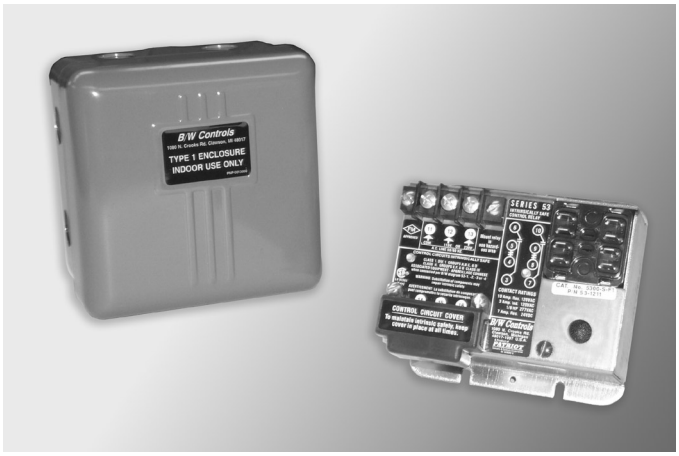
AMETEK®

Series 5300

B/W Controls

Intrinsically Safe Relays



B/W Series 53 Controls Relays were developed especially to provide an intrinsically safe and economical means of detecting and controlling a wide range of processing variables in areas containing explosive atmospheric mixtures.

Tested and approved by FM and CSA for use in applications involving Class I, II, and III locations, these compact solid-state relays are designed to provide an external probe or pilot control circuit that is inherently incapable of releasing sufficient electrical energy to ignite even the most flammable gases or vapors classified in Groups A, B, C, and D, and combustible dusts or fibers classified in Groups E, F, and G.

INSTALLATION OPTIONS

When mounted in an approved explosion-proof enclosure, B/W Series 53 Relays can be located within a hazardous area, providing the power wiring to the relay and from the load contacts is installed in accordance with applicable codes for the location. The most economical method of installation, however, is to mount the relay in a non-hazardous environment and run the external control circuit through an approved seal to a pilot device or level sensing electrodes in the hazardous area as shown on page 2.

This permits use of low-cost general purpose enclosures for both the relay and pilot device. Ordinary wires in conduit or an approved cable can be used for the intrinsically safe probe or pilot control circuit. Moreover, distance between the Series 53 Relay and the pilot device can be 10,000 feet or more, depending on resistance and capacitance of the wires used for the external control circuit.

RELAY TYPES AND OPTIONS

B/W Series 53 Relays can be supplied with either Standard or Power load contacts, and equipped with variable resistance potentiometer or choice of fixed resistors to meet the operating requirements of countless level sensing and pilot switching control applications.

Standard load contacts are more than adequate for most applications and, in fact, assure greater reliability where light loads and low voltages and currents are involved. The higher rated Power contacts are available to handle heavy-duty loads, but are not recommended for use at less than 10% of their specified ratings.

Intrinsically safe control circuit approved by Factory Mutual and the Canadian Standards Association for Class I, II, III; Division 1; Groups A, B, C, D, E, F, G hazardous locations.

BASIC SPECIFICATIONS

Dual Voltage: 115 or 230 volts AC - 50/60 Hz.

Load Contacts: Double pole, double throw.

Standard Contact Ratings: 10 amperes resistive load or 3 amperes inductive load at 120 volts AC; 1/8 hp at 120 or 277 volts AC; 7 amperes resistive load at 24 volts DC.

Optional Power Contact Ratings: 25 amperes resistive load at 120 or 277 volts AC.; 1 hp at 120 volts AC or 2 hp. at 277 volts AC; 25 amperes resistive load at 28 volts DC.

Power Required: 9 volt-amperes, 6 watts.

Control Circuit Energy: Inherently limited to less than 1 milliampere at 9.6 volts DC to assure intrinsically safe operation under any abnormal fault condition.

Operating sensitivity is important only in level control applications where the relay is operated from electrodes and the liquid is used as a conductor to complete the external sensing circuit. Since liquid resistances vary, several operating sensitivities are offered. In such applications, the relay must have a sensitivity greater than the specific resistance of the liquid being controlled. When operated from a B/W Unifloat® multi-level sensing system or other pilot switching device, a fixed 10,000 ohm sensitivity is recommended.

Regardless of sensitivity ratings, however, all B/W Series 53 Relays are designed to operate continuously with external probe or pilot circuit resistances as low as zero without damaging the relay. This permits intrinsically safe operation at all times from electrodes or pilot switches.

