1336FORCE Series A Start-up Procedures

Introduction

This chapter describes the procedure for the proper start up and tuning of the 1336 FORCE AC drive. Among the proce dures you must perform in this chapter are the following:

•Pre-power checks

•Power-on checks

•Communication Configuration

•Parameter Programming

•Motor and Feedback Polarity Checks

•Drive Tuningand Calibration Safety Precautions

ATTENTION: Only qualified personnel familiar with the 1336 FORCE AC Drive and its associated machinery should plan and implement the installation, startup and subsequent maintenance of the Drive. Failure to comply may result in personal injury and/or equipment damage.

ATTENTION: Working with energized industrial control equipment can be hazardous. Severe injury or death can result from electrical shock, burn, or unintended actuation of controlled equipment. Hazardous voltages may exist in the cabinet even with the circuit breaker in the off position. Multiple sources of power may be connected to this drive. Recommended practice is to disconnect and lock out control equipment from power sources, and discharge stored energy in capacitors, if present before coming in contact with any equipment in this cabinet. During startup it will be necessary to work in the vicinity of energized equipment. The Safety Related Practices of NFPA 70E, "ELECTRICAL SAFETY FOR EMPLOYEE WORKPLACES" must be followed at all times.
DO NOT work alone on energized equipment!

ATTENTION: Potentially fatal voltages may result from improper useage of an oscilliscope and other test equipment. The oscilliscope chassis may be at potentially fatal voltage if not properly grounded. Avoid using the oscilloscope to measure high voltage signals. In most cases the waveform can be obtained from a low level test point. If an oscilliscope is used to measure high voltage waveforms, use only a dual channel oscilliscope in the differential mode with X-100 probes. It is recommended that the oscilliscope be used in the A minus B Quasi-differential mode with the oscilliscope chassis grounded to an earth ground. Refer to equipment safety instructions for all test equipment before using with the 1336 FORCE Drive.

ATTENTION: This Drive contains ESD (Electro-Static Discharge) sensitive devices. Static control precautions are required when installing, testing, servicing or repairing this assembly. These precautions should be applied when working with logic boards AND any components in the power section. A properly grounded wrist strap should be worn when contacting any component in the drive. If you are not familiar with static control procedures, before servicing, reference Allen-Bradley Publication 8000-4.5.2, Guarding against Electrostatic Damage or any other applicable ESD protection handbook.

Required Tools and Equipment

The following equipment is required for start-up and tuning.

•Digital Multimeter (DMM) capable of 1000V DC/750V AC, with input resistance of at least 1 megohm.

•Hand Tachometer used to monitor motor velocities.

•User Manuals for optional equipment.

•DriveTools Software (optional)

This start-up sequence specifies using hand instruments such as multimeters, tachometers, ammeters and an oscilliscope to carry out this start-up test procedure. If you have the optional DriveTools software for the 1336 FORCE Drive, it can be used to simplify the startup procedure. This option can be used to set input commands, manipulate parameters and verify frequencies and voltage levels.

IMPORTANT: With a Series A 1336 FORCE drive it is necessary to use either a PLC or DriveTools to carry out the Startup. Performing a Startup sequence with any programming terminal such as a GPT or HIM SHOULD NOT be attempted with a Series A drive.

Drive Information

During Startup the following information should be recorded for reference. It is important that an accurate list of drive components be maintained and referred to when contacting service personnel.

Table 3-A. Data Checks -

DRIVE NAMEPLATE DATA

Catalog Number: _____

Serial Number: _____

Series: _____

AC Input _____ Volts _____ Amps

AC Output _____ Volts _____ Amps

Horsepower Rating: _____ kw _____

MOTOR NAMEPLATE DATA:

Catalog Number: _____

Serial Number: _____

Series: _____

AC Input _____ Volts _____ Amps

Horsepower Rating: _____ kw _____

Poles: _____

RPM: _____

Hz: _____

ENCODER NAMEPLATE DATA:

Catalog Number: _____

Serial Number: _____

Series: _____

Input Power Supply: _____ Volts

Input Signal Level: _____ Volts

Output Type: _____

Pulses Per Rev: _____ PPR

Maximum Speed: _____

Maximum Frequency: _____

MOTOR CONTROL BOARD:

