Kit Instructions

1332-MOD-G4

BCD Interface • Series B

Description

The BCD Interface Option, MOD-G4, accepts digital signals from a programmable controller or computer in a Binary Coded Decimal (BCD) format and generates frequency (speed) and direction (forward/reverse) signals for a single Bulletin 1332 Adjustable Frequency Drive. Provisions are included to connect the BCD signals through a terminal block suitable for discrete wires or through a 40 pin ribbon cable connector. The ribbon cable connector input is suitable for use on multiplexed systems for independently controlling the speeds of up to 20 Drives.

Specifications

Power Source

- 115/230V AC, single-phase power is required to operate the control logic and outputs of the BCD Interface Board.
- Remote +5V power source (Customer Supplied), +5.25V DC, ±5%, 50mV P-P ripple (maximum), 0.5A (minimum).

IMPORTANT: The BCD Interface Board has an integral power supply monitor for the customer supplied +5 V DC power source. If the power supply voltage drops below 4.75V DC, the board is inhibited from accepting any new data until the voltage is restored to acceptable levels. This prevents the board from responding to unintelligible or incorrect data caused by a decaying power supply.

Control Inputs

- Digital Frequency Inputs: 5V TTL logic level, low equals true logic in a BCD format. Up to 13 inputs may be required based on the resolution of frequency control desired.
- Direction: If direction control is desired, one 5V TTL logic level input is required. Low equals true (reverse) logic.
- Strobe: A 5V TTL logic level is required to signal the board to read the data presented to it (strobing). Low equals true logic.
- Sinking Current: Each TTL input will be required to "sink" approximately 20mA when the board is strobed.

Optional Inputs

- Manual Speed Pot: 10k ohm, 2W, customer supplied
- Forward/Reverse Selector Switch: Customer supplied
- Remote Manual/Auto Selection: A customer supplied 115V AC input can be accepted for Remote Manual/Auto operation selection.

Outputs

- Direction: The BCD Interface option has a solid-state contact output which connects to the standard Bulletin 1332 Drive for direction control.
- Frequency: The BCD Interface Board generates a 0 to +10V DC signal based on the input, for use as the frequency (speed) input to the Bulletin 1332 Drive.

Specifications *(Continued)*

IMPORTANT: The Bulletin 1332 has a 20 to 1 speed range. This means that the Drive has a minimum frequency output even when receiving a zero speed command. Because of this, the BCD Interface Board has been designed to ignore speed commands in the first 5% of selected speed range.

Example

Maximum speed range of 60 Hz is selected.

Actual Drive output frequency will be from 3 to 60 Hz.

BCD Interface Board output will be from 0-10V (3-60 Hz).

A BCD input command from 0.0 to 3.0 Hz applied to the BCD Interface Board will not change the output. However, a BCD input command above 3.0 Hz will change the output accordingly, as shown below.

BCD Input *(Hz)*	**Interface Board Output** *(Volts)*	**Bulletin 1332 Output** *(Hz)*
0.0	0.000	3.0
3.0	0.000	3.0
3.1	0.017	3.1
10.0	1.228	10.0
60.0	10.000	60.0

Description of Operation

The BCD Interface Board generates an analog signal suitable for speed control of the Bulletin 1332 Drive. In addition, a direction control signal can also be generated for the Drive.

Several modes of operation exist when using the BCD Interface option:

- Remote Automatic (BCD) Control
- Remote Manual Control
- Local Manual Control

Remote Automatic (BCD) Control

When the Bulletin 1332 Drive is switched to Remote input and the BCD Interface Board is in the Automatic mode, the frequency output of the Drive is determined by the BCD data. The board can accept up to 13 bits of frequency data to control the Drive frequency up to 200 Hz in 0.1 Hz increments. The data is received in a BCD format such that four bits determine the value of each decade of frequency information as shown below.

Frequency Decade	**Data Bits**
0.1 Hz	4 bits (.8 - .4 - .2 - .1)
1.0 Hz	4 bits (8 - 4 - 2 - 1)
10.0 Hz	4 bits (80 - 40 - 20 - 10)
100.0 Hz	1 bit (100)
	13 bits total

In addition to the frequency data listed above, one "strobe" bit is required to signal the board to read the frequency data at the input lines. The strobe requirement prohibits the board from reading data until the strobe is applied. This permits the frequency data at the input to be changed without the BCD Interface Board or the Drive responding to the change.

