Variable Frequency Drive (VFD)
FP605 Mechanical Specification Submittal
Flange (IP55/UL Type 12 backside) Drives

GENERAL

The FP605 is an industrial fan and pump PWM (pulse-width-modulated) AC drive. Three-phase input line power is converted to a sine-coded, variable frequency output, which provides optimum speed control of any conventional squirrel cage induction motor, permanent magnet motor, or synchronous reluctance motor. The use of IGBTs (Insulated Gate Bipolar Transistors), with a carrier frequency range of 2 kHz to 12.5 kHz, permits quiet motor operation.

This drive has one control logic board for all horsepower ratings. Printed circuit boards employ surface-mount technology, providing both high reliability, and small physical size of the printed circuit assemblies. The microprocessor delivers the computing power necessary for complete three-phase motor control in industrial applications.

Operating Principle: Input three-phase AC line voltage is first rectified to a fixed DC voltage. Using pulse width modulation (PWM) inverter technology, the DC voltage is processed, to produce an output waveform in a series of variable-width pulses. Unique firmware algorithms optimize motor magnetization through control of voltage, current, and frequency applied to generate a nearly sinusoidal output waveform.

STANDARDS

UL 508C (Power Conversion)
CSA 22.2 No. 274 (Adjustable Speed Drives)
UL 1995 (Plenum)
EN 61800-3
EN ISO 13849-1
EN IEC 62061
EN IEC 61800-5-1, -5-2
EN IEC 63000
EN IEC 61508-1, -2
EN IEC 61326-3-1
EN IEC 61000-6-7
RCM/ACMA: EN 55011
IEC 60529
IEEE C62.41
IBC
HCAI (OSHPD)
NFPA 70
NEMA ICS 7.1-2014
IEC 60146-1-1
UL, cUL listed, CE, RCM, TUV marked

ENVIRONMENTAL & SERVICE CONDITIONS

Flange (UL Type 12 backside) drives are intended for mounting inside separate Type 12 enclosures with heatsink external, when the external environment is dirty or dusty. No additional adapters required.

Ambient service temperature: -10°C to 50°C, 60°C maximum with derate

Ambient storage temperature: -20°C to 70°C

Humidity: 0% to 95%, non-condensing

Altitude: to 1,000 meters; 4,000 meters with derate

Service factor: 1.0

Vibration: 9.81 m/s² (1 G) maximum at 10 to 20 Hz, 2.0 m/s² (0.2 G) at 20 Hz to 55 Hz

Conformal coating: IEC 60721-3-3, 3C2, 3S2

RoHS 2 Compliant

WEEE Directive

QUALITY ASSURANCE

In-circuit testing of all printed circuit boards is conducted to ensure proper manufacturing

Final printed circuit board assemblies are functionally tested via computerized test equipment

All fully assembled controls are computer tested with induction motor loads to assure unit specifications are met

The average MTBF (Mean Time Between Failure) is 28 years

CONSTRUCTION

Input section of the VFD - VFD power input stage converts three-phase AC line power into a fixed DC voltage via a solid-state full-wave diode rectifier with MOV (Metal Oxide Varistor) surge protection. An internal 3% DC choke on positive side of the DC bus reduces harmonics for cleaner power and power line transient protection.

Intermediate section of the VFD - DC bus maintains a fixed DC voltage with filtering and short circuit protection as a DC supply to the VFD output section. It is interfaced with the

VFD diagnostic logic circuit to continuously monitor and protect the power components.

POWER AND CONTROL ELECTRONIC HOUSINGS

Flange (IP55/UL Type 12 backside) drives: 208 V/240 V, 75 through 150 HP; 480 V, 150 through 600 HP

Microprocessor-based control circuit

Non-volatile memory (EEPROM): all programming memory is saved when the VFD is disconnected from power

Digital operator keypad and display provide local control and readout capability:

- Local/Remote/Start/Stop commands
- Speed Reference command
- Reset command

10-year designed heatsink cooling fan with programmable on/off/temperature control.

USB Mini-B port for quick and easy PC connection or any USB On-the-Go device

PROTECTION

Suitable for use on a circuit capable of delivering not more than 100kA RMS symmetrical amperes

Output current overload rating of 110% for 60 seconds, 140% for 2 seconds, 175% instantaneous

Output short circuit protection

Current limited stall prevention (overload trip prevention) during acceleration, deceleration, and run conditions

Optically isolated operator controls

Fault display with fault storage (10 most recent faults) and fault trace history

"Hunting" prevention logic

Restart after momentary power loss

Electronic ground fault protection

Electronic motor overload/overtemperature protection (UL approved) with thermal memory selection

Electronic motor overload relay protects the motor while in operation

Proof of flow/loss of flow detection

DC bus charge indication

Output section of the VFD - Insulated Gate Bipolar Transistors (IGBTs) convert DC bus voltage to a variable frequency and voltage, utilizing a PWM sine-coded output to the motor.

Heatsink overtemperature with speed fold-back feature

Cooling fan operating hours recorded

Input/output phase loss protection

Overtorque/undertorque detection

Reverse prohibit selectable

Multiple emergency override modes for continuous no fault operation

OPERATION

PI control, output frequency and speed display can be programmed for other speed-related and control indications, including: RPM, CFM, GPM, PSI, in WC, % of maximum RPM, or custom

Pump status display capability:

- System pressure setpoint
- Control operation status
- Pump motor output frequency
- Transducer feedback
- Drive status monitors
- Drive lifetime monitors

Power loss ride-through (2 seconds capable)

VFD accepts either a direct acting or a reverse acting speed command signal.

