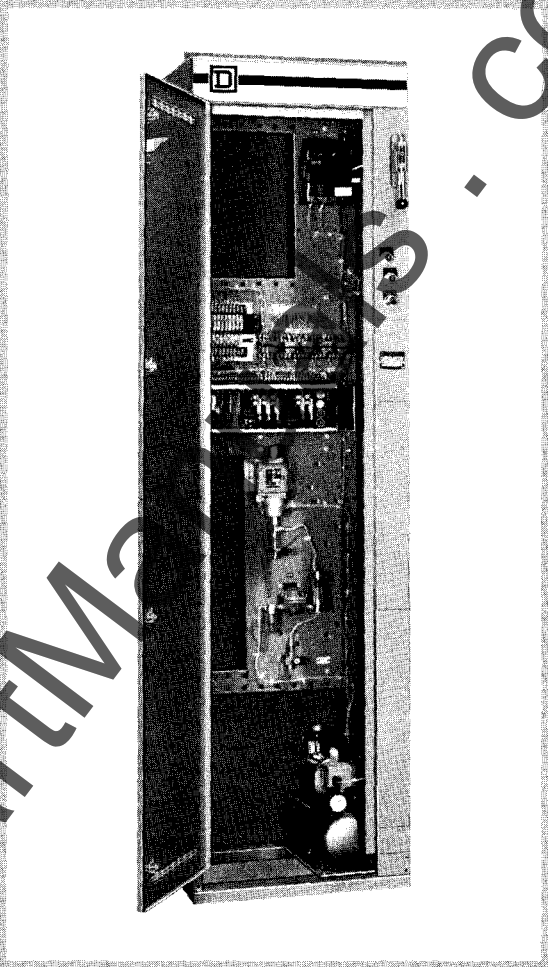


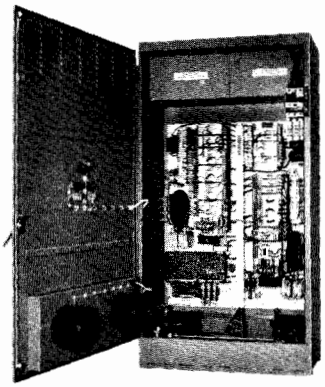
Director Automatic Speed Reference And Sequence Controller

CONTENTS

AC ADJUSTABLE SPEED CONTROL SYSTEMS
SELECTION GUIDE

AC adjustable speed control systems are coordinated solid state ac adjustable speed controllers for all variable torque loads and with proper application, many constant torque and constant horsepower loads. These systems consist of: Class 8807 or Class 8808 adjustable speed controllers and Class 8809 director automatic speed reference and sequence controls.

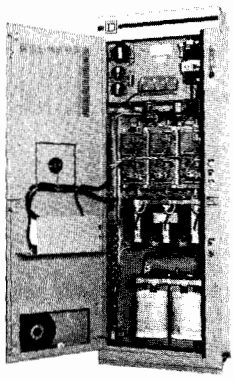
CONTROL SYSTEMS



Class 8807 OMEGAPAK™ Adjustable Frequency Controller

- 6 to 60 Hertz or 12 to 120 Hertz Speed Range Capability
- Current Source Design
- Stepless Speed Control
- Control for Standard NEMA B Design Squirrel Cage Motors
- High Efficiency
- MCC Construction

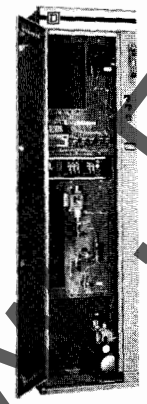
Refer to Class 8807 Catalog



Class 8808 ECONOPAK™ Slip Power Recovery Controller

- 230V, 460V, 575V, 2300V and 4160V Primary Voltage
- 50% and 100% Speed Range Adjustable Speed Controllers
- Simplex and Duplex Adjustable Speed Control
- Stepless Speed Control
- Control for Wound Rotor Motors
- High Efficiency
- MCC Construction

