guide.

Chapter 4. TUNING THE DRIVE

Chapter Objective

The information in this chapter will enable you to set up and tune the HFC system to meet your requirements.

Initial Precautions

Be sure to consider the following precautions before tuning the drive:

1. It is desirable to know the polarity of the motor and the tachometer, as this will remove the danger of *runaway* (motor uncontrollably ramps to maximum speed). If this information is not available, then be prepared for the possibility of runaway. If the polarity is known, the following information will help you ensure proper motor and tachometer connections:
   - A positive input signal on VEL.COM1 with respect to VEL.COM2 will result in a positive voltage on MOTOR 1 with respect to MOTOR 2, and this should result in a negative tachometer voltage on TACHO with respect to 0V (pin 4). (Normally, the shaft rotates clockwise.)
2. Ensure that the motor mechanism is clear of obstructions and is at the mid-position of its total travel distance.
3. Verify that the voltage selector link is in the correct position (110V or 240V). Refer to instructions in Chapter 2 if you need to change the position.
4. ***Before*** connecting the AC motor supply leads from the transformer, measure the secondary voltage(s) at the isolating transformer. These should not exceed 63VAC at the nominal AC input voltage.
5. On multi-axis systems, work on only one axis at a time. To avoid confusion, disconnect axes that have not yet been set-up, and disable axes that have been set-up.

Tuning Procedure

Use the following procedure to tune each drive in your chassis (see precaution 5 above). The controls in this section refer to the potentiometers on the drive card: Aux. Gain, Balance, Tac Gain, Sig Gain, I Limit (current limit), and Time Con. (time constant).

This procedure assumes that you have completed the connection and test procedures provided in Chapters 2 and 3, and that the motor is coupled to the load/mechanism.

Step 1 **Make sure the power to the drive is off.**

Step 2 Rotate the Sig Gain control fully clockwise (CW), and the other four controls fully counter-clockwise (CCW). Then turn the Tac Gain control approximately six turns CW.

Step 3 Apply a zero velocity demand input by connecting VEL.COM2 and VEL.COM1 (PL1 pins 1 and 2) together.

Step 4 Switch on the power (AC supply and motor supply) to the chassis, and check that no fault LEDs are illuminated. If any fault LEDs illuminate, refer to Chapter 6, *Maintenance & Troubleshooting*. On the standard HFC chassis, check that the fan is running.

Step 5 ***Slowly*** rotate the I Limit control CW until the motor starts to rotate.

> If the motor starts to accelerate towards full speed (*runaway*), switch off the power and check that the Tac Gain control has been rotated by at least six turns CW. If it has, reverse the tachometer connections (see Chapter 2). If, because of system grounding and shielding criteria, it would be inconvenient to change the tachometer connections, then reverse the motor connections. **Do not change the tachometer connections and the motor connections.**
>
> Switch on the power and the motor should now rotate slowly.

Step 6 Set the peak current by rotating the I Limit control CW to the desired current. Five turns CW gives approximately 50% (12A) peak current; 10 turns gives approximately 75% (18A) peak current (see Figure 4-1).

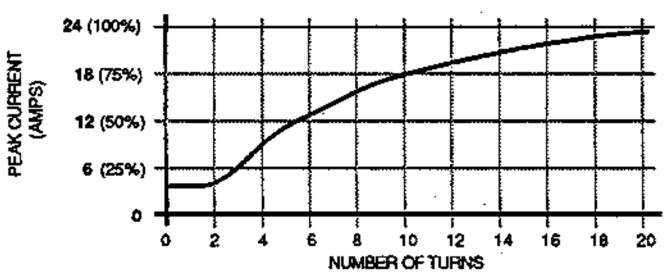


Figure 4-1. Relationship Between Current Limit Control and Current Output

Step 7 Adjust the Balance control until the motor shaft rotates towards the CW limit. Check that the motor stops when the CW end-of-travel limit switch is tripped. If it fails to stop, remove power and reverse the limit switch connections (see Chapter 3). When power is re-applied, further movement should be prevented. Now rotate the Balance control in the opposite direction and check operation of the CCW limit switch. Using the Balance control, return the axis to the centre of travel, adjusting the control until the motor shaft remains stationary when it reaches the centre point. The speed of return can be increased by reducing the Tac Gain.