Bi-directional "Speed Search" capability to start into a rotating load. Two types: current detection and residual voltage detection

DC injection braking, to prevent fan "windmilling"

Remote Run/Stop command input

Eight programmable multi-function input terminals (24 VDC) providing 60+ programmable features

Three programmable 0 to 10 VDC or 4-20 ma analog inputs: functions including frequency reference, PID setpoint, PID feedback, PTC motor temperature and others

Two programmable 0 to 10 VDC or 4-20 ma analog outputs: proportional to drive monitor functions including output frequency, output current, output power, PI feedback, output voltage and others

Three programmable multi-function output relays: Form A rated 2 A @ 250 VAC & 30 VDC providing 50+ functions

One fixed “Fault” Form C output relay: Rated 2 A @ 250 VAC & 30 VDC

Eight programmable application presets

8-Line, 32-character Local-Remote LCD display provides readout functions that include output frequency, output
User parameter initialization to re-establish project specific parameters

Automatic parameter backup with selectable time intervals

Ramp-to-stop, coast-to-stop, DC injection braking-to-stop or coast-to-stop with timer selection

Auto restart capability: 0 to 10 attempts with adjustable delay time between attempts

One custom selectable Volts/Hertz pattern and multiple preset Volts/Hertz patterns

Frequency reference input signal, adjustable for bias and gain

While the VFD is running, operational changes in control and display functions are possible, including:

Acceleration time: 0 to 6000 seconds
Deceleration time: 0 to 6000 seconds
Frequency reference command
Monitor display

Automatic energy saving optimizer, reduced voltage operation

PRODUCT FEATURES

VFD efficiency: 96% at half-speed; 98% at full-speed

Controlled speed range of 40:1

Maximum output frequency: 400 Hz

Functional safety: Safe Torque Off (SIL3, Cat.3, PLe)

140% starting torque capability, available from 3 Hz to 60 Hz

Displacement power factor of .98 throughout the motor speed range

Remote speed reference (speed command) signal:

0 to 10 VDC (20 kΩ)
4 to 20 mA DC (250 Ω)

24 VDC, 150 mA transmitter power supply

Data logging – record status for up to 10 monitors with adjustable sample time

Built-In real time clock for time and date stamping events

Custom monitors (up to 12 monitors) with bar graph, analog gauge, and trend plot display functions

Two internal (PI) controls

voltage, output current, output power, DC bus voltage, interface terminal status, PI feedback and fault status

Over 100 programmable functions resettable to factory presets

Drive internal PI closed-loop control with selectable engineering units

Independent PI control for use with external device

Feedback signal low pass filter

Feedback signal loss detection and selectable response strategy

Feedback signal inverse and square root capability

Input and output terminal status indication

Diagnostic fault indication

“S-curve” soft start / soft stop capability

Serial communication loss detection and selectable response strategy

“Up/Down” floating point control capability

Critical frequency rejection capability: three selectable, adjustable bandwidths

Analog/Digital Virtual I/O – internally sends an output to an input (no wiring needed)

Adjustable carrier frequency, from 2 kHz to 12.5 kHz

Dynamic noise control for quiet motor operation

Programmable security code

Cloud service (Yaskawa Drive Cloud) for product registration and parameter storage

Store up to four additional parameter sets in keypad

16 preset speeds

Built-in Modbus RTU communications

Optional network communications include:

- EtherNet/IP
- EtherNet/IP dual port
- EtherCAT
- Modbus/TCP
- Modbus/TCP dual port
- PROFINET RT dual port
- PROFIBUS-DP
- DeviceNet
- LonWorks
- BACnet MSTP

- APOGEE/METASYS
- CANopen
- CC-Link
- MECHATROLINK II
- MECHATROLINK III

Rotational as well as Stationary motor auto-tuning

"High Slip Braking" (HSB) function stops the motor in up to half the time it would take without this function

Control Methods Include:
V/F Control
Enhanced PM Motor control
SynRM Motor Control

Motor Types:
Induction
Permanent Magnet
Synchronous Reluctance

LCD Local/Remote keypad with copy keypad capability

Motor preheat function

Self-regulating lead/lag control for multiple drives (up to 5 fans or pumps)

Drive/motor alternation control (share motor run time for lead drive/motor)

Up to four PID setpoints

Enhance pump control features:

Easy sleep/wakeup PID setup
No flow/deadhead protection
Submersible motor thrust bearing control
Automatic system restart
Sleep boost
Low and high pressure feedback detection
Power loss utility start delay timer
Loss of prime (LOP)/pump dry-run protection
Pre-charge control (controlled pipe fill)
Optional dual transducer feedback for redundancy
Impeller de-scaling/de-ragging control

Low city, low/high water alarm digital input selections

Draw down start level selection for PID setpoint

Contactor Multiplexing features:

Stage/de-stage control – add/remove pump based on feedback or output frequency
Speed reduction after lag pump staging
Setpoint boost after de-staging
Hard current limit
Back spin timer

Flash upgradeable firmware

Programming and firmware upgrade without three-phase main power

DriveWizard Mobile App (Bluetooth or USB-on-the-Go)

DriveWizard Mobile application programming

LED Status Ring