Refer to Class 8808 Catalog



Class 8809 Director Solid State Automatic Speed Reference Controller

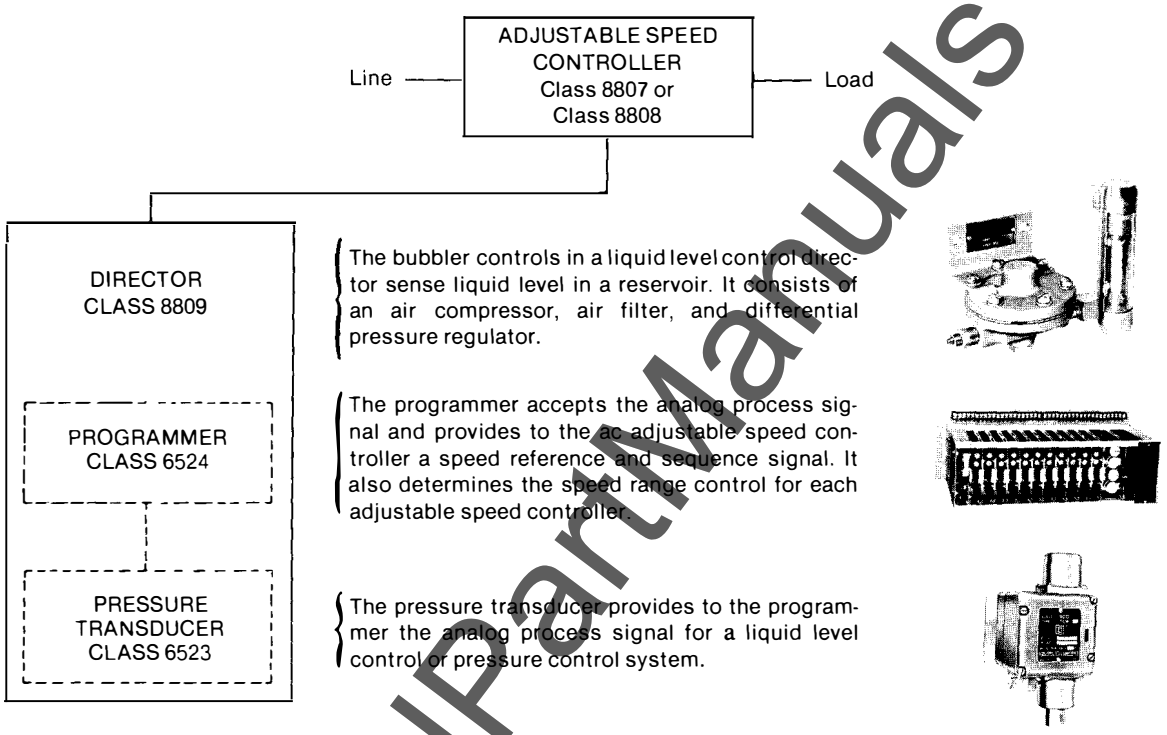
- Simplex and Duplex Solid State Level, Pressure, Flow, or Temperature Control
- Programs Adjustable and Constant Speed AC Adjustable Speed Motors
- MCC Construction

Refer to Class 8809 Catalog

CLASS 8809

DIRECTOR
AUTOMATIC SPEED REFERENCE AND SEQUENCE CONTROLLER
FOR AC ADJUSTABLE SPEED CONTROL SYSTEMS

Class 8809 director automatic speed reference and sequence controller is for use with ac adjustable speed control systems. The Class 8809 director is most frequently applied in liquid level control or hydraulic pressure control, but is readily adaptable to flow or temperature control.



PRICING INSTRUCTIONS

1. ADJUSTABLE SPEED CONTROLLERS — Refer to the appropriate Class 8807 or Class 8808 catalog sheets when adjustable speed controllers are specified.
2. DIRECTOR CONTROLS — Determine if level, pressure flow, temperature or other is to be automatically controlled. Refer to the Class 8809 catalog.
3. BUBBLER CONTROLS — Refer to the Class 8809 liquid level director catalog to determine price and standard features. Include any additions or modifications.
4. PROGRAMMER — All basic automatic speed reference directors include one Class 6524 programmer, less sequencing and speed programming cards. Only one programmer is required for any automatic speed referenced ac adjustable speed control system. Include from additions and modifications table one sequencing card (item 14) for each constant speed motor and/or alarm circuit and one speed programming card (item 13) for each adjustable speed motor. Include any other appropriate addition or modification.
5. PRESSURE TRANSDUCER — Included in the basic liquid level and pressure director system price. Refer to Class 6523 in the Class 6520 catalog to determine type number for the desired operating range. For additional reliability, a standby pressure transducer may be included from the additions and modifications table.