Step 8 Rotate the Time Con control CW until the motor shaft starts to oscillate (characterized by a high-pitched ringing sound). *Optimum drive performance is achieved at the point when the motor first starts to ring*. Failure of the system to oscillate is not a problem. It usually means that the system has a high mechanical resonance frequency.

Step 9 Rotate the Sig Gain control fully CCW, then rotate it six turns CW. Periodically apply and remove short velocity input signal pulses at approximately 1-second intervals. *If the control system will not permit this method of control, remove the signal connections and use a separate DC power source (i.e., a battery or a DC power supply) to provide the signal.*

Note the response of the system. The objective is to optimise the motor's responsiveness to the input signal. Adjust the Tac Gain control to give the shortest settling time without overshoot (shaft vibrates back and forth to settle into position) and without sluggishness (shaft noticeably decelerates to a stop). Turning the control CW makes the motor more responsive (*stiff*), and turning the control CCW makes the motor more sluggish.

If the final speed changes considerably, you may want to change the velocity input signal to compensate. If the motor begins to oscillate (or oscillate louder than the setting derived from step 8) turn the Time Con control CCW.

Step 10 Increase the Sig Gain or the input signal to run the motor at high speed (**not full speed**) and check for smooth behaviour. If there are still signs of roughness/loud ringing, try turning the Time Con control CCW or try reducing the Tac Gain.

Step 11 Remove the input signal and, if necessary, readjust the Balance control until the motor shaft is stationary.

Step 12 Finally, set the Sig Gain to give the required speed in relation to the input signal.

If you will not be using one of the signal inputs, be sure to turn the corresponding potentiometer fully CCW. If possible, physically connect the unused *input to logic 0V (on the PL1 connector). This should ensure that the unused input does not pick any electrical noise.*

Chapter 5. HARDWARE REFERENCE

Chapter Objective

This chapter is designed to function as a quick-reference tool for the drive specifications.

Drive Specifications

Parameter	Value
Peak motor current (per axis)	± 24A
Max. continuous motor current per axis (see note *)	± 12A (in foldback mode)
Max. motor current without foldback	± 12A
Foldback delay	≈2 seconds at 24A
Typical motor supply voltage	65VDC
Absolute maximum motor supply voltage	100VDC
Minimum motor supply voltage	24VDC
Min. recommended motor load inductance	0.5mH
Torque amplifier bandwidth	2.5 kHz min. (1mH motor)
Switching frequency	18kHz
Form factor	Better than 1.01 (1mH motor)
Pre-amp gain	0 - 2500 V/V (HFC) 0 - 2000 V/V (HFC100)
Power gain	4.0 A/V
Dead band	Zero
Gain linearity	± 2%
Typical input amplifier drift	10 µV/°C
Current limit adjustment	0 - 24A
Output current meter (PL1 pin 9)	±12V for ±24A (output impedance is 2.2kΩ)
Power dump current	9A at 100 volts
Power dump max. continuous power Standard With supplementary resistor (special)	 25W 80W
AC supply inputs: Motor supply AC supply (single-phase) +10%/-15% HFC HFC100	 20 to 60V RMS 110 or 240VAC, 50-60Hz @ 0.5A 110/120VAC, 50-60Hz @ 0.5A
Auxiliary DC output	±15VDC at 250mA (HFC) ±15VDC at 100mA (HFC100)
Ambient temperature range (see note **)	0° - 50°C (32° - 122°F)
Maximum weights: HFC with 4 drive cards HFC with 5 drive cards HFC100	 8 kgs (17.6 lbs) 10 kgs (22 lbs) 2.7 kgs (5.9 lbs)

Table 5-1. HFC Series Drive Specifications

* For the standard HFC only (not HFC100), each of the two motor supplies can deliver a continuous output power of 1.5KW at 20A max. These supplies may be connected either in parallel to deliver 2.7KW at 36A max., or in a 3-phase single supply configuration which can deliver 2.25KW at 30A max.

