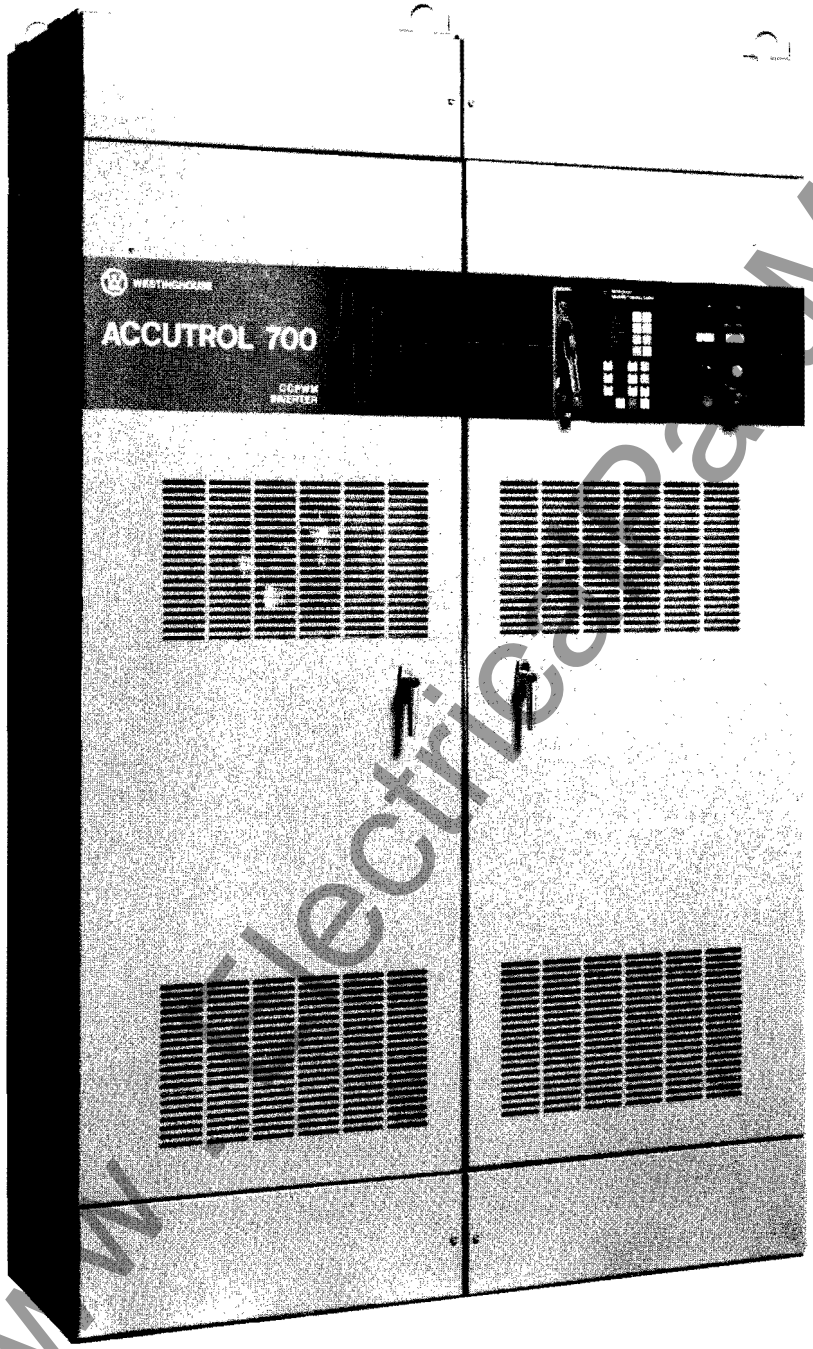
# Accutrol 700 High Performance Adjustable Frequency Motor Control




## General Description

The Westinghouse Accutrol 700 is a high performance microprocessor based digital motor speed controller utilizing a "Current Controlled Pulse Width Modulated" technique (CCPWM) for producing adjustable frequency speed control for induction and synchronous motors. The CCPWM technology results in more reliable trip-free operation than competitive products using variable voltage, current source, and conventional PWM technologies.