ORDERING INFORMATION REQUIRED

A. Liquid Level Control Director
   1. Wet Well Area In Square Feet
   2. Control Level Range In Feet
   3. Bottom Of Wet Well Elevation In Feet
   4. Bottom Of Bubbler Pipe Elevation In Feet
   5. Station System Curves
   6. Station Pump Performance Curves
   7. Pump Operating Elevations In Feet

B. Pressure Control Director
   1. Control Pressure Range
   2. Station System Curve
   3. Station Pump Performance Curves
   4. Pump Operating Pressures

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DIRECTOR
AUTOMATIC SPEED REFERENCE AND SEQUENCE CONTROLLER
PRICING INFORMATION

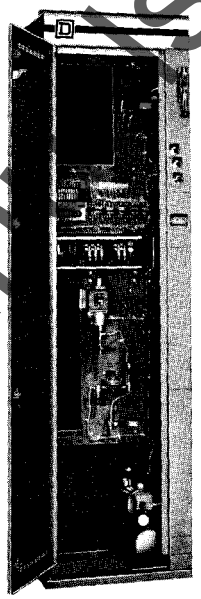
LIQUID LEVEL CONTROL

The bubbler controls are used to sense liquid level in a reservoir. A differential pressure regulator provides a constant flow of air, approximately 1 to 2 cubic feet per hour, through a bubbler pipe extended to near the bottom of the reservoir. The pressure in the pipe is proportional to the height of the liquid above the bottom of the bubbler pipe and is sensed and converted to an electrical signal by the pressure transducer. The signal from the pressure transducer is fed to the programmer which contains the sequencing cards for the various pumps, alarms, etc.

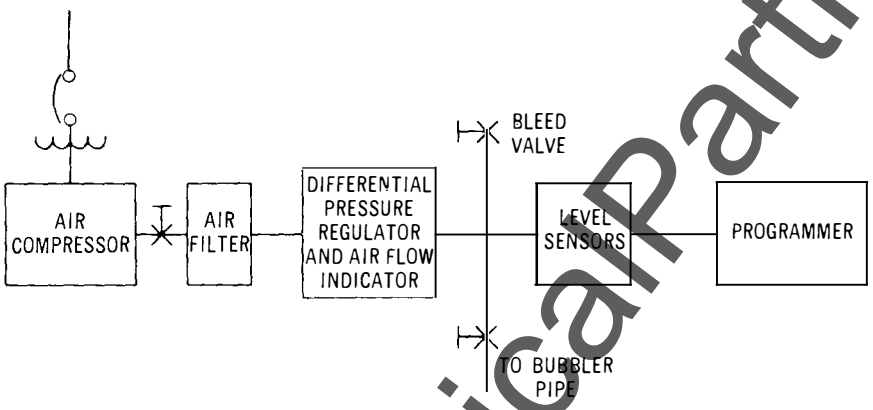
Basic liquid level control pump director includes:

- 1 — 1/12 horsepower air compressor with a two gallon storage tank, pressure gauge, and pressure switch
- 1 — Air filter
- 1 — Differential pressure regulator with air flow indicator
- 1 — Bleed valve for calibration
- 2 — Hand valves
- 1 — Control circuit transformer
- 1 — Circuit breaker with external flange mounted operator
- 1 — Class 6523 pressure transducer
- 1 — Class 6524 programmer* with IM and power supply card
- 1 — Door mounted level gauge, 4½ ″ diameter

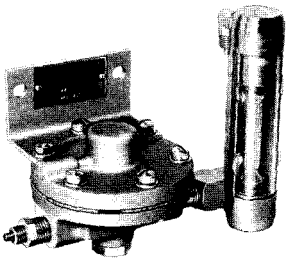
*Programmer does not include any sequencing or speed programming cards.