	Operating Sensitivity Maximum Control Circuit Resistance	Maximum Lead Wire Lengths*	Application Recomendations
5300-S-V	Variable 10,000 ohms to 1 megohm	Same as F1 - F5	Covers all applications described for F1 - F5
5300-S-F1	Fixed, 10,000 ohms	50,000 ft.	Unifloat and other dry contacts, ordinary water with medium to high mineral content, sewage, water soluble oil and starch solutions, long distance applications
5300-S-F2	Fixed, 22,000 ohms	50,000 ft.	Water with low mineral content (soft-not distilled or demineralized), sugar syrup solutions, long distance applications
5300-S-F3	Fixed, 68,000 ohms	50,000 ft.	Steam condensate, corn syrup, strong alcohol solutions up to 50%
5300-S-F4	Fixed, 330, 000 ohms	50,000 ft.	Alcohol solutions up to 70%
5300-S-F5	Fixed, 820,000 ohms	35,000 ft.	Deionized or distilled water, 95% glycerine, 90% hydrogen peroxide, 95% ethyl alcohol granular solids with high moisture content
5300-S-F6	Fixed, 2.2 megohms	12,000 ft.	Glacial acetic acid, acetone, granular solids with some moisture content
5300-S-F7	Fixed, 5.6 megohms	4,000 ft.	M.E.K. (Methyl Ethyl Keytone)
5300-S-F8	Fixed, 12.0 megohms	2,00 ft.	Anhydrous Ammonia

PRINCIPLE OF OPERATION

B/W Series 53 INTRINSICALLY SAFE RELAYS are designed to operate on either 115 or 230 volts AC at 50/60 hertz. The relay is capable of performing control functions directly from electrodes suspended in a well or tank, the B/W Unifloat level sensing system, or various pilot devices such as pressure flow and limit switches, thermostats and push-buttons, etc.

In addition, the operating characteristics are virtually unaffected by ambient temperatures ranging from - 40ºF to +180ºF, or by variations from 80% to 110% of their rated voltage. The controls are also furnished with a fixed sensitivity resistor or a variable resistance potentiometer to permit adjustment of operation based on the resistance of the liquid or material to be controlled. See table on page 1.

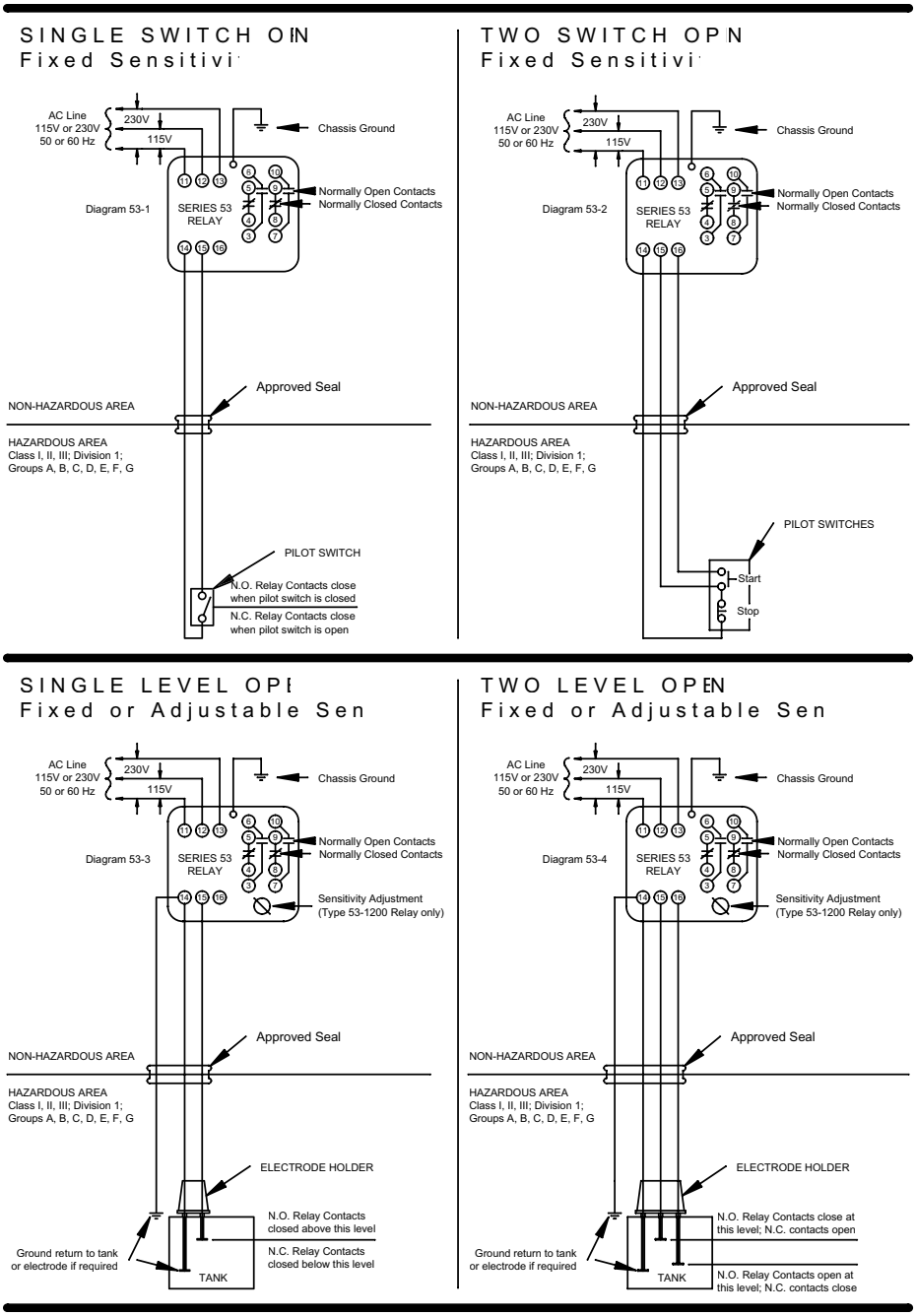
The basic components of this control are a transformer, a circuit board with voltage divider circuit, a silicon controlled rectifier (SCR), a field effect transistor (FET) and a load relay to provide isolated DPDT contacts. The sensing circuit voltage is 9.6 volts DC.