The Accutrol 700 microprocessor based regulator executes a Westinghouse proprietary "Vector Torque Control" algorithm. This flux vector control system optimizes motor torque performance without the need for external encoders. The torque optimized output waveform is low in harmonic distortion to help reduce motor heating.

The Accutrol 700 rectifies the incoming Ac supply voltage to a fixed Dc potential. The Dc voltage is inverted into variable voltage and frequency Ac output by a torque optimized, current controlled regulator over a 2 to 120 Hz speed range.

## Application

High torque performance capability makes the Accutrol 700 well suited for even the most demanding industrial speed control applications, such as conveyors, extruders, cranes and hoists.

For applications with tough environments and torque requirements the Accutrol 700 constant torque ratings allow the use of Ac induction motors with their inherent advantages as compared to expensive and hard to maintain Dc motors. Typical examples would be petro-chemical process pumping, as well as paper and steel mill drives.

Centrifugal pumps and fans are particularly suited for the Accutrol 700 variable torque ratings as considerable energy savings is achieved by varying the speed to control the flow of gas or liquid instead of using throttling devices such as dampers or valves.

# Accutrol 700 Adjustable Frequency Motor Control

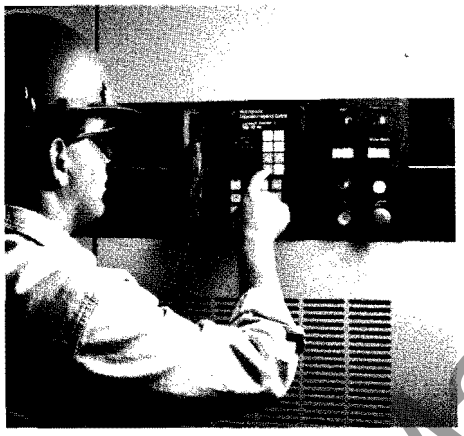
## Accutrol 700 Technology

**Current Controlled PWM (CCPWM)**
The Westinghouse Accutrol 700 CCPWM technology results in true current and voltage regulation. Conventional PWM and variable voltage drives regulate voltage but at best only monitor current. The ability to control current results in the elimination of nuisance overcurrent trips common to previous generations of variable voltage and PWM drives.

**Vector Torque Control**
Vector torque control is a flux vector control system, without encoders. This Westinghouse proprietary control algorithm monitors current and flux vectors at the motor terminals. The output PWM waveform is modulated to optimize motor torque and results in a near sine wave output providing important performance benefits.

- Higher torque at low speeds
- Faster torque response to impact loads
- Reduced output harmonics that cause motor heating
- Eliminates voltage and torque boost adjustments

**Multi-Motor Operation**
Many industrial facilities limit the size of their 480 volt motors to 150 or 250 Hp. The Accutrol 700, with its ability to control the speed of many motors simultaneously, is the right choice for multi-motor applications like cooling tower fans and material handling processes. The Accutrol 700 can control the speed of any number of motors up to a total connected load of 600 full load amps.



**Parameter Tuning**
The Accutrol 700 eliminates the trial and errors encountered at start-up. Most drive set-up parameters may be adjusted safely while the drive is operating. "On-the-Fly" parameter tuning eliminates the need to stop the drive and restart each time an adjustment is needed.

**Full Regeneration**
The Accutrol 700 can be modified to enable motor generated power to be returned to the utility power system. This optional feature makes Accutrol 700 a candidate for traditional Dc drive applications. The regenerative option is particularly useful for crane, hoist, and mill run out table applications.