Board Revision Level: _____

PLC COMM BOARD:

Board Revision Level: _____

GATE DRIVER BOARD:

Board Revision Level: _____

STANDARD ADAPTER BOARD:

Board Revision Level: _____

PLC Comm Adapter Board Jumper Settings:

U2: 1___ 2___ 3___ 4___ 5___ 6___ 7___ 8___

U3: 1___ 2___ 3___ 4___ 5___ 6___ 7___ 8___

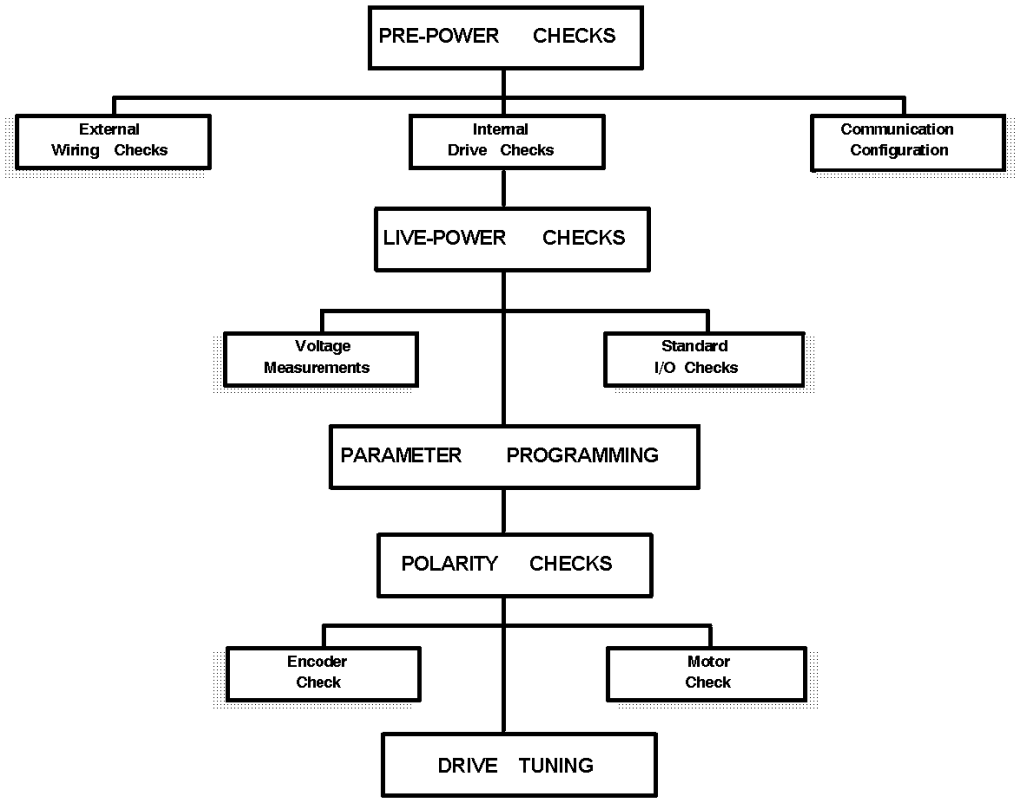
U4: 1___ 2___ 3___ 4___ 5___ 6___ 7___ 8___

U5: 1___ 2___ 3___ 4___ 5___ 6___ 7___ 8___

General

Only qualified electrical technicians and/or electrical engineers familiar with solid state controls and circuitry should attempt a 1336 FORCE start-up. Figure 3.1 outlines the sequence that is required to start-up the 1336 FORCE Drive.

Figure 3.1.
Bulletin 1336 FORCE Start-Up Sequence



Pre-Power Checks

Pre-Power checks are meant to identify any problems prior to applying voltage to the system. The drive should be checked for any damage that may have occurred during shipment and installation. You should also verify that all jumpers and configuration controls are properly applied for the application at hand. Finally, you must check all wiring external to the drive for accuracy and reliability.