Description of Operation *(Continued)*

Example

Assume that the existing Drive frequency is 60 Hz and the desired frequency is 100 Hz.

It's possible that:

The input data could be 160 Hz if the 100 Hz bit was present before the 60 Hz bits were removed.

OR

The data could be 0 Hz if the 60 Hz bits were removed before the 100 Hz bit was present.

Control of the strobe permits the Interface Board and Drive to ignore any undesired combinations.

Once the desired frequency data is present at the input, the strobe is applied which signals the board to read the data. The board then loads the data into a storage buffer for memory. The stored data is internally fed to a precision digital to analog (D/A) converter which in turn generates a 0 to 10V DC output (speed reference) signal for the Drive.

In addition to frequency data, there are provisions for the board to read one separate input data bit to control direction. When this bit is set, it is read along with the frequency data and stored. A separate circuit monitors this bit and controls a solid-state switch which is connected to the direction control terminals of the Drive. The option can now control the forward or reverse operation of the Drive as follows:

Direction Bit	Direction
"0" (False = High)	Forward
"1" (True = Low)	Reverse

When power is first applied to the BCD Interface Board or the board is switched to Manual Control, the storage buffer is erased to reset the buffer and start out with a loaded frequency of zero and a forward direction.

Remote Manual Control

The BCD Interface Board has provisions for switching to a Remote Manual mode of operation through the use of a selector switch located on the board or a customer supplied 115V, single-phase, 60 Hz AC input signal. When in Manual, a remote manual speed pot and remote forward/reverse selector switch (if direction control is desired) is required. In the Remote Manual mode, the D/A converter is disabled and the remote manual speed pot is used for the speed output signal. Internal circuits generate a power supply for the speed pot and select which signal is fed to the Drive. The BCD input for direction control is also ignored in this mode, with the remote forward/reverse selector switch monitored to determine direction of Drive rotation.

Local Manual Control

All outputs of the BCD Interface Board will be ignored if the Bulletin 1332 Drive is switched from Remote to Local at the Local Operator Panel of the Drive.

When in the Local mode, the Bulletin 1332 will respond to the speed pot and forward/reverse selector switch located at the local operator's station. Refer to the *Bulletin 1332 Instruction Manual* for further information.

Description of Operation *(Continued)*

Start/Stop Operation

IMPORTANT: In all cases the start/stop operation of the Drive is controlled at the Drive. The BCD Interface Board does not perform any start/stop commands. However, the method of controlling the start and stop of the Drive may be affected by the desired mode of operation of the BCD Interface Board. Refer to the *Bulletin 1332 Instruction Manual* for further information.

The Bulletin 1332 Drive uses the same local/remote selector switch to change the forward/reverse direction and start/stop control from the local operators station to the remote inputs. To accept the BCD Interface Board direction commands, the switch must be in the Remote position. When this is done, other provisions (remote start/stop) must be made to start and stop the Drive. The Drive local/remote frequency selector switch is independent of the local/remote direction and start/stop selector switches. Therefore, it is possible to have the Drive accept the BCD Interface Board speed commands while also accepting the local commands for start/stop and direction.

Operation

Table A provides a listing of the Drive and BCD Interface Board switch positions and the resultant operation.

Table A
Bulletin 1332 Operation

Drive Switch Settings		BCD Board	
SW3 *Local/Remote*	SW4 *Local/Remote*	S1 *Manual/Auto*	Operation
Local	Local	Ignored	Speed, Direction and Start are controlled by the Local Operator Panel of the Drive (SW1, SW2 & frequency pot).
Local	Remote	Auto	Speed is controlled by the BCD input. Direction, Start and Stop are controlled by the Local Operator Panel (SW1 & SW2).
Local	Remote	Manual	Speed is controlled by the Remote Manual speed pot. Direction and Start by the Local Operator Panel.
Remote	Remote	Auto	Speed and Direction are controlled by BCD inputs. Start/stop controlled by inputs to the Drive Control Terminal Block.
Remote	Remote	Manual	Speed and Direction are controlled by Remote Manual inputs. Start/Stop controlled by inputs to the Drive Control Terminal Block.