**"Clean Power" Line Harmonic Reduction**
Westinghouse has patented this technique to virtually eliminate line harmonics reflected into the utility power system. This optional feature includes a phase shifting transformer and up to 18 semiconductors which results in line harmonic reduction that meets the latest IEEE 519 current and voltage harmonic standards on any power system. Benefits include:

- Meets IEEE 519 current and voltage standards
- Eliminates the need for expensive system harmonic studies
- Eliminates the need for harmonic filters that cause voltage switching transients
- Eliminates transformer derating due to harmonic currents
- Helps prevent malfunction of sensitive electronic equipment
- Improves total power factor
- Permits applications of VFD's on generator and other high impedance power systems

**Stall Prevention**
The Accutrol 700 maximizes system uptime by using current controlled regulation in concert with stall prevention techniques to avoid overload conditions. The Accutrol 700 will apply maximum capacity for acceleration, deceleration and constant speed operation. When the motor load exceeds the capacity of the drive, the Accutrol 700 will automatically limit the rate of acceleration or deceleration until the load is within operational limits. During constant speed overloads the Accutrol 700 will regulate current and reduce output frequency until the overload has passed.

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**WARNING:** This literature is a general description of the equipment only. For proper installation, operation and maintenance of the equipment, consult the Instruction Manual. This should not be considered all inclusive. Improperly installing and maintaining these products can result in death or serious personal injury. Before attempting installation or maintenance, read and understand all instructional materials related to the product. If further information is required, you should consult Westinghouse Electric Corporation.

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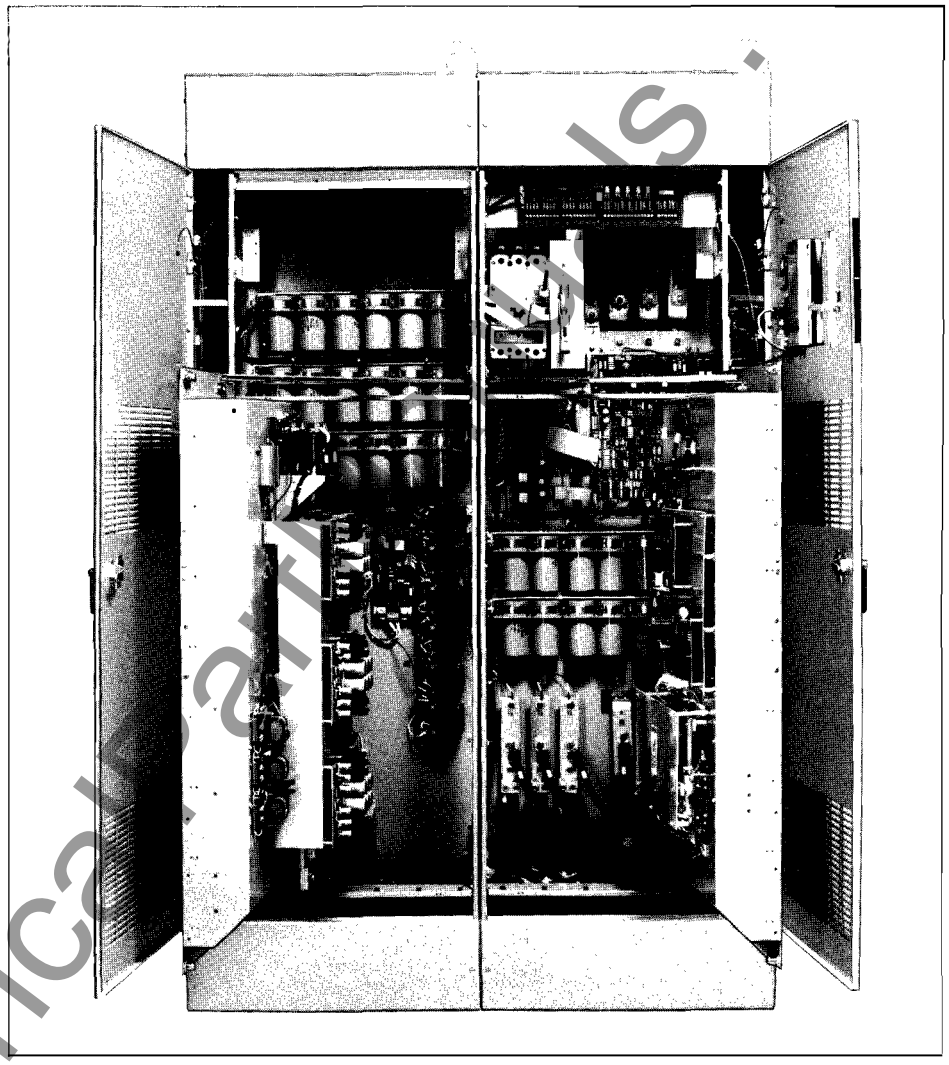
# Accutrol 700 Adjustable Frequency Motor Control

## Accutrol 700 Standard Features

**Standard Design Features**
The Westinghouse Accutrol 700 is a microprocessor based, space effective, high performance Ac drive. It has been designed for front accessibility with easily removable or hinged assemblies to allow fast and efficient maintainability.