External Wiring Checks:

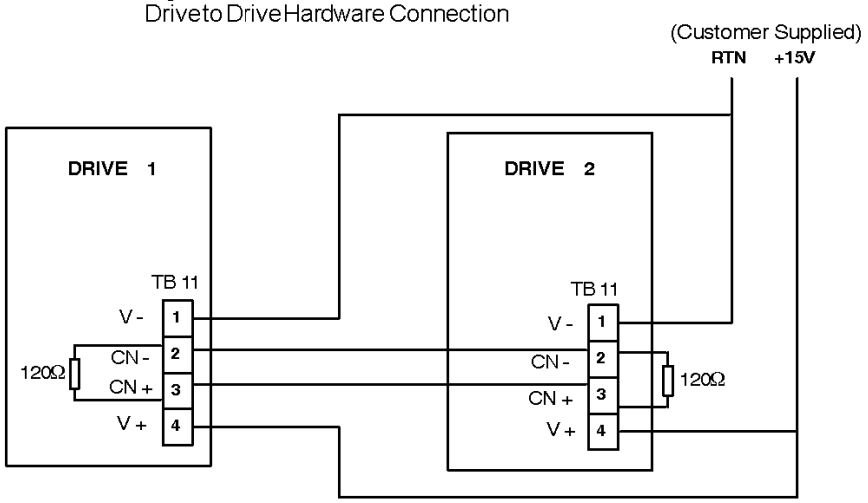
1. Verify that all external I/O wires are properly terminated in the terminal blocks. A full point-to-point continuity check should be performed on all I/O wiring connected to the drive.
2. Verify that the incoming power connections are properly connected and tight. Also verify that the power source is properly sized and protected for your particular drive.
3. Verify that the motor power connections are properly connected and tight. Motor Phasing should be checked, Motor Phase A should be connected to Drive output phase A, likewise Phase B and C should be properly terminated to their respective terminals. This phasing will be double checked later in this procedure.
4. Verify that the encoder feedback device is properly connected. The encoder should be a quadrature device with a 12V input power requirement and either 12V or 5V differential outputs. Jumpers J3 and J4 on the Main Control Board (Figure 2.7) must be set for the desired output. Phasing of the encoder should be checked in that A and /A, B and /B are properly terminated. This phasing will be double checked later in this procedure.
5. Verify that the standard I/O inputs on the PLC Comm Board are configured for the proper input voltage level. The Standard I/O can be configured for operation at 24V DC or 120V AC. To select the proper voltage set the jumpers on J5, J6, J7 and J8 across pin 1 and 2 if the input voltage level is 120V AC, and across pins 2 and 3 if the input voltage level is 24V DC.

Communication Configuration

Drive to Drive Communication - Drive to Drive Communication (D2D) provides high speed communications between drives based on a Control Area Network (CAN) chip. D2D is capable of connecting up to 64 Drives together using three different transfer rates, 125K (64 nodes), 250K (64 nodes), and 500K (32 nodes) baud.

Hardware Setup - The hardware setup for D2D consists of a shielded cable going from CN+ and CN- between the drives. The shields are to be tied together and grounded at one point. Place a 120W terminating resistor on both ends of the cable. The 8 -18 VDC that powers the D2D is to be supplied by the customer. Figure 3.2 shows a typical D2D connection. Recommended cable is Device-Net cable (Belden YR 29832).

Figure 3.2.
Drive to Drive Hardware Connection



Communication - The D2D allows each drive to transfer two words and receive two words from two different drives for a total words received of four (Figure 3.3).

Figure 3.3.
D2D Communication

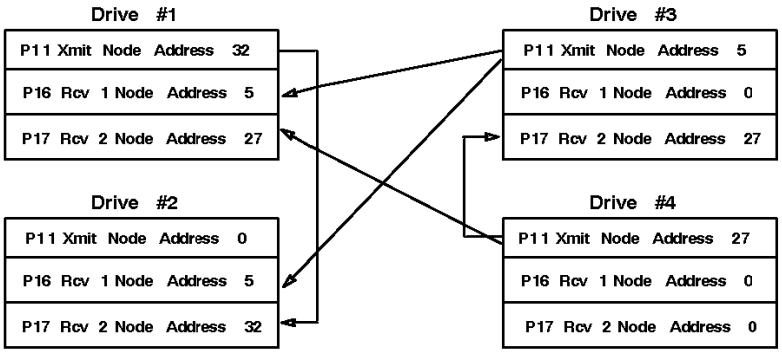
Transmit
P11 Node Address
P14 Data 1 Indirect
P15 Data 2 Indirect
P20 Data 1
P21 Data 2