** The HFC100 requires fan cooling when operated at 12A continuous in temperatures above 104°F (40°C).

Chapter 6. MAINTENANCE & TROUBLESHOOTING

Chapter Objectives

The information in this chapter will enable you to do the following:

- Maintain the drive to ensure long life
- Isolate and resolve system hardware problems

Drive Maintenance

Check that the drive card is free of particles and has a free flow of air over its entire surface. Ensure that all electrical connections are sound and tight. Enclosures must be connected to earth through to provide a low-impedance path for ground-fault or noise-induced currents. All earth ground connections must be continuous and permanent.

Trouble-shooting

This section discusses methods to identify, isolate, and resolve problems that may occur with your HFC Drive system.

Problem Isolation

Try to determine if the problem is mechanical, electrical, or software-related (if you are using a software-based controller).

Where possible, isolate each system component and ensure that each one functions properly when it is run independently. You may have to remove system components and re-install them individually to detect the problem. If you have spares available, you may be able to use them to replace existing components in your system to help identify the source of the problem.

However, take care not to substitute a working spare if there is a risk of damage due to a fault elsewhere.

> **WARNING**
>
> **Make sure to remove power before disconnecting system components or changing wiring.**

If the problem persists, contact an Applications Engineer on one of the numbers at the front of this user guide.

Module Removal and Replacement

Use the following procedure to remove drive cards and power supply cards from the chassis:

1. **Ensure that all supplies are switched off, and allow time for the capacitors to discharge. On the standard HFC chassis, wait for the LEDs on the large HV capacitors to turn off. On the HFC100 chassis, wait for the LED on the AC input card (just above the large capacitor) to turn off.**

2. Note the position of the interconnecting cable(s), and then remove them. **This is VERY important as incorrect re-connections can result in damage and invalidate the warranty.**

3. Remove the motor supply connections from module to be removed.

4. Unscrew the four bolts (or screws for the HFC100) that secure the module to heatsink (or chassis - HFC100).

5. Remove the module from the chassis, easing the board retainer away from the module if necessary. The board retainer is the notched metal plate attached to the standard HFC chassis opposite the heatsink.

6. Ensure that the replacement drive card has jumpers LK1 and LK2 configured the same as the suspect unit.

Replacement is a reversal of removal, but great care should be taken when replacing all connections to ensure that they are not reversed, missing, or misplaced.

Fuses

Refer to Table 6-1 for fuse values for both the drive and the power supply.

Fuse Identification/Location	Value
Drive card fuse (FS1)	20A (quick-acting, high-breaking capacity)
Power supply card fuses	
FS1 (dump fuse)	2A (time-delay, low-breaking capacity)
FS2 (AC supply fuse)	1A (time-delay, low-breaking capacity)
HFC100 AC input card fuses:	
FS1 (motor supply fuse)	25A (quick-acting, high-breaking capacity)
FS2 (motor supply fuse)	25A (quick-acting, high-breaking capacity)
FS3 (AC input fuse)	500mA (time-delay, low-breaking capacity)

Table 6-1. HFC Series Fuse Specifications

Resetting the Drive

Operation of the protection circuits is indicated by LEDs on the power supply and drive card(s). Faults detected on the power supply card result in all axes being disabled. All faults are latched and may be reset, once the cause of the fault has been corrected, either by cycling power to the chassis or by closing the reset switch (grounding power supply card connector PL4 pin 1 to pin 2) for at least one second.

Power Supply Fault LEDs

The majority of faults that can occur on this card will result in illumination of one or more of the LEDs. Fault diagnosis on this card will therefore be listed under the relevant LED. Refer to Figure 5-1 for the identification of the power supply LEDs.

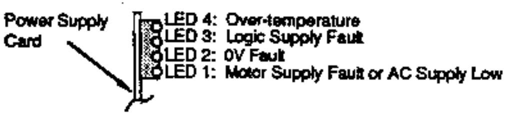


Figure 6-1. Power Supply LEDs

LED 1 Failure of the dump circuit to cope with regeneration may result in this LED being on. Check if the fault occurs during a period of deceleration. If so, then consult the manufacturer regarding increasing the dump capability. If the motor supply bus normally has a value of more than 90V (i.e. when the motor is stationary), then there is a danger of the over-voltage protection operating under average regeneration conditions. Lowering the normal operating value of the motor supply may cure this apparent fault.