Installation

The BCD Interface Board is supplied as a loose board for customer mounting. Included with the board are four 1/4 turn Nylock standoffs to aid in mounting the board.

Installation requires that the board be mounted a maximum of 3 feet (.9m) from the Drive.

Mounting Instructions

1. Remove input power from the Drive.
2. Locate the area where the BCD Interface Board is to mounted.
3. Using the dimensions provided in Figure 1, mark the location of the holes to be drilled.

Installation
(Continued)

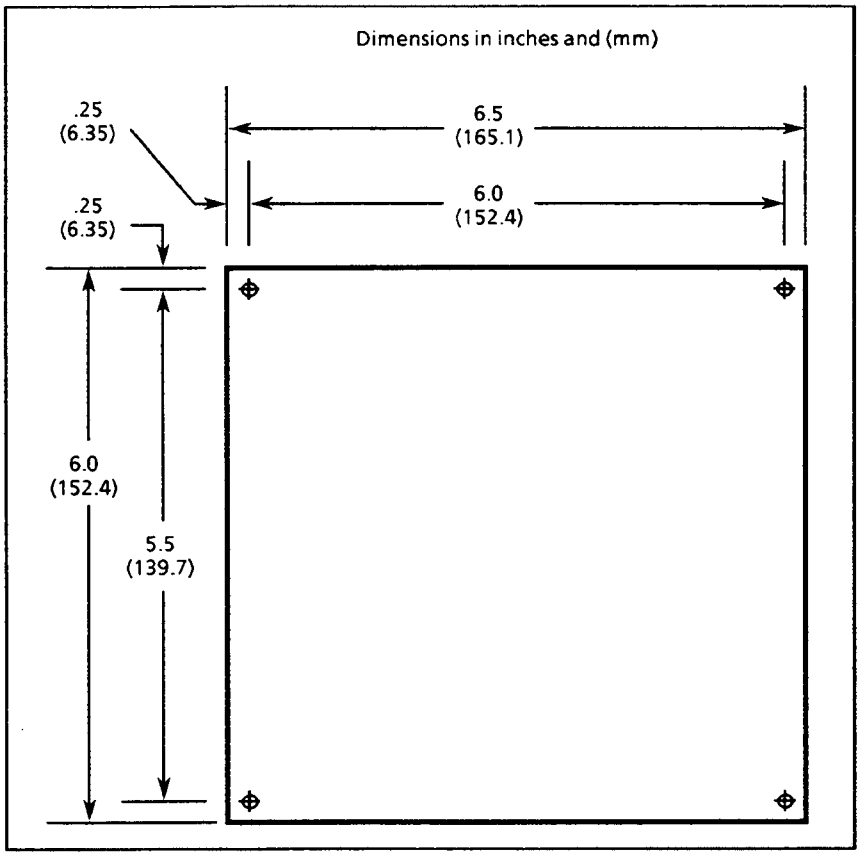

Figure 1 – BCD Interface Board Dimensions

4. Drill four (4) - 1/4" (6.35mm) holes at the locations marked in the previous step.
5. Insert the standoffs into the holes.
6. Install the board onto the standoffs and lock in place. See Figure 2.

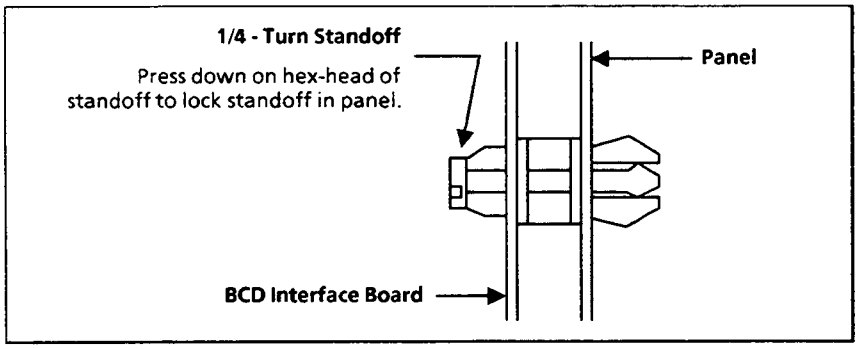

Figure 2 – Board Installation

7. Wire the option as described in the following section.

Wiring

WARNING: To avoid a shock hazard, ensure that all power has been removed to the Drive **before** performing the following connections.