Standard design features and layout are described below.

- Accutrol 700 will operate on 480 ±10% power systems
- Current limiting fuses provide short circuit protection for the power converter section as well as greater short circuit interrupting capability
- 120 Vac external control connections are provided by highly accessible terminal blocks
- NEMA 12 ventilated enclosure, standard for 200 Hp VT and above models, reduces the need for filters
- Motor control center compatibility
- Top or bottom cable entry or exit is standard
- Current limiting reactor supplies output line-to-line and line-to-ground short circuit withstand during continuous operation and limits dv/dt effects on the motor
- Completely transistorized inverter section
- Complete testing; all circuit boards are functionally tested under cycled temperature, then the completed assembly is tested at full load for 24 hours
- Top or bottom cable entry



**Standard Protective Features**
- Able to withstand output line-to-line and line-to-ground short circuits without component failure
- Electronic ground fault protection
- Output phase loss protection
- Input phase loss protection
- Overvoltage protection
- Overfrequency protection
- Overtemperature protection
- Electronic motor overload relay
- Drive overload protection

**Accutrol 700 Standard Control Features**
- Digital control via keypad with lockout
- Current controlled PWM output
- "Vector torque control" encoderless flux vector control system
- Bi-directional coasting motor start with anti-windmill protection allowing starting into a reverse spinning motor
- Trip contact
- Carrier frequency adjustment
- Slip compensation
- Dc brake
- Three levels of password protection
- Jog and thread speeds
- Linear or S curve acceleration

**Control Features Continued**
- Parameter tuning
- Stall prevention
- 120 Vac control compatible
- Automatic restart
- Isolated process follow inputs
- Process control output
- Local and remote control
- Electronic reversing
- 7 preset speeds plus independent jog and thread speeds
- 3 critical speed lockouts

# Accutrol 700 Adjustable Frequency Motor Control

## Accutrol 700 Digital Operator Station


### Standard Keypad Features

The Accutrol 700 keypad represents the most operator friendly control station available in Ac motor speed control.

- Two line 40 character vacuum fluorescent display is superior to LED and LCD displays and eliminates the need for deciphering codes
- Status LEDs indicate operational mode, drive ready, up to speed, run, alarm, and fault conditions
- "Start control" selects location of start stop command from hand to auto
- "Speed control" selects location of drive speed control from local to remote
- Start, stop and reset provide local control and fault/alarm acknowledgment
- F1 and F2 button can be configured to individual job requirements
- Keypad lockout feature prevents unauthorized access to drive control parameters.



### Monitoring Display

The Accutrol 700 has the most extensive monitoring capability available. Two monitored values may be viewed simultaneously. Monitored values include:

- Input volts (3 phases)
- Input current (3 phases)
- Kilowatts
- Output volts (3 phases)
- Output current (3 phases)
- Output frequency, RPM, % speed
- Elapsed time meter
- Trip log
- Drive temperature
- Date and time



### Trip Messages

- Drive overload
- Overtemperature
- Undervoltage
- Overvoltage
- Overfrequency
- Fault phase A, B, or C
- Ground fault
- Motor overload relay
- Output phase loss A, B, or C
- Input phase loss A, B, or C