A rectifier is used to convert the sensing circuit voltage from AC to 9.6 volts DC; the FET is used to provide a high sensitivity. This permits positive operation on liquids with very high resistance.

Since the voltage divider circuit compares the liquid resistance to an internal sensitivity resistor on the control, it is important that the sensitivity selected be rated higher than the resistance of the liquid or other sensing circuit.

The load relay is energized when the level sensing circuit is completed.

When operating from electrodes and liquid is below lower electrode, a high resistance is sensed across terminals 14 & 15, and a negative, or out-of-phase, signal is fed to the SCR. When liquid rises to touch the upper electrode, a low resistance is sensed across terminals 14 & 15, and the signal to the SCR becomes positive, or in-phase, turning the SCR on, which, in turn, energizes the load relay. When the load relay is energized, an internal holding circuit contact closes to hold in the relay through the lower electrode and the liquid resistance unit liquid level falls below the lower electrode, at which time the SCR turns off and de-energizes the load relay.



INTRINSICALLY SAFE SYSTEM INSTALLATION

As defined by the National Electrical Code, Factory Mutual and Underwriters Laboratories, an intrinsically safe control system consists of equipment and associated wiring that are inherently incapable of releasing sufficient electrical or thermal energy under normal or abnormal conditions to cause ignition of a specific hazardous atmospheric mixture at its most easily ignited concentration in air.

Abnormal conditions would include any two independent mechanical or electrical faults occurring simultaneously -- such as accidental damage to any part of the equipment, wiring and insulation, and any other failure of electrical components due to application of over-voltage, improper adjustment or maintenance, and other similar conditions.

When properly installed in accordance with the diagrams on page 2, B/W Series 53 Relays meet the most stringent requirements of FM and CSA for intrinsically safe operation from push-buttons, pressure or float switches, thermostats, humidistats or any other type of general purpose pilot control device. In addition, they may also be actuated by probes or electrodes in contact

with any conductive liquid or moist bulk material to perform a wide variety of mixing, measuring, metering and flow or level control functions.

In such installations, inexpensive general purpose enclosures may be used for both the control relay and the pilot device -- and wiring between the two may be of any type approved for non-hazardous locations without violating provisions of Article 500-517 of the National Electrical Code. It is essential, however, that

(**1) an approved seal be used at the point where the intrinsically safe pilot control circuit enters the hazardous area, and**

(2) the pilot circuit wiring be isolated from other wiring.

These instructions relate primarily to the B/W electrode system of liquid level sensing. See B/W Form 465 for complete specifications, wiring and electrode equipment, etc.