Wiring
(Continued)

Prior to wiring the power and BCD signals, wiring between the Drive and BCD Interface Board should be performed. Refer to Figure 3 or 3A for these connections.

WARNING: Incorrect polarity of remote inputs may cause personal injury from uncontrolled machine motion. Connect remote inputs (terminals 4 & 5 of the Drive) only as shown in Figure 3 or 3A.

Power Wiring

The BCD Interface Board will accept a 115 or 230V AC, single-phase input power source at TB4. Prior to connecting the power source, the input voltage being used must be selected at jumper J3. To correctly set the jumper, select the proper jumper for the input voltage being used (115V or 230V) and insert at J3. Refer to Figure 3 or 3A.

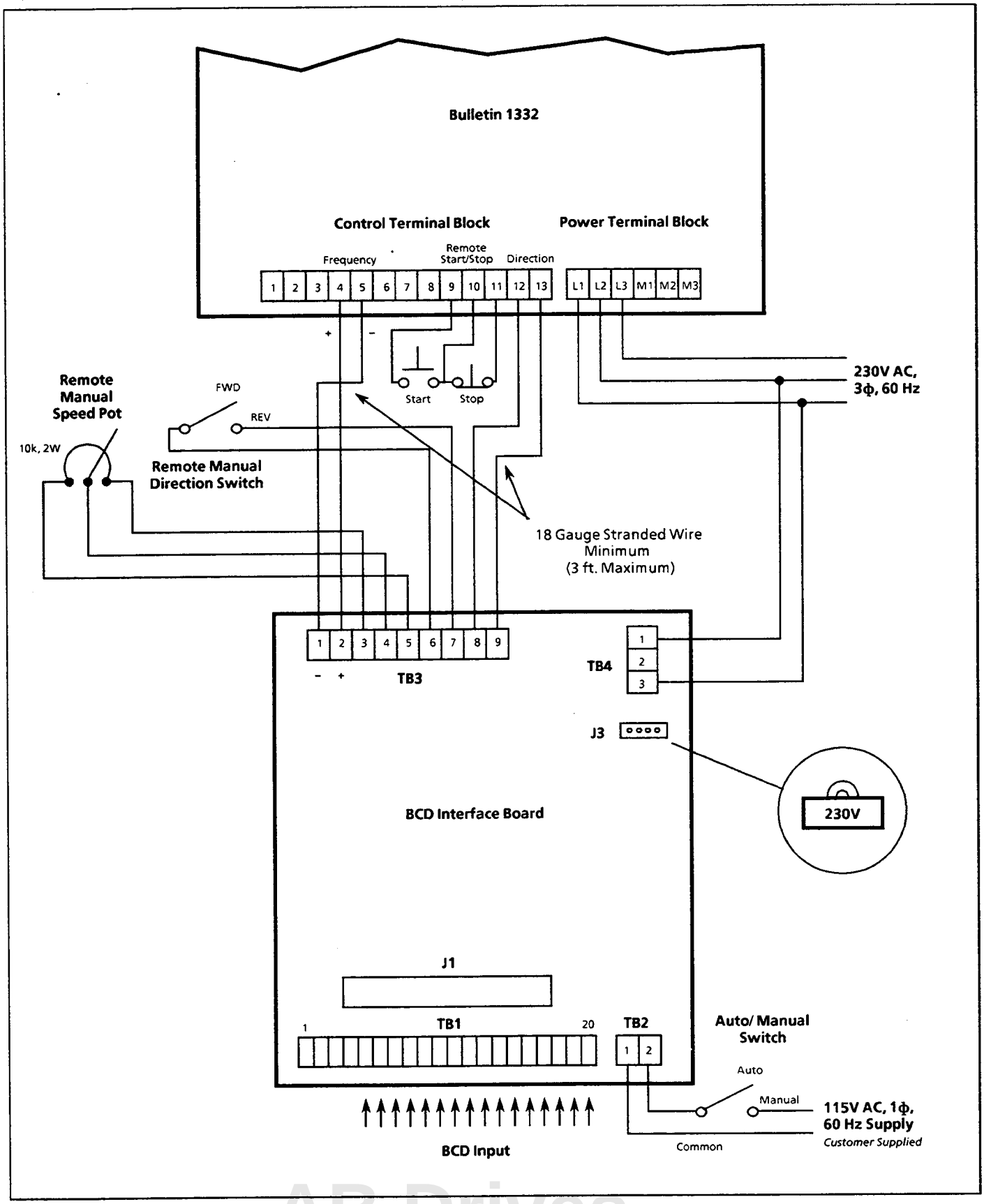

Figure 3 – Interconnection Diagram for use with 230 Volt Drives

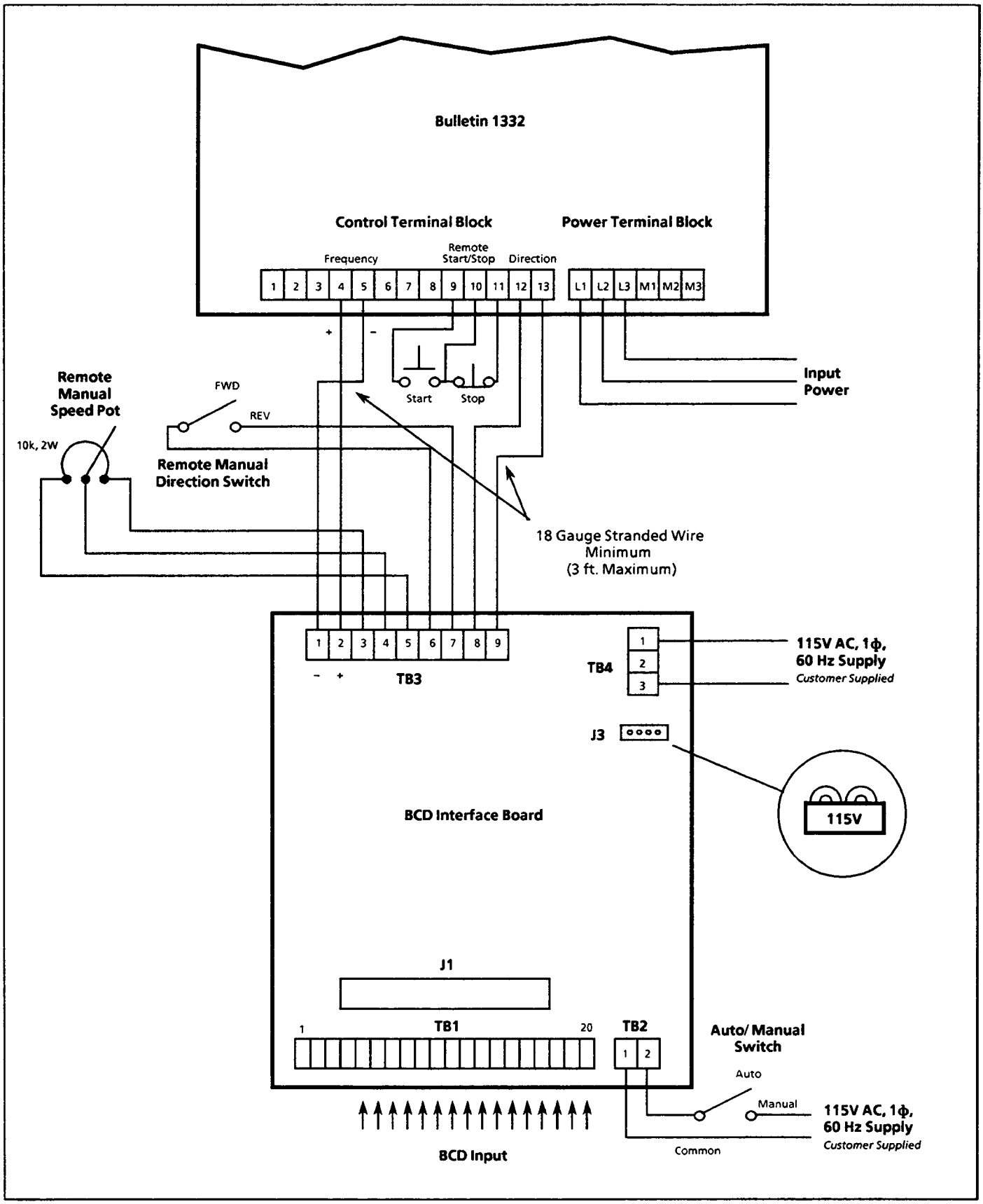

Figure 3A – Alternate Connections for use with 115V AC Supply

Wiring
(Continued)

BCD Signal Wiring

The BCD signals can be connected through a terminal block suitable for discrete wires or through a 40 pin ribbon cable connector. The ribbon cable connector input is suitable for use on multiplexed systems for separately controlling the speeds of up to 20 Drives. A description of each version follows.