### Alarm Messages

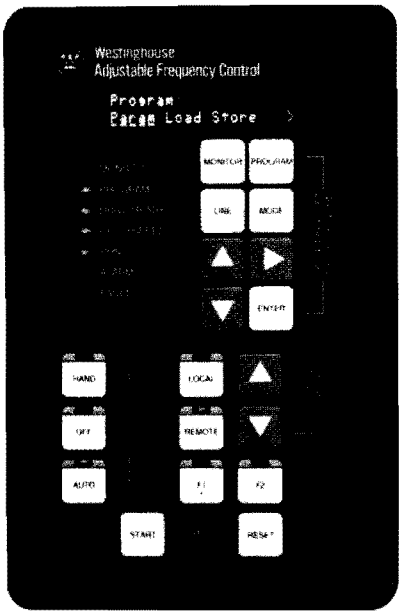
- Torque limit
- Decel limit
- Drive overloaded
- Regenerating
- Low battery
- Dead battery

# Accutrol 700 Adjustable Frequency Motor Control

## Accutrol 700 Programming Operation

### Accutrol 700 Programmable Parameters

The Accutrol 700 programmable parameters are preset at the factory to provide complete functionality under typical operating conditions. An operator would select hand or auto start control and select local or remote speed control by depressing the associated button on the digital operator keypad and the drive is ready to operate.




### Programmable Parameters

The Accutrol 700 may be customized to meet the requirements of many specific applications through the programming of over 40 drive parameters. The Accutrol 700 offers the user 3 different programming modes selectable by the "Mode" key. Programmable parameters include:

- Date
- Time
- Process follow calibration
- Acceleration rate
- Deceleration rate
- Acceleration pattern
- Electronic overload relay
- Automatic restart
- Torque limit
- Jog speed
- Thread speed
- 7 preset speeds
- 3 jump speeds (to avoid resonant speeds)
- Volts/Hertz
- Dc brake
- Slip compensation
- 3 levels of password protection
- Keypad lockout password

### Options

- Communications
- PID/setpoint

### Parameter Programming Modes

### Parameter Programming Mode

The operator may change any parameter while the drive is running or idle. The new parameter will be activated after the enter key has been depressed.

### Parameter Tuning Mode

Should an operator desire to fine tune a particular drive parameter the Accutrol 700 provides a parameter tuning mode. In this mode changes in the drive parameter are made immediately without depressing the enter key. This will allow process follower, setpoint PID loops and other drive parameters calibrated with immediate feedback from the drive and motor system.

### Default Mode

From any parameter location the operator may depress the mode key to review the factory default setting of that particular parameter. Should the operator desire the factory setting will be activated for that parameter by depressing the enter key. A global factory default function is available should an operator desire to reset all parameters to factory settings.

## Diagnostics and Communications

### Trip Log (Standard)

The Accutrol 700 continually monitors and updates all vital control functions. All trips and alarms are displayed on the keypad in English. The Accutrol 700 will store a minimum of the last 5 trip events along with the time, date, cause of trip, reset status, and input and output phase failure indication.

### Historical Data Record Option

In addition to the trip log the Accutrol 700 will record over 120 items of important drive status and electrical system information preceding the most recent trip. This "Historical Data", available via the optional serial communications link, provides valuable information required to determine the drive component or electrical system condition that caused the trip.

- Logs a complete set of historical data every several milliseconds for 10 seconds preceding the last trip.
- Provides an unsurpassed level of diagnostic information.

(Optional Westinghouse Data Card)

### Westinghouse Data Card Features

- Saving Accutrol 700 set-up data
- Down-loading new Accutrol 700 set-up data
- Logging historical data
- Extends trip log and historical data log storage capability.

### Accutrol 700 Communications Option

The Accutrol 700 provides a serial link communications capability that allows easy access to all drive monitoring, diagnostic capabilities. Communication features include:

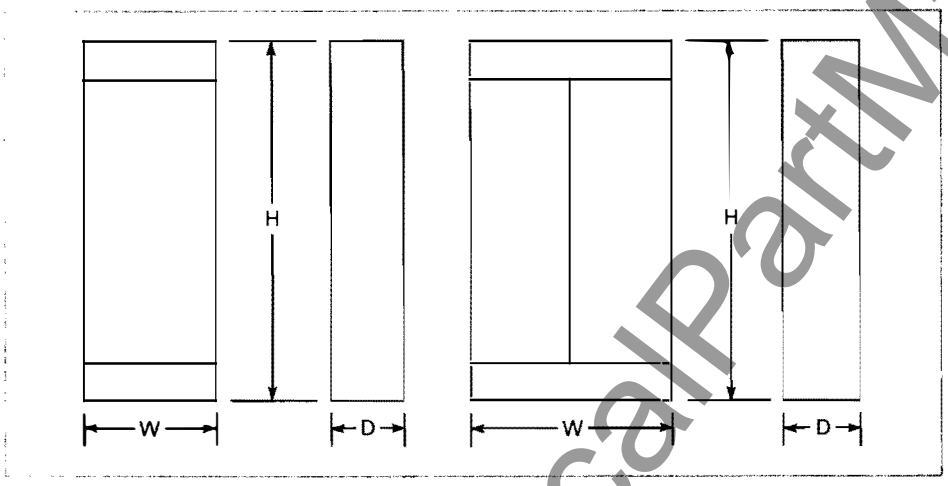
- Remote monitoring
- Remote drive programming
- Historical data logging
- Westinghouse IMPACC system communications
- Modbus protocol
- Modem communication
- Printer protocol
- RS-232C, RS-422, or RS-485

# Accutrol 700 Adjustable Frequency Motor Control

**Accutrol 700 Ratings Δ**

| Hp (VT) Variable Torque | Hp (CT) Constant Torque | Catalog # | Continuous Amps | One Minute Amps |
|---|---|---|---|---|
| 100 | 75 | A71001 | 124 | 144 |
| 125 | | A71251 | 156 | 172 |
| 150 | 100 | A71501 | 180 | 198 |
| 200 | 150 | A72001 | 240 | 270 |
| 250 | | A72501 | 300 | 330 |
| 300 | 200 | A73001 | 360 | 396 |
| 350 | 250 | A73501 | 420 | 462 |
| 400 | 300 | A74001 | 480 | 559 |
| 500 | 400 | A75001 | 600 | 720 |

Δ Based on NEMA B 4 and 6 pole motors




**Approximate Mounting Dimensions**

| Catalog Number | Enclosure | Inches W | D | H | Approx. Weight Lbs. |
|---|---|---|---|---|---|
| A71001 – A71501 | NEMA 1 | 32 | 21 | 90 | 800 |
| A72001 – A72501① | NEMA 12 vent. | 56 | 21 | 90 | 2000 |
| A73001 – A75001① | NEMA 12 vent. | 60 | 21 | 90 | 4000 |

①NEMA 12 ventilated enclosures isolate cooling air from main cabinet housing electronics.

## Standard Conditions for Application and Services

Humidity: 0 to 95% noncondensing and noncorrosive
Altitude: to 3300 feet (1000 meters)
Ambient Temperature: 0 to 40°C
Ac Incoming Line (Nominal): 480 volts, three phase, 60 Hz; 380 volts, three phase, 50 Hz
Ac Incoming Line Variation: +10% −10%
Ac Line Frequency Variation: +/− 2 Hz
Input Short Circuit Interruption Rating:
Input Breaker: 65,000 amps (optional)
Input Fuses: 200,000 amps
Drive Service Factor: 1.0
Overload Capability: 110% of continuous rating for 60 seconds (150% for constant torque ratings)
Recommended Motor Design
Service Factor: 1.15
High Efficiency

**Ratings**
- 100 to 500 Hp, 460 volt variable torque
- 75 to 400 Hp, 460 volt constant torque
- 75 to 400 Hp, 380 volt variable torque
- 60 to 350 Hp, 380 volt constant torque
- .95 or better displacement power factor at all speeds
- 97% minimum efficiency at full speed and load

**Control Specifications**
- PWM, current controlled
- Sine coded output wave form
- "Vector torque control" torque optimization
- Digital control and data entry
- 0.5% speed regulation with slip compensation

**Standard I/O**
- 2 analog inputs
- 4 analog outputs
- 16 digital inputs
- 6 digital outputs

**Accutrol 700 Optional Features**
- Dynamic brake
- PID/set-point control
- Communications
- Westinghouse data card
- Motor control center mounting
- "Clean power" low harmonic (meets IEEE 519)
- Full energy recovery regeneration
- Electric and solid state bypass
- Line reactor
- 3 to 15 psig process input
- Remote keypad
- Isolation transformer
- Output contactor

# Accutrol 700 Adjustable Frequency Motor Control

## Typical Specification

**Adjustable Frequency Ac Controllers**
(460 Volt 100-500 Hp variable torque)
(75-400 Hp constant torque)

**Scope**
This section describes the Adjustable Frequency Controllers (AFC's) 100 Hp and above to be used in conjunction with the equipment as described in this section and as detailed on the applicable drawings.