Class 8809 Type DLP-1
Liquid Level Control Director
NEMA 1 Enclosure



Basic Bubbler Control



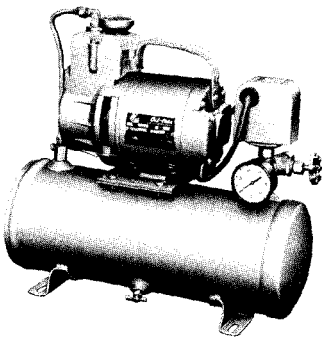
Differential Pressure Regulator
and Air Flow Indicator

Basic Liquid Level Director for Proportional Control			
Type	NEMA 1 Motor Control Center Without Bus*	Type	NEMA 1 Wall Mounted Enclosure►*
DLP-1	**$3832.**	DLP-2	**$3392.**

Basic Liquid Level Director for Integral Control			
Type	NEMA 1 Motor Control Center Without Bus*	Type	NEMA 1 Wall Mounted Enclosure►*
DLI-1	**$3917.**	DLI-2	**$3477.**

► Air compressor with two gallon storage tank separately mounted by purchaser.

* The basic liquid level control programmer does not include any sequencing or speed programming cards. Refer to pricing instructions.



Air Compressor

CLASS 8809

DIRECTOR
AUTOMATIC SPEED REFERENCE AND SEQUENCE CONTROLLER
PRICING INFORMATION AND MODIFICATIONS

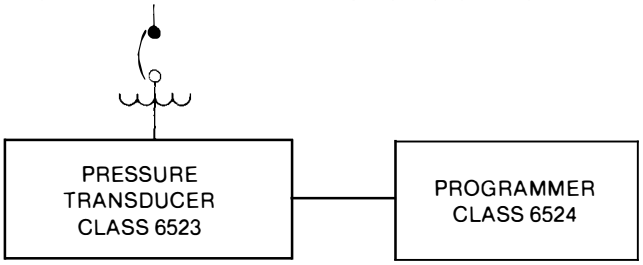
PRESSURE CONTROL

The pressure transducer is used directly on the pump discharge line to sense hydraulic pressure. The pressure transducer converts the discharge pressure into an electrical signal. The signal from the pressure transducer is fed to the programmer which contains the speed programming and sequencing cards for the various pumps, alarms, etc.

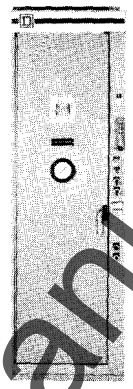
Basic pressure control pump director includes:

1 — Control circuit transformer
1 — Circuit breaker with external flange mounted operator
1 — Class 6523 pressure transducer
1 — Class 6524 programmer* with IM and power supply card

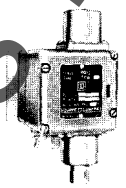
*Programmer does not include any sequencing or speed programming cards.



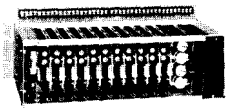
Basic Pressure Control



Class 8809 Type DPI-1
Pressure Control Director
NEMA 1 Enclosure



Class 6523 Type TCW-32
Pressure Transducer



Class 6524 Type PGR-2
Programmer

Basic Pressure Director for Integral Control			
Type	NEMA 1 Motor Control Center Without Bus*	Type	NEMA 1 Wall Mounted Enclosure*
DPI-1	**$3402.**	DPI-2	**$2962.**

*The basic pressure control programmer does not include any sequencing or speed programming cards. Refer to pricing instructions.