Terminal Block Wiring - TB1

Refer to Figure 4 for a diagram of TB1 and the signal designations for the terminal block. Refer to Figure 8 for the typical interconnect drawing and wiring requirements.

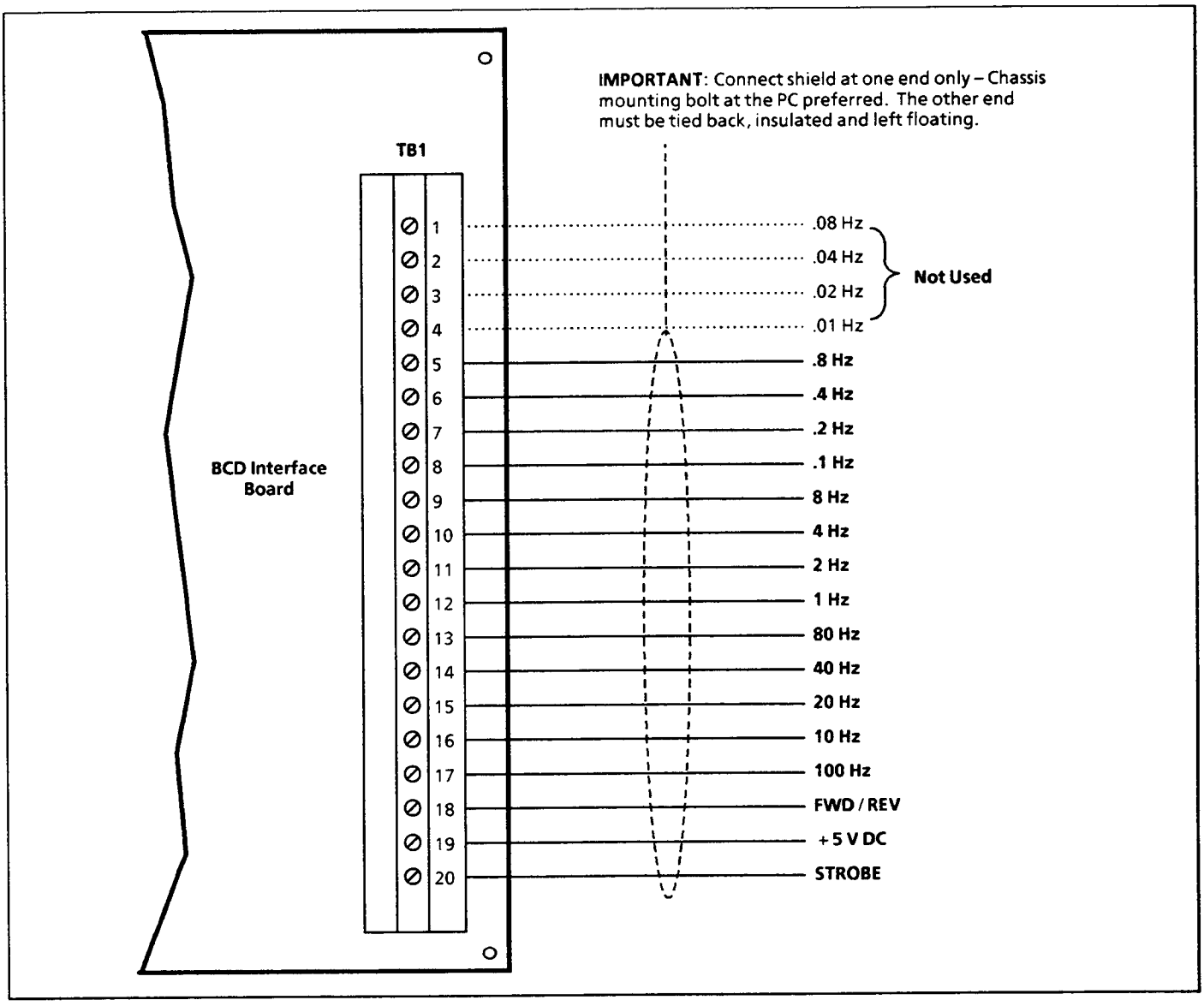

Figure 4 – TB1 Signal Designations

Ribbon Cable Termination

The BCD input data is terminated at a 40 pin ribbon cable connector (3M part number 3417-6040 or equivalent) which plugs into connector J1, of the BCD Interface Board. The ribbon cable permits up to 20 Drives to be controlled from data delivered by one cable having 20 strobe lines. The board has a set of jumpers (labeled J2) that select which one of the 20 strobes the board will use as its strobe input.

Wiring
(Continued)

Do not make any connections at TB1 when connections are made at the ribbon cable connector.

IMPORTANT: Only one Drive should be strobed at any time. Ensure that each Drive has its own unique strobe.

The pin connections for J1 and strobe select jumpers for J2 are shown in Table B.

Table B
Ribbon Cable Connections

J1 Pin Number	Description	J2 Jumper Position
1	Strobe, Drive # 1	1-2
2	Strobe, Drive # 2	3-4
3	Strobe, Drive # 3	5-6
4	Strobe, Drive # 4	7-8
5	Strobe, Drive # 5	9-10
6	Strobe, Drive # 6	11-12
7	Strobe, Drive # 7	13-14
8	Strobe, Drive # 8	15-16
9	Strobe, Drive # 9	17-18
10	Strobe, Drive # 10	19-20
11	Strobe, Drive # 11	21-22
12	Strobe, Drive # 12	23-24
13	Strobe, Drive # 13	25-26
14	Strobe, Drive # 14	27-28
15	Strobe, Drive # 15	29-30
16	Strobe, Drive # 16	31-32
17	Strobe, Drive # 17	33-34
18	Strobe, Drive # 18	35-36
19	Strobe, Drive # 19	37-38
20	Strobe, Drive # 20	39-40
21	+ 5V Supply	
22	+ 5V Supply	
23	100 Hz Data Input	
24	Direction Data Input (Fwd/Rev)	
25	Not Used	