Receive 1
P12 Node Address
P16 Data 1 Indirect
P17 Data 2 Indirect
P22 Data 1
P23 Data 2

Receive 2
P13 Node Address
P18 Data 1 Indirect
P19 Data 2 Indirect
P24 Data 1
P25 Data 2

Node Address - The node address for the transmit is the address at which the drive will transmit its two words of data. The node address for each of the receives is the address of the drive which you wish to receive two words of data from. If the node address is set to zero then the transmit or receive is disabled. It is up to you to make sure there are no duplicate transmit node addresses. If duplicate addresses exist, you must change one address. Refer to the example in Figure 3.4.

Figure 3.4.
Node Address Transmittal



Note that a drive cannot receive its own address and both receives cannot be set to the same address unless it is zero.

Data Indirect - The indirect function for the transmit indicates to the D2D transmit (TX) where it should take data from. The receive it indicates to the D2D receive (RX) where it should put its data. Indirect parameters can have either VP parameters entered into them, or they can have indirect data parameters entered into them as shown in the following examples.

Transmitter Example:

P14 Drive Transmit indirect 1 - Any VP Parameter or - P20 (Drive Xmit Data 1)

P20 would then have a value or be linked to a non VP parm.

Receiver Example:

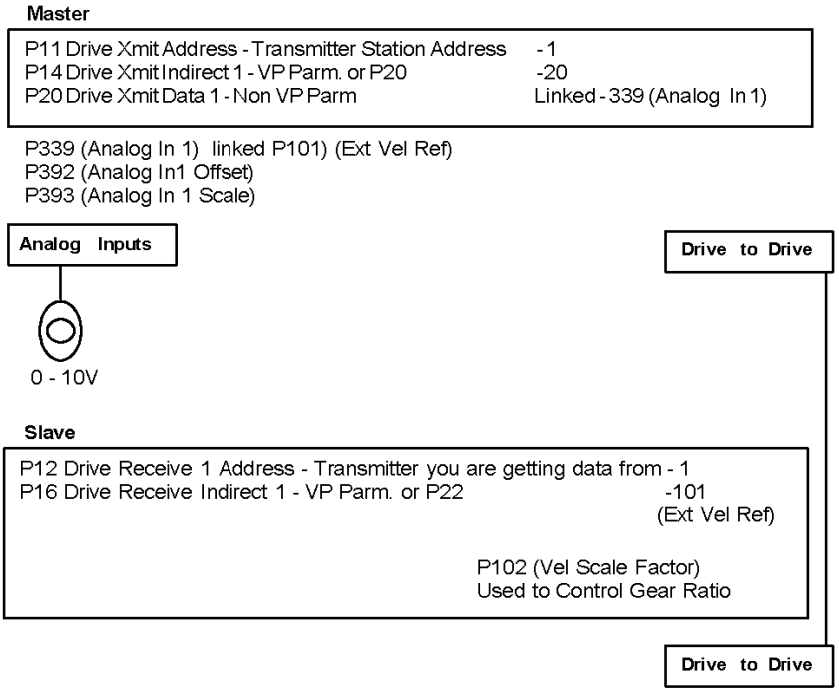
P16 Drive Receive Indirect 1 - Any VP Parameter or - P22 (Receive 1, Data 1)

P22 would then have a value or a non VP parm linked to it.

Data - The D2D TX and RX data exists as non VP parameters in the parameter table. This allows data outside the Motor Control Board to get access to the D2D. Data parameter examples were shown in the previous transmitter and receiver examples.