If the active pull-off bus is missing, then this LED will be on. This can be confirmed by removing all power, removing the interconnecting cables to drive card(s), and switching on the AC power supply ONLY (i.e. not the motor supply). If LED 1 is still illuminated then either the power supply card is faulty or the transformer is faulty.

To narrow the cause further, remove the power supply card (see *Module Removal and Replacement* above) and replace with another, after having first checked that the voltage selector link on the new card is correctly set. If the fault still persists, then it is the transformer that is faulty and this will need to be replaced. If the fault is no longer apparent, then the power supply card is faulty and should be returned for repair.

LED 2 A *0V fault* can be caused by arcing between the motor brushes and the motor case, or by one or both of the motor connections being shorted to the system metalwork. Check for either of these conditions before proceeding. If both these possibilities have been eliminated then substituting cards may help to ascertain if this is a board fault.

A faulty power supply card can cause the 0V fault to be indicated, but a faulty drive card may also be a cause. If it is established that either the power supply card or an axis card is at fault, then the system should be returned for repair (see *Returning the System*).

LED 3 Illumination of this LED indicates a logic supply fault.

First check if excessive current is being drawn from the ±15V auxiliary outputs (PL1 pins 10 and 12). The maximum permitted load is 250mA (HFC), or 100mA (HFC100).

If this is not the cause of the fault indication, then the fault would appear to lie with either a drive card or with the power supply card itself. To eliminate the cards which are not responsible, proceed as follows:

1. Switch off power to the chassis and allow time for the supplies to discharge (capacitor LEDs off).
2. Disconnect the motor supply.

3. Remove all drive card interconnect cables.
4. Apply power (AC supply ONLY). Do not connect the motor supply.
6. If LED 3 is still illuminated, then the fault lies with the power supply card.
7. If LED 3 is off, then the problem lies with one of the drive cards and the faulty card can be discovered by repeating the procedure with each drive card connected in turn.

It is possible that these tests will show that it is the number of drive cards connected that causes the fault, in which case the fault lies with the power supply card.

LED 4

This LED indicates an over-temperature fault. (For the standard HFC, check to see if the fan is running.) Check for obstructed air flow around the drive cards. Also check to ensure the ambient air temperature around the unit is less than 50°C (122°F) when all the nearby heat-producing equipment is operating at normal temperature. The HFC100 requires fan cooling when operated at 12A continuous in temperatures above 40°C (104°F).

Drive Fault LEDs

Faults associated with the axis (drive) card will either result in the illumination of the motor short-circuit LED (LED 1) or the excessive continuous current LED (LED 2).

LED 1 (Red)

This LED is illuminated in the event of a short circuit between the motor terminals. It may also occur if either terminal is shorted to ground, either by arcing from the brushes or by a more direct connection.

If no external reason can be found, then switch off all supplies (motor and AC) and remove the associated motor connections from connector PL4 on the drive card in question. Switch on the AC supply and <u>then</u> the motor supply. If LED 1 is now illuminated, then the drive card is at fault and should be returned for repair.

LED 2 (Yellow)

This LED illuminates to indicate that excessive continuous current is detected and the foldback circuit has reduced the motor current (see *Changing The Foldback Reset Function* in Chapter 3 for more information).

Incorrect Motor Operation

The following are solutions for common motor operation problems. If none of these checks isolates the problem, substitute the drive card to determine if it is faulty.

Noise From Motor or Unstable Motor Operation

This is usually caused by the Tac Gain or Time Con controls being turned too far clockwise. Re-adjustment should resolve the problem. However, if the problem persists, check to see if the motor-to-tachometer coupling is defective.

Motor Runaway

Motor runaway is characterized by the motor ramping uncontrollably to the maximum speed. This can be caused either by the tachometer connections being broken or reversed, or by the Tac Gain control being turned too far counter-clockwise. First turn the Tac Gain control clockwise to ascertain whether this cures the fault. If not, then check the tach leads to determine if they are broken or disconnected. If the fault persists, reverse the tach connections.