ADDITIONS AND MODIFICATIONS

Item	Description	Price
	BUBBLER CONTROL MODIFICATIONS	
1	Pressure reducer regulator when external air source exceeds 100 psi.	**$ 122.**
2	Each additional hand valve	**72.**
3	Each Class 9012 pressure switch	**143.**
4	Three way solenoid valve	**152.**
5	Omission of 1/12 horsepower air compressor. Deduct	**515.**
6	Replace 1/12 horsepower compressor with a ¼ horsepower compressor and 2 gallon storage tank.	**158.**
7	Standby 1/12 horsepower compressor with 2 gallon storage tank and automatic transfer on failure of main compressor. Include Item 10 if alarm circuit is required.	**770.**
8	Standby compressor, 1/12 horsepower with 2 gallon storage tank and automatic transfer on failure of main compressor—time clock alternation with main compressor. Include Item 10 if alarm circuit required.	**1240.**
9	Emergency air supply tank with approximately 5 days capacity and automatic transfer on failure of compressor or plant air system. Include Item 10 if alarm circuit is required.	**925.**
	CONTROL CIRCUIT MODIFICATIONS	
10	Audible alarm, indicating light, silencer and reset, push buttons to indicate loss of air pressure or other specified malfunctions.	**327.**
11	Manual purge control, includes door mounted push button, timing relay and necessary solenoid valves.	**620.**
12	Timed automatic purge control includes sequence timer, timing relay and necessary solenoid valves.	**775.**
13	Each SP card for adjustable speed programming: Class 6524 type PC-1 without acceleration time control. Class 6524 type PC-2 with acceleration time control.	**294.**† **317.**†
14	Each SQ card for ON-OFF sequencing: Class 6524 type PC-3.	**162.**†
15	Variable set point added to programmer type PGR-7-2.	**18.**
16	Spare power supply card: Class 6524 type PC-4.	**186.**
17	Spare IM card, for level control systems: Class 6524 type PC-5.	**$256.**
18	Spare IM card, for pressure control systems: Class 6524 type PC-6.	**$ 373.**
19	Spare IM card for pressure control system with variable set point control: Class 6524 type PC-7.	**397.**
20	Calibration potentiometer/extender card: Class 6524 type P-1.	**250.**
21	Omission of Class 6524 Programmer Deduct	**755.**
22	Omission of Class 6523 Pressure Transducer *ⓘ Deduct	**670.**
23	Selector switch for manual alternation of pumps, mounted and wired on door, including necessary relays: 2 Motors — adjustable speed 3 Motors — adjustable speed 2 Motors — constant speed 3 Motors — constant speed	 **520.** **778.** **370.** **550.**
24	Clock circuit for automatic alternation of pumps, 24 hour timing: 2 Motors — adjustable speed 3 Motors — adjustable speed 2 Motors — constant speed 3 Motors — constant speed	 **815.** **1070.** **535.** **700.**
25	HAND-OFF-AUTO selector switch	**92.**
26	Pilot light	**48.**
27	4 pole control relay	**120.**
28	Pneumatic timing relay	**132.**
29	Motor driven timer	**345.**
30	Power failure timer to prevent simultaneous starting of pumps in a multi-pump system: 2 Pumps 3 Pumps 4 Pumps	 **132.** **264.** **396.**
31	Standby Pressure Transducer with selector switch	**910.**
	POWER CIRCUIT MODIFICATIONS	
32	Three phase power bus	**360.**
33	Ground bus	**143.**

† Add **$120.** to price of each card for a pilot relay when the card is used to switch the coil circuit of a 3 pole contactor greater than Square D Size 3.

* Pressure transducer is omitted when the director will be receiving an analog signal other than level or pressure. The Programmer will receive the appropriate analog signal from a transducer not supplied by Square D.

ⓘ Consult the factory when temperature, flow, or other control system is specified.

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DIRECTOR
AUTOMATIC SPEED REFERENCE AND SEQUENCE CONTROLLER
APPLICATION DATA

LIQUID LEVEL CONTROL

Air Supply Pressure Rating . . 20 Psi minimum to 100 Psi maximum

Maximum Depth of Bubbler Tube Below Liquid Level . . . . 40 feet

Control Voltage . . . . . 120 volts, 60 Hertz, single phase

Air Flow Volume . . . . . 1 to 2 cu. ft. per hour

Sequencing Card . . . . . Minimum differential between pick up and drop out is 0.1 VDC.

Speed Programming Card . . . Minimum differential between pick up and drop out is 0.1 VDC. Minimum speed, operating range and range offset adjustments are on this card.