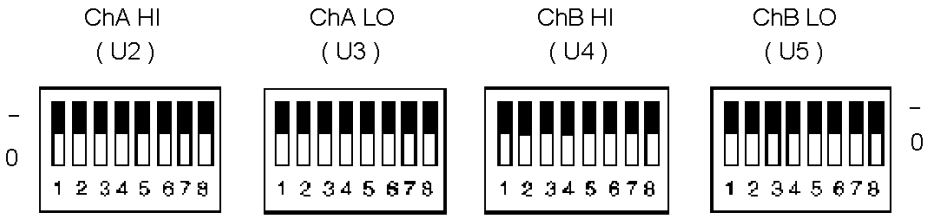
Master/Slave Drive to Drive Communication - Figure 3.5 illustrates an example of D2D applied to a master/slave drive set up. The master drive receives its speed reference from a speed pot wired to analog input 1 on a PLC Comm board. P339 (Analog In1) is linked to P101 (Ext Vel Ref) on the master drive. P392 (Analog In 1 Offset) and P393 (analog In1 Scale) are set accordingly. Analog Input 1 must be passed from the master drive to the slave drive and connected to the P101 (Ext Vel Ref) using the D2D protocol. Setting up the Master drive requires that a transmit address be chosen. An address 1 is chosen in this example. P14 (Drive Xmit Indirect 1) will have a value of 20 entered into it (which means look to P20 (Drive Xmit Data 1)). P20 (Drive Xmit Data 1) must be **linked** to P339 (Analog In1). This is where the data comes from that will be transmitted.

Figure 3.5.
Master/Slave Communication Example



The slave drive is set up by first setting P12 (Drive Receive 1 Address). P12 contains the address of the tranmitter that you wish to receive data from. In this example, a value of 1 is entered, indicating that data should be read from transmitter 1. P16 (Drive Receive Indirect 1) should be set to P101 (Ext Vel Ref). It should be noted that the typical transmission **time** from the master to the slave is between **4ms to 6ms** using links, otherwise using indirects it is only 2ms to 4ms.

PLC Comm Plug Configuration - The PLC Comm Adapter incorporates an Allen-Bradley Communication Plug which is preset. Verify that the Plug (Figure 3.6) is configured correctly for your application by checking the PLC Comm Adapter User Manual.



DIP SWITCHES

Power On

After all pre-power checks have been completed, the incoming power may be applied. The application of power for each system can be different. Make sure you know the safety controls associated with the system. Power should only be applied if you have a thorough understanding of the 1336 FORCE Drive and the associated system design.

1. Measure the incoming line voltage between L1 and L2, L2 and L3, and L1 and L3. Use the DMM on AC Volts, highest range (1000 VAC). The input voltage should equal the drive rated input voltage present on the drive's nameplate within +/-10%. If the voltage is out of tolerance, verify the drive rating is correct for the application, if it is, adjust the incoming line voltage to within +/-10%. Record these measurements in the Voltage Measurement Table.
2. Measure the Motor Control Board Power Supply voltages. Record the measurements in the Voltage Measurement Table 3B.
3. Measure the PLC Comm Board Power Supply voltages. Record the measurements in the Voltage Measurement Table 3B.
4. If a Standard Adapter Board is supplied, measure the Standard Adapter Board Supply Voltages. Record the measurements in the Voltage Measurement Table 3B.
5. Measure the Standard I/O input voltage. This voltage is user selectable and should be either 120VAC or 24VDC nominally. Record the voltage level in Table 3-B.

Table 3-B. Voltage Measurement Table

Test Points	Expected Voltage	Measured Voltage
L1 to L2	Rated AC Line	
L2 to L3	Rated AC Line	
L1 to L3	Rated AC Line	
Motor Control Board:		
TP1 to TP2	4.85 to 5.10V	
TP3 to TP4	13 to 17V	
TP5 to TP4	-13 to -17V	
TP26 to TP27	10.4 to 13.6V	
PLC Comm Board:		
TP1 to TP2	4.85 to 5.10V	
TP4 to TP3	13 to 17V	
TP4 to TP5	-13 to -17V	
TP19 to TP14	10.4 to 13.6V	
Base Driver Board:		
J2 to J2	4.85 to 5.10V	
J2 to J2	11 to 17V	
J4 to J4	10.5 to 13V	
Standard I/O Voltage	120VAC +/-10%	
J3, 8, 9 or 10 to J3	or 24VDC +/-10%	

Communication Configuration

The Standard I/O of the 1336 FORCE Drive should be checked to verify proper operation. The Standard I/O is used to interface control circuits into the drive. It is very important that this interface is functioning properly.