The controllers with all options shall be built in compliance with the latest standards of ANSI, IEEE, NEMA and the National Electric Code.

**Construction**
The AFC will be of the Pulse Width Modulated design converting the fixed utility voltage and frequency to a variable voltage and frequency output via a two step operation. AFC's utilizing a third power section are not acceptable. Adjustable Voltage and Current Source AFC's are not acceptable. Transistors shall be used in the inverter section. GTO's and SCR's are not acceptable.

The AFC will be current regulated. AFC's permitting instantaneous overcurrent trips other than an output short circuit are not acceptable.

All AFC's 100 Hp and above will utilize a vector torque control strategy to regulate motor flux to optimize motor torque without the need for encoders. AFC's requiring voltage, dwell and current adjustments to achieve improved torque are not acceptable.

The AFC's will be capable of operating any NEMA B squirrel cage induction motor with a load rating within the capacity of the AFC.

The AFC will limit harmonic distortion reflected onto the installation distribution system to a voltage and current distortion level as defined by IEEE 519 for general system applications. Harmonic attenuation will be provided by the addition of drive line reactance or multi-converter phase shifting arrangement. Tuned harmonic filters are not acceptable. Harmonic calculations shall be provided upon request.

Efficiency shall exceed 97% at 100% speed and load and efficiency shall exceed 90% at 50% speed and load.

Line side displacement power factor shall exceed (0.95) regardless of speed and load.

The AFC shall be rated for 110% overload current for one minute for variable torque loads, 150% for constant torque loads.

**Enclosure**
AFC's from 100 to 150 Hp shall be housed in a NEMA 1 enclosure. AFC's 200 Hp and above shall be housed in a NEMA 12 ventilated enclosure isolating cooling air from the main cabinet containing drive electronics.

Standard operating conditions shall be:

a) Incoming three phase 480 volt Ac power, +/− 10%, 60 Hz +/− 2 Hz.
b) Humidity 0 to 95% (noncondensing and noncorrosive).
c) Altitude 0 to 3,300 feet above sea level.
d) Ambient temperature 0 to 40 degrees C.

AFC's shall include the following system interfaces:

a) Two isolated process control speed reference interface to receive an isolated 0-10 volts Dc or 4-20 ma Dc signal. Four analog output signals 0-10 volts Dc for external metering.
b) Run relay with an isolated set of form C contacts.
c) Dedicated terminal blocks for interface with remote start contact and remote safety trips.
d) 120 volt control to allow AFC to interface with remote contacts at a distance up to 500 feet and with three wire control.
e) The AFC will include serial communications. All AFC parameter programming, monitoring and diagnostic functions shall be available via this serial link. MODBUS protocol shall be provided to allow direct communications with existing programmable logic controllers. The AFC shall be addressable should more than one AFC occupy the same serial network. (optional)
f) PID/set-point control will be provided and programmable via the digital keypad. Proportional, integral and derivative gains shall be tunable while the drive is running. (optional)
g) The AFC shall directly interface to IMPACC communications monitoring and control network. (optional)
h) 40 character vacuum fluorescent display indicating monitored and drive diagnostic information in English language. Coded messages are not acceptable.
i) A dry contact output to indicate protective trip-out (open on trip).

Control operator devices to be mounted on the front door of the AFC will be digital speed control keypad, hand-off-auto start control selector (with LED status indication), and a local-remote speed control selector (with LED status indication).

LED or indicating lights will be provided to indicate run, fault, alarm, up to speed and drive ready status.