When applying Solid State Pump Control Systems, the following items must be considered:

Proportional Control
Integral Control
System Stability
Bubbler Tubing

PROPORTIONAL CONTROL

In level controlled systems using proportional type control pumps are programmed to operate at different liquid levels, as the reservoir level rises and falls with varying influent.

Parameters such as reservoir size, operating range and pumping capacity will determine if a proportional control system can operate excessive pump on-off cycling.

INTEGRAL CONTROL

In level controlled systems using integral type control, pumps are programmed to operate at one set point level (set wet well level). For normal influent rates, the wet well level does not rise and fall with varying flow as it would in the proportional system.

Parameters such as reservoir size, operating range and pumping capacity will determine if an integral control system should be used.

SYSTEM STABILITY

The pumping system electrical and hydraulic parameters must be coordinated to prevent excessive pump cycling from occuring. Pumping capacity, operating range and wet well area are the parameters considered in coordinating a pumping system. The following formula can be used to determine if a proportional or integral control system should be supplied.

$$SF = \frac{GPM}{OR \times SQ.FT.}$$

SF = Stability Factor to determine if an integral system should be used.
GPM = Pumping Capacity of Pump Station.
OR = Operating Range of Wet Well.
SQ.FT. = Wet Well Area in Square Feet.

If the stability factor is equal to or greater than 10, excessive cycling of the pumps can be expected using proportional type control. When these conditions exist, an integral type control should be used.

BUBBLER PIPE

The bubbler piping from the pump director to the reservoir or wet well should be ⅜" or ¼" in diameter. This size piping will allow the level controls to respond to level changes, without causing time delays.

Purge controls can be added to the bubbler system to provide high pressure air through the bubbler pipe to prevent clogging. When purge controls are added, solenoid valves are included to isolate the pressure transducer during purging, to prevent misoperation of the system due to higher pressure in the bubbler pipe and to protect the transducer from damage.

INTEGRAL CONTROL

Control Voltage . . . . . 120 Volts, 60 Hertz, 1 Phase.

Pressure Transducer Output Signal . . . . . Regulated current signal that varies with input pressure. Maximum output adjustable between 3 ma dc and 20 ma dc.

Pressure Connection . . . . . ¼ - 18 inside pipe thread.

Programmer Input Signal. . . . 0 - 10 ma dc, 0 - 20 ma dc or 0 - 50 ma dc.

Sequencing Card . . . . . Minimum differential between pick up and drop out is 0.1 Vdc.

Speed Programming Card . . . Minimum differential between pick up and drop out is 0.1 Vdc. Minimum Speed, Operating Range and Range Offset adjustments are made on this card.

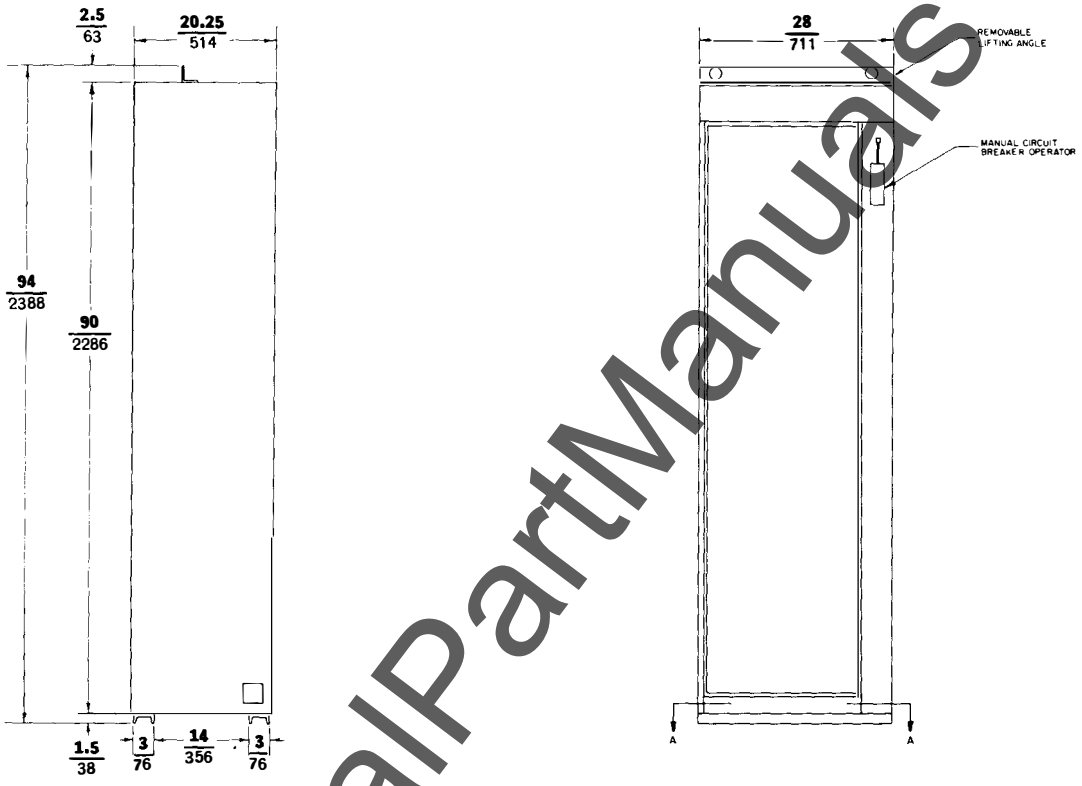
In pressure, flow, or temperature controlled systems using integral control, pumps (fans) are programmed to operate at one set point. Pump (fan) discharge rates are not allowed to rise or fall with varying demands as it would in a proportional systems.