No Movement in One Direction

Check if there is a mechanical reason for the inability to move in one direction. Check also that the limit switch inputs are not active, as this will prevent movement in one direction.

Motor creep

This is usually caused by an incorrect setting of the Balance control. First check this setting by turning the Sig Gain and Aux Gain controls fully clockwise. Then adjust the Balance control until the motor shaft is stationary, confirming that there is zero velocity command on the VEL.COM1 and VEL.COM2 inputs (PL1 pins 2 and 1).

If, when resetting the Sig Gain control (and/or Aux Gain control) the motor starts to creep, check that for zero speed command, the input to the module is 0V. If it is, then ensure that any unused signal inputs are grounded to avoid pickup, and that all used signals are supplied in twisted pairs or shielded cables.

Reducing Electrical Noise

Special care must be taken to eliminate sources of possible noise interference. Potential sources of electrical noise include inductive devices such as solenoids, relays, motors, and motor starters when they are operated by a hard contact. We recommend that you mount the chassis in a NEMA enclosure to protect it from electrical noise.

For more information on identifying and suppressing electrical noise, refer to the Technical Data section of the *Digiplan or Compumotor Motion Control Catalogue*.

Returning the System

If you must return your HFC system to effect repairs or upgrades, use the following steps:

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

2. Before you return the unit, have someone from your organization with a technical understanding of the HFC system and its application include answers to as many of the following questions as possible:

- What is the extent of the failure/reason for return?
- How long did it operate?
- Did any other items fail at the same time?
- What was happening when the unit failed (i.e., installing the unit, cycling power, starting other equipment, etc)?
- How was the product configured (in detail)?
- With what equipment is the unit interfaced?
- What was the application?
- What was the system environment (temperature, enclosure, spacing, unit orientation, contaminants, etc.)?
- What upgrades, if any, are required (hardware, user guide)?

3. In UK, call Digiplan for a GRA (Goods Returned Authorisation) number. Returned products cannot be accepted without a GRA number. The phone number for Digiplan Repair Department is 0202 690911. For Customer Service/Applications Department phone 0202 699000.

Ship the unit to:

Parker Hannifin plc
Digiplan Division,
21, Balena Close,
Poole,
Dorset,
England.
BH17 7DX

4. In the USA, call Compumotor for a Return Material Authorization (RMA) number. Returned products cannot be accepted without an RMA number. The phone number for Compumotor Applications Department is (800) 358-9070.

Ship the unit to:

Parker Hannifin Corporation
Compumotor Division
5500 Business Park Drive
Rohnert Park, CA 94928
Attn: RMA # xxxxxxx

5. Elsewhere: Contact the distributor who supplied the equipment.

Appendix - DC Series Servo Motor Data (USA only)

Description

There are six DC series motor models designed to operate with the UD2, UD5, UD12, and HFC servo drives. The following table identifies the motor/drive compatibility.

	DC2250	DC3353	DC3363	DC4060	DC4090	DC4520
UD2 Drive	Yes	Yes	-------	-------	-------	-------
UD5 Drive	Yes	Yes	Yes	Yes	-------	-------
UD12 Drive	-------	-------	-------	Yes	Yes	Yes
HFC Drive	-------	-------	-------	Yes	Yes	Yes

Table A-1. Motor/Drive Compatibility

Each motor is configured to be controlled by the drive operating in a torque amplifier mode. Each motor includes a 1000-line incremental encoder operating at 5VDC and completely housed in its own bearing structure.

For additional information on motor specifications and speed/torque curves, refer to the *Compumotor Positioning Control* catalogue.

Connections

DC Series motors come standard with a 10-foot combination motor/tach and encoder cable. Depending on the motor model, the cable assembly is either low-power (p/n 71-011808-10) or high-power (p/n 71-011807-10). The low-power cable is used for motor models DC2250, DC3353, and DC3363. The high-power cable is used for motor models DC4060, DC4090, and DC4520.

The encoder leads are stripped and ready to connect to the controller's encoder connector. Motor and tachometer connections are discussed below. Refer to Figure 1 for cable color codes.