1. The DRIVE ENABLE (TB20 terminal 1) on the PLC Comm Board input allows the drive to honor a START command and allows the transistor firing commands to be enabled. D21 on the PLC Comm board, a green LED, reflects the present state of the DRIVE ENABLE. If D21 is illuminated, then the drive is enabled and the transistors will be allowed to fire. Parameter 54 bit 1 also reflects the status of the DRIVE ENABLE input.
2. The EXTERNAL FAULT (TB20 terminal 4) PLC Comm input allows the you to tie a signal into the 1336 FORCE that will be monitored by the Velocity Processor (VP). If the input voltage is removed, the VP will issue a fault or warning based on the configuration of that fault and the red LED D16 on the PLC Comm board will be illuminated. When Input voltage is applied, D12 will not be illuminated.
3. The MOTOR THERMOGUARD (TB20 terminal 2) input allows you to tie a signal from the thermo-switch in the motor into the 1336 FORCE that will be monitored by the Velocity Processor (VP). The red LED D18 will illuminate if an overtemp condition occurs.

4. The NORMAL STOP (TB20 terminal 3) input is stop command that will stop the drive according to the specified Stop Mode. The drive responds the same way it would if the STOP bit were set in any Logic Command. The red LED D13 reflects the present state of the STOP input. When a Stop is in effect the LED is illuminated and the Drive is not allowed to run.

5. The FAULT OUT (TB20 terminals 8,9,10) input is a Form C relay contact. Red LED D11 reflects the status of relay contact. If the LED is illuminated the contact is not energized. Startup Configuration Procedures After you have completed all wiring and power up the drive, the parameter configuration procedure must be completed in a two step sequence.

ATTENTION: Failure to complete the parameter configuration in Steps 1 and 2 could result in injury to personnel, ordamage to the drive and the motor, when attempting to perform the remaining steps in the Configuration Procedure.

You must perform parameter configuration in the following order:

1. Set P310 to a value of 1. This will allow access to the Advanced Programming Parameters.

2. Enter the values for all Inverter Parameters (220 - 227).

IMPORTANT: The carrier frequency (Parm 222) for 125 HP and larger drives must remain at 4 Khz or lower. If the carrier frequency is increased, the output current must be derated due to heating effects caused by the increase in carrier frequency.

3. Enter the values for all Motor Parameters (228 - 235).

4. Perform the Phase Rotation test only after entering all Inverter and Motor parameter values.

ATTENTION: During Startup the motor will rotate. Hazard of personal injury exists due to unexpected starts, rotation in the wrong direction or contact with the motor shaft. If possible, uncouple the motor from the load and place a guard around the motor shaft.

Phase Rotation Test

Typically the default values are adequate to perform the phase rotation test. Toggle the start bit in the logic command in order to start the test. When using default values, the motor shaft will rotate at approximately 85 RPM for a 4 pole, 60 Hz motor.

Interpreting Phase Rotation Results:

1. In phase rotation, the motor should turn in the direction you define. If the motor turns in the wrong direction, reverse any two motor leads.

2. In phase rotation with the motor now turning in the correct direction, the sign of the velocity feedback (P146) should be positive. If it is negative, reverse the A and /A (NOT A) encoder leads or the B and /B (NOT B) leads.

3. If no motor rotation occurs, refer to the troubleshooting section of the manual.

Torque Block Tuning

The Torque Block can be tuned by setting bits 2 thru 5 in parameter 256 to a value of one, and executing a Start command.During this test the Drive enable light will come on for approximately 1 minute with no motor rotation. After this one minute time period, shaft rotation will occur. Once the shaft stops rotating, the Drive enable light will go out, and bits 2 thru 5 in Parameter 256 will be set to a value of zero. This indicates a successful Torque Block tune. If the Drive faults during the Torque Block tuning, verify the Motor and Inverter data and re-execute the test. If continued problems occur, refer to the Troubleshooting section; Sequential Torque Block tuning.