ELECTRODE LEAD WIRES
Shielded cable is not required. Generally the size of the wire used is based upon the physical strength required to meet given installation conditions. Size 14 to 18 gauge wire is generally strong enough for wiring, although size 26 gauge wire is adequate for positive relay operation. In some long distance applications, communication cable or telephone circuits may be used. In all cases, however, control circuit wires must have good insulation, and splices or connections must be watertight and insulated from ground.

Special Note -- Electrode lead wires must *not* be run in the same conduit with power or load carrying circuits.

ELECTRODE LEAD WIRE LENGTH
The maximum lead length is determined by the resistance of the lead wires. These controls will operate reliably with electrode lead lengths of several miles, but it is important to select the correct sensitivity to assure positive operation over these extreme distances. Refer to Table on page 1 for suggested maximum lead lengths. If your application involves greater distances than those shown, please contact factory.

GROUND CONNECTIONS
In all installations using electrodes, a good external ground connection and a dependable return circuit to the liquid are required. In most instances, grounding to a metal pipe leading to the tank is suitable, but electrical conduit should not be used for this purpose.

If a good ground connection to the liquid is not available, an additional ground or common electrode is required. When used, the ground or common electrode should extend slightly below the longest operating electrode. In addition, it is also desirable to ground the control chassis directly to the ground terminal or through a mounting screw.

If PVC well casings or drop pipes are used to contain the electrodes, a ground or common electrode is required.

SERVICE INSTRUCTIONS
B/W Solid state controls are designed and built to require a minimum of service in the field. Each one is tested at the factory to insure positive operation, and should not be altered or tampered with prior to installation. If a control does not operate properly after it has been installed, the following information will be helpful in determining the probable cause.

The load relay is energized when the liquid reaches the upper electrode or Unifloat reed switch level, and electrode current is flowing. Be sure the relay sensitivity has been selected properly and a good ground connected to terminal 14.

A -- Load Relay Will Not Pull In
1. Power Failure or No Voltage at AC Line Terminals.
Voltage at power input terminals should be 115 volts AC between terminals 11 & 12 or 230 volts AC between terminals 11 & 13.

2. Defective Control.
To check control, disconnect electrode and load connections from control terminals. Apply line voltage to the appropriate terminals (11-12) or (11-13), and touch terminals 14 and 15 with an insulated jumper wire. Load relay should pull in when the jumper is connect, and drop out when the jumper is removed. Failure to do so indicates a defective control.

3. Poor Ground Connection.
Controls will not function unless a good dependable ground connection is made to terminal 14. If a load relay does not pull in when liquid contacts the upper electrode, check ground connection to be sure it complies with installation instructions.

4. Broken Wires.
A broken or loose wire from the control to the upper electrode or the ground (common electrode) will prevent load relay from pulling in. Broken wires can be checked by shorting the upper electrode to ground, or to the common electrode if used, at the electrode holder. If relay fails to pull in, one or both of the electrode leads is open. The individual leads can be checked by running temporary wires from the control to the electrode holder outside of conduit. **Careful -- Wires Must Not Contact any Power Leads.** If the load relay now pulls in, when shorting electrodes as noted above, the break is between the control and electrode holder. If load relay pulls in when the leads are shorted with a jumper at holder, but not at electrode tips, the break is in the electrode suspension wire.

5. Sensitivity Resistor Too Low.
If the sensitivity resistor value is too low for the resistance or conductivity of the liquid to be controlled, the load relay will not pull in, or it will buzz and chatter before pulling in. In either case the relay should be replaced with a higher sensitivity relay (see table, page 1). If in doubt about sensitivity selection, furnish factory with details on liquid, or send sample of liquid for testing.

6. Fouled Electrodes.
Accumulation of dirt, oil, grease, or other deposits on the electrodes may insulate them and prevent load relay from pulling in. If this occurs, the electrodes should be inspected and cleaned at regular intervals, as required, to eliminate the difficulty. If unusual quantities of oil, grease or sludge are encountered, the electrodes can be mounted inside a pipe that is flushed with clean water. A 4” pipe should be used -- with the bottom located below the lowest expected water level, and vent holes provided at the top so that the level inside and outside the pipe will be the same. A small

flow of water entering the top of the pipe will cause an outward flow of water from the bottom of the pipe and prevent undesirable material from entering. Thus, the electrodes have a clear surface on which to operate, and will stay clean.