Metered data to be displayed on the front door of the AFC will be, 3 phase input and output voltage and current, output frequency, kilowatts, drive temperature, time, date, elapsed time, and motor rpm.

All AFC programmable parameters will be adjustable from a digital operator keypad located on the front door of the AFC.

Parameters shall include:

a) Programmable maximum and minimum run frequency, and acceleration and deceleration times.
b) Selectable carrier frequencies, V/Hz, and critical frequency avoidance lockout.
c) Adjustable electronic overload, and torque limit levels.
d) Multiple attempt restart.
e) Jog, thread and 7 preset speeds.
f) Keypad lockout and factory default overrides.

Standard adjustments shall include "parameter tuning" function allowing the following variables to be adjusted while running: Input reference signal calibration, PWM carrier frequency, acceleration time, deceleration time and critical frequency avoidance.

**Features**
The AFC will include the following protective features:

a) Input circuit breaker door interlocked and padlockable. (optional)
b) Speed compensated electronic motor overload relay.
c) Undervoltage protection.
d) Overfrequency protection.
e) Overtemperature protection.
f) Ground fault protection.
g) Input and output phase loss protection.
h) Dc bus overvoltage protection.
i) Able to withstand output line-to-line and line-to-ground short circuits without component failure.
j) Surge protection from Ac line transients.
k) The AFC will incorporate stall prevent techniques adjusting output volts and frequency to avoid overload conditions during acceleration, deceleration and continuous operation.

The AFC will have the ability to start into a spinning motor. The AFC will be able to determine the motor speed in any direction and resume operation without tripping.

**Service and Testing**
Each AFC shall undergo a minimum 24 hour factory burn-in test. The AFC's shall be burned in at 100% inductive or motor load for 24 hours without an unscheduled shutdown. Copies of factory test report will be available with final drawings upon request.

The manufacturer shall provide a start-up service package for all AFC's provided. Service shall include inspection, final adjustment, operational checks, and a final report for record purposes. The service shall be performed by local factory trained service engineers. The service center must be permanently located within 250 miles of the jobsite.

**Acceptable Manufacturers**
Adjustable Frequency Controllers are specified on the basis of Westinghouse Accutrol product line for function and quality. All AFC's shall be of the same manufacturer.

# Accutrol 700 Adjustable Frequency Ac Motor Control

## Reasons for Choosing Westinghouse

| | |
|---|---|
| • UL Label① | Nationally recognized testing laboratory ensures safety for operating personnel. |
| • .95 Power Factor | Westinghouse Accutrol 700 provides a .95 displacement power factor throughout entire speed range. |
| • 120 Volt Control Power | Interface with remote operator stations is safe and simple regardless of distance. |
| • Efficiency | 97% full load efficiency allows greater energy savings on all applications. |
| • Enclosures | NEMA 1 and NEMA 12 ventilated enclosures are available depending on ratings |
| • Line Fuses | As standard, incoming line power fuses (current limiting type) are included to protect the power electronics. |
| • Extensive Options | Wide array of pre-engineered modifications allow the Accutrol 700 to be tailor-made for each application. |
| • Line Reactors | Available mounted inside the Accutrol 700 enclosure to reduce sensitivity to line unbalance and transients and also reduce harmonic line distortion. |
| • Interfacing Flexibility | Control connections include provisions for various permissive contacts and allow multiple combinations of operator controls. |
| • Westinghouse Circuit Breaker | Optional feature provides drive input disconnect and protection. |
| • Digital Keypad | Provides complete access to all drive set-up parameters. No pot adjustments are required. |
| • Diagnostics and Communications | All trip and alarm conditions are displayed in English. A trip log and a historical log are collected. All data is available remotely via serial communication. |
| • Quality Assurance | All components and circuits are 100% tested, completed units undergo a 24 hour burn-in test to provide the most reliable unit possible. |
| • Start-up Service | Westinghouse Service Engineers inspect and adjust units to allow worry free start-ups. |
| • Experience | From the internal Westinghouse contactors and breakers used within the units to incorporating the controllers into a motor control center line up and supplying your total electrical distribution system, Westinghouse has the capabilities to meet your needs. |

● Applied for

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