If pump (fan) operating range, capacity, or cycling are application considerations; then an integral control system should be considered.

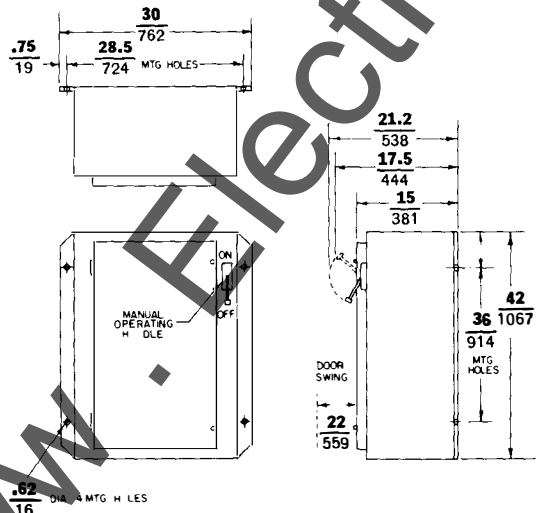
CLASS 8809

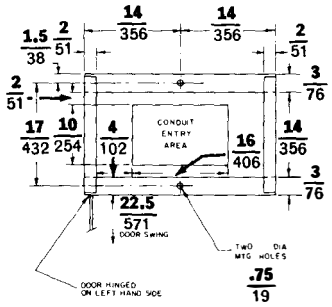
DIRECTOR
AUTOMATIC SPEED REFERENCE AND SEQUENCE CONTROLLER
DIMENSIONS AND WEIGHTS

Class 8809 Type DLP-1 and DLI-1, and DPI-1 Enclosures



Class 8809 Type DLP-2 and DLI-2, and DPI-2 Enclosures





SECTION A-A

Dual Dimensions: **INCHES** / Millimeters

APPROXIMATE WEIGHTS	
NEMA 1 Motor Control Center Without Bus	NEMA 1 Wall Mounted Enclosure
500 Lbs.	150 Lbs.

AUTOMATIC SPEED REFERENCE AND SEQUENCING CONTROL DIRECTOR SPECIFICATIONS-GENERAL

1.0 GENERAL

An automatic speed reference director shall be provided to work in conjunction with adjustable speed controllers specified elsewhere. The director shall consist of a sensor, programmer and other equipment as specified below, and shall be actuated by an air bubbler system or direct pressure sensing to provide integral liquid level or pressure control. The system shall be designed to operate from 120 volt, 1 phase, 60 Hertz power.