7. Electrodes Too Short.
It is possible for an installation to be completed in which the upper electrode is suspended at a point where the liquid cannot make contact. All installations should, of course, be checked to make sure that the proper electrode lengths are provided. If stand pipes are used, make sure pipe is vented above upper electrode setting.

B -- One Level Operation
If control operates at one level only (starts and stops at one electrode level) check following:

1. Electrode Wires.
If wires between control and electrodes are interchanged, load relay will not operate over a range in level, but from the lower electrode only. To correct, simply reverse electrode connections 15 and 16 either at terminal strip or electrode holder.

2. Holding Circuit.
If the holding circuit (terminals 15-16) is not closing, the load relay will operate from the upper electrode only. If the holding circuit is not opening, the relay will operate from the lower electrode only. This holding circuit contact can be checked for continuity with an ohmmeter. If defective, the complete relay must be replaced.

C -- Intermittent Operation
If control occasionally short cycles or operates intermittently, check the following:

1. Continuously monitor input voltage for fluctuations or voltage spikes.

2. Check for physical vibration caused by contactors or magnetic starters mounted nearby.

3. Check A-4 & A-6.

D -- Constant Chatter
If load relay contacts chatter continuously, check defective control as in A-2.

1. If relay now operates correctly, check A-4 & A-6, B; C-1 and C-2.

2. If relay still chatters with terminals 14 & 15 jumpered together, the load relay is defective, or the capacitor across the load relay coil may be defective. In either case the complete relay should be replaced.

E -- Load Relay Will Not Drop Out
If relay will not drop out when liquid falls below lower electrode, check the following points:

1. Defective Control -- See A-2.

2. Grounded Electrode Leads.
A ground in the lead wire to the upper or lower electrode will prevent the relay from dropping out on low liquid level.

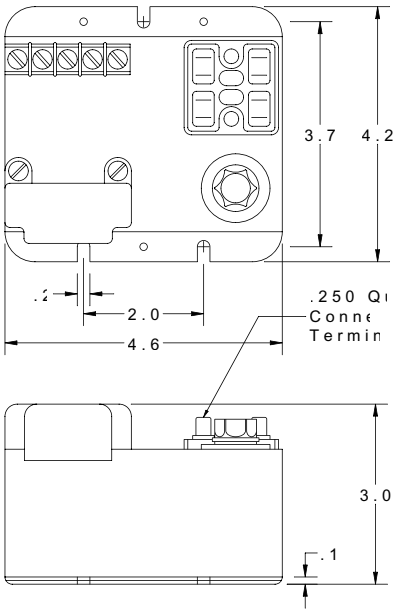
If the distance from the holder to the control is relatively short, the best way to check for ground is to connect replacement wires from the terminal strip to electrode holder, outside of conduit, and test for proper operation. **Careful -- Wires Must Not Contact Any Power Leads**. If load relay drops out properly, it is safe to assume that a ground exists in the original wires to the electrode holder.

If the load relay does not pull in, short the relay with a piece of insulated wire by bridging between relay terminals 14 & 15. The load relay should drop out when this connection is broken. If the relay does not drop out, a short to ground is indicated in the lower electrode lead between the control and the electrode holder. If any of these conditions exist, disconnect the power and replace the grounded wires.

3. Electrode Holder.
Excessive dirt or moisture over the insulation at the electrode holder or the electrodes can cause faulty operation. The interior of the electrode holder and its underside should be kept clean and dry. Conduit connection should be made so that no condensation can enter the holder. The underside of vertically mounted holders should never come in contact with the liquid. Insulated rod electrodes should be used with horizontally mounted holders. Electrodes should be kept clean and free of dirt or grease. A periodic check should be made to make sure that they do not become fouled with floating debris or insulating deposits.

4. Length of Electrode Lead Wire.
On installations with excessive distance (over 2,000 feet) between a Series 5300 control and the tank, capacitance in the lead wires from the control to the electrodes may affect normal operation. Check the chart on page 1 for maximum lead wire lengths. Capacitance can cause the load relay to hold in when the liquid leaves the lower electrode.

SERIES 53 RELAY CHASSIS DIMENSIONS



CONTROL REPAIRS
All B/W Controls are tested at the factory prior to shipment to insure proper operation. They should be handled with care during installation to avoid breaking electrical connections. If the control does not operate properly after it has been installed, and service instructions indicate a defect, repair should be attempted only at the factory due to the intrinsically safe rating on the relay.

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