Velocity Loop Tuning

You must use the following sequence when tuning the Velocity Loop:

1. Set **Parameter 53** to a value of 1 (Bit 0 = 1). This sets the drive in velocity mode.
2. Set **Parameter 40** (Autotune Torque Limit) to a value of 75%.
3. Set **Parameter 41** (Autotune Speed Limit) to a value of 75%.
4. Set **Parameter 256** (Bit 6 = 1) to a value of 64. This will enable the Motor Inertia Test.
5. Toggle the Start bit in the logic command.

IMPORTANT: this must be done within 30 seconds of entering a value in **Parameter 256** .

While the Velocity Loop test is being performed, the motor will accelerate up to 20% of base speed, and then accelerate to the speed set in **Parameter 40** before decelerating to zero speed. The Enable light will go off when the test is finished.

6. To update the velocity loop gains, set Bit 8 to a value of 1 in **Parameter 256** . The maximum bandwidth will appear in Parameter 44.
7. Enter the desired bandwidth in **Parameter 43** .

Note: Both the Ki & Kp gains in Parameters 139 and 140 will change depending on the value entered in **Parameter 43** .

Note: **Parameter 141** KF will also affect the values that are calculated for both Parameter 139 and Parameter 140. Leave Kf = 1 for initial tune.

8. After you have entered the desired bandwidth in **Parameter 43** , and the gains have been updated in Parameters 139 and 140, set **Parameter 256** back to a value of zero.
9. Now you will be able to start the drive in Velocity Mode. Begin by giving the Drive a small speed reference. Slowly increase the drive speed reference, observing both Parameter 146 (Velocity Feedback) and Parameter 167 (Internal Torq Ref). Both of these parameters should be stable during steady state conditions. If they are not, adjust Kp and Ki accordingly, if the steady state condition cannot be obtained, perform another Velocity Loop Tuning sequence. After you are able to succcessfully run the motor in velocity mode by itself, it should be connected to the process and the system inertia test should be performed.

System Inertia Test

With the motor connected to process, the following test sequence must be followed:

1. Set Bit 7 to a value of 1 in parameter 256.
2. After the appropriate value is set in Parm 256, a Start command should be given to the drive. When started, the motor will accelerate up to 20% of base speed, and then accelerate to the speed set in parameter 40 before decelerating to zero speed. The enable light will go off when the test is finished, and the value in P256 will be set to a value of 0.
3. After successful completion of the inertia measurement, whether motor inertia or system inertia, Bit 8 of parameter 256 should be set. This allows bandwidth calculations to be made automatically. The bandwidth calculations are based on the value that is displayed in Parm 44 (maximum Bandwidth). Parm 43 (Desired Bandwidth) is where the user will enter the desired Bandwidth display in X.XX rad/ sec. Both Parm 139 (Velocity KI Gain) and 140 (Velocity KP Gain) gains will change according to the bandwidth entered in Parm 43. Parm 43 must be less than or equal to the value displayed in Parm 44.

Note: Parameter 141 (Velocity Feedforward) will also affect the values that are calculated for both Parm 139 & 140. Leave Kf = 1 for Initial tune.

4. After you have entered the desired bandwidth in Parmeter 43, and the gains have been updated in Parameters 139 and 140, set Parameter 256 back to a value of zero. This will prevent Parm 139 and Parm 140 from changing if Parm 43 were to be accidentally changed.

5. Now you are ready to start the drive in Velocity Mode. The drive can be started using Preset Speed 1 (P119) for a reference by turning on Bits 13 & 1 in Parm 367. To stop the Drive enter a value of 1 in Parm 367.

6. Begin by putting a small reference in Parm 119 (approximately 10% of Base Speed). Observe the motor shaft, making sure it has stable rotation. Slowly increase the drive speed reference observing both Parameter 146 (Velocity Feedback) and Parameter 167 (Torq Ref). Both of these parameters should be fairly stable during steady state conditions. If they are not, adjust Kp and Ki accordingly, if the steady state condition cannot be obtained, perform another Velocity Loop Tuning sequence.

***** IF YOU ARE USING A PLC COMM BOARD**

The analog outputs on a PLC Comm Board can be used to link the Velocity Feedback (parm 146) and Torq Reference (Parm 167). When these outputs are linked, a chart recorder can be connected to the Analog Output channels. This will allow the user to record the drives response to given changes in the reference.