2.0 COMPONENTS

2.1 **Bubbler System and Auxiliary Controls** — The bubbler system shall provide a constant air flow of from 1 to 2 CFH to the bubbler dip tube. The system shall consist of 1/12 horsepower air compressor with a 2 gallon storage tank, an air filter, a constant differential regulator to regulate the air flow, a rotometer type air flow indicator, and a standby 1/12 horsepower compressor with a 2 gallon tank. The back pressure of the bubbler, which is exactly equal to the height of the liquid over the bottom of the bubbler tube shall be continuously monitored by the sensor. Upon loss of the normal air supply, the standby compressor shall be automatically switched into service, actuating a visual alarm and providing a contact closure for use with a telemetry device.

Necessary shut-off and bleed valves shall be provided to manually change the pressure in the bubbler pipe without changing the water level in the reservoir for simulating level conditions to adjust the pressure sensor or programmer cards.

Alarm indicating lights shall be provided to alert personnel to "High Level", "Low Level" or "Loss of Normal Air" conditions. A relay circuit shall be provided to signal a remote annuciator of these conditions. A timer alternating circuit shall be provided to alternate the (2) variable speed pumps every 24 hours. The timer circuit shall have a manual override.

A pressure gauge calibrated in feet (or inches) of water shall be provided to indicate level of water above the bottom of the bubbler pipe.

2.2 **Sensor** — The sensor shall be a Square D Class 6523 bellows actuated LVDT (linear variable differential transformer) type pressure transducer with self contained solid state power supply and amplifier circuits. The output of the sensor shall be a smooth 0 - 10 MA dc current signal, proportional to the pressure input, and shall be linear to within 5% of the maximum output on either increasing or decreasing pressure. Pressure transducers using potentiometers or complicated lever arm systems shall not be acceptable.

2.3 **Programmer** — The programmer shall be a Square D Class 6524 solid state unit including individual plug-in printed circuit cards for power supply, sequencing and speed programming of each drive, sequencing of alarms, and metering.

The programmer shall be capable of accepting a 0-10 ma dc, or 0-20 ma dc, or 0-50 ma dc analog control input signal.

The power supply shall provide the regulated dc voltage required in the programmer. It shall have sufficient capacity to drive a full complement of speed programming and sequencing cards.

The speed programming cards shall determine the start-stop operation, the operating range, and the minimum speed of each adjustable speed pump with independent potentiometer adjustments on each card. The sequencing operation of each speed programming card shall be monitored with self-contained indicating lights. One speed programming card shall be furnished for each adjustable speed pump.

The sequencing cards shall determine the on-off operation of each alarm with independent potentiometer adjustments. The sequencing operation of each sequencing card shall also be monitored with self-contained lights. One sequencing card shall be furnished for the high level alarm, and one for the low level alarm.

Each sequencing and speed programming card shall be adjustable over the entire range of the wet well.

The metering card shall monitor the input signal to the programmer and the adjustable speed signal output from each speed programming card and provide adjustment of the set point.

Each of the cards in the programmer shall be coated with a clear protective coating. All plug-in connectors shall be gold flashed and shall be keyed to prevent improper insertion. All potentiometers and selector switches on the cards shall be sealed against corrosive atmosphere.

All of the above equipment shall be mounted in a NEMA 1 motor control center type enclosure.

3.0 OPERATION

The control system shall be of the integral (set point) type. The system shall constantly compare the actual (level, pressure, temperature, flow, or other) with the set point to be maintained. Pump (fan) capacity shall be varied in order to maintain the selected set point.

Under normal conditions the lead pump (fan) will be running and its speed will be varied by the integrator output in order to maintain an essentially constant discharge capacity around the set point. The capacity will be adjusted to exactly match the demand. Should the demand increase to exceed the capacity of the lead pump (fan) or should a lead pump (fan) failure cause a loss of capacity, the integrator circuit shall detect a failure of the lead pump (fan) to maintain the (level, pressure, temperature, flow, or other) at or below the set point and the lag pump (fan) will automatically start.

During low demand conditions the lead pump (fan) shall decrease to minimum speed as soon as the integrator circuit detects that the demand has dropped and remained below the set point. The lead pump (fan) shall continue to run at minimum speed until its shut off point is reached or until the demand exceeds the set point. After the lead pump (fan) shuts off it will remain off until the demand reaches a start point just below the set point.