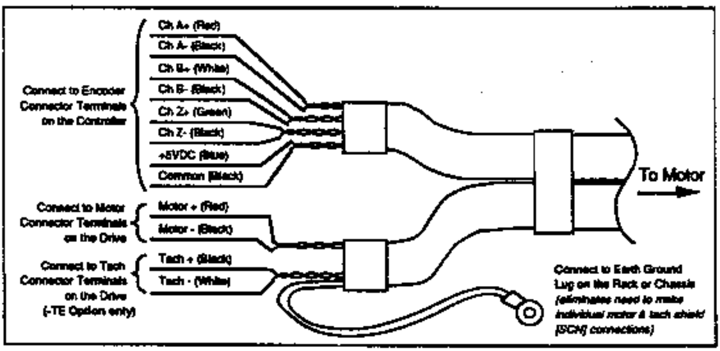


Figure 1. DC Motor Cable Color Codes

WARNING

Ensure that AC power is removed from the drive and controller before connecting the DC Series motors.

Motor and Tach

The motor and tachometer (tach) leads have molex terminals installed. Refer to Figures 2, 3, and 4 for motor and tach connections to the HFC, the UD12 (UR4 rack), and the UD2/5 (UR3/8 racks), respectively. ***Tach leads are used only for the TE motor option (for velocity amplifier operation).***

If you must extend the motor or encoder cables, use the following guidelines:

- Encoder cables must be extended in shielded twisted pairs (22 AWG wire).
- Motor cables must be extended in shielded twisted pairs. Use 16 AWG wire for the low-power cable (p/n 71-011808-10), and 18 AWG wire for the high-power cable (p/n 71-011807-10).

HFC Connections

To connect the motor leads to HFC series drives, you must remove the molex terminals and attach the fast-on connectors found in the HFC ship kit.

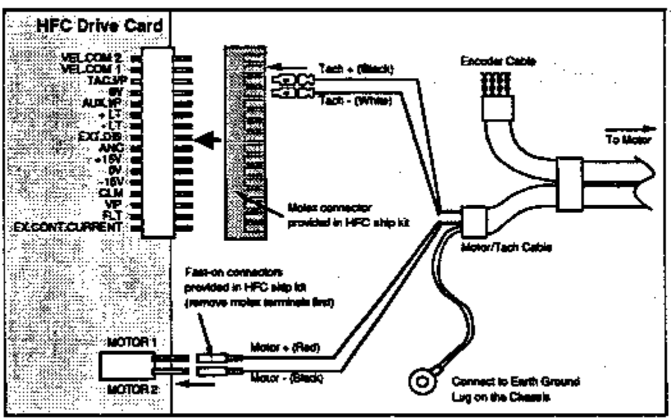


Figure 2. HFC Motor and Tachometer Connections

UD12 Connections

To connect the motor and tach leads to the UR4 rack, you must remove the molex terminals and strip the leads to insert them into the motherboard screw-terminal connector.

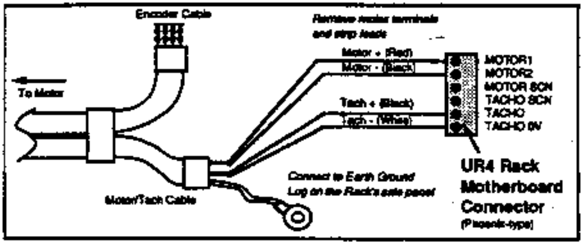


Figure 3. UD12 (UR4 Rack) Motor and Tachometer Connections

UD2/5 Connections

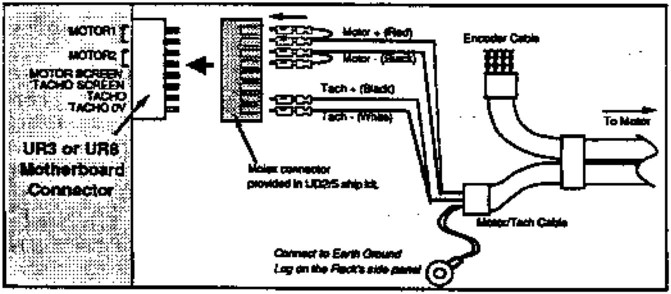


Figure 4. UD2/5 (UR3/8 Rack) Motor and Tachometer Connections

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