26	Not Used	
27	Not Used	
28	Not Used	
29	0.1 Hz Data Input	
30	0.2 Hz Data Input	
31	0.4 Hz Data Input	
32	0.8 Hz Data Input	
33	1 Hz Data Input	
34	2 Hz Data Input	
35	4 Hz Data Input	
36	8 Hz Data Input	
37	10 Hz Data Input	
38	20 Hz Data Input	
39	40 Hz Data Input	
40	80 Hz Data Input	

Adjustments

Switch Settings

The range of frequency operations is affected by settings on both the BCD Interface Board and the Bulletin 1332 Drive. To assure proper operation over the desired frequency range the settings in the Drive and on the BCD Interface Board must be matched. Refer to Table C to determine the Drive and BCD Interface Board settings and Figure 5 for component locations.

Table C
BCD Interface Board and Drive Settings

Frequency Range	DSW2 Switch Settings *Bulletin 1332 (SW1, SW2, SW3)*		Jumper Setting *BCD Interface Board*
3 to 60 Hz	3 to 60 Hz	(OFF-OFF-OFF)*	60 Hz
6 to 120 Hz	6 to 120 Hz	(OFF-ON-OFF)*	120 Hz
12 to 200 Hz	12 to 240 Hz	(OFF-OFF-ON)*	200 Hz

* Refer to the Bulletin 1332 Instruction Manual for DSW2, SW4 settings.

IMPORTANT: The Bulletin 1332 is capable of a maximum frequency of 240 Hz. The format of the BCD interface only permits a maximum input of 199.9 (200) Hz. The output of the board is scaled to the appropriate level in the 200 Hz range to produce a maximum output of 200 Hz at the Drive, when operating in the 240 Hz range.

IMPORTANT: The Bulletin 1332 has a 20 to 1 speed range. This means that the Drive has a minimum frequency output even when receiving a zero speed command. Because of this, the BCD Interface Board has been designed to ignore speed commands in the first 5% of the selected speed range. Refer to the example presented on page 2 for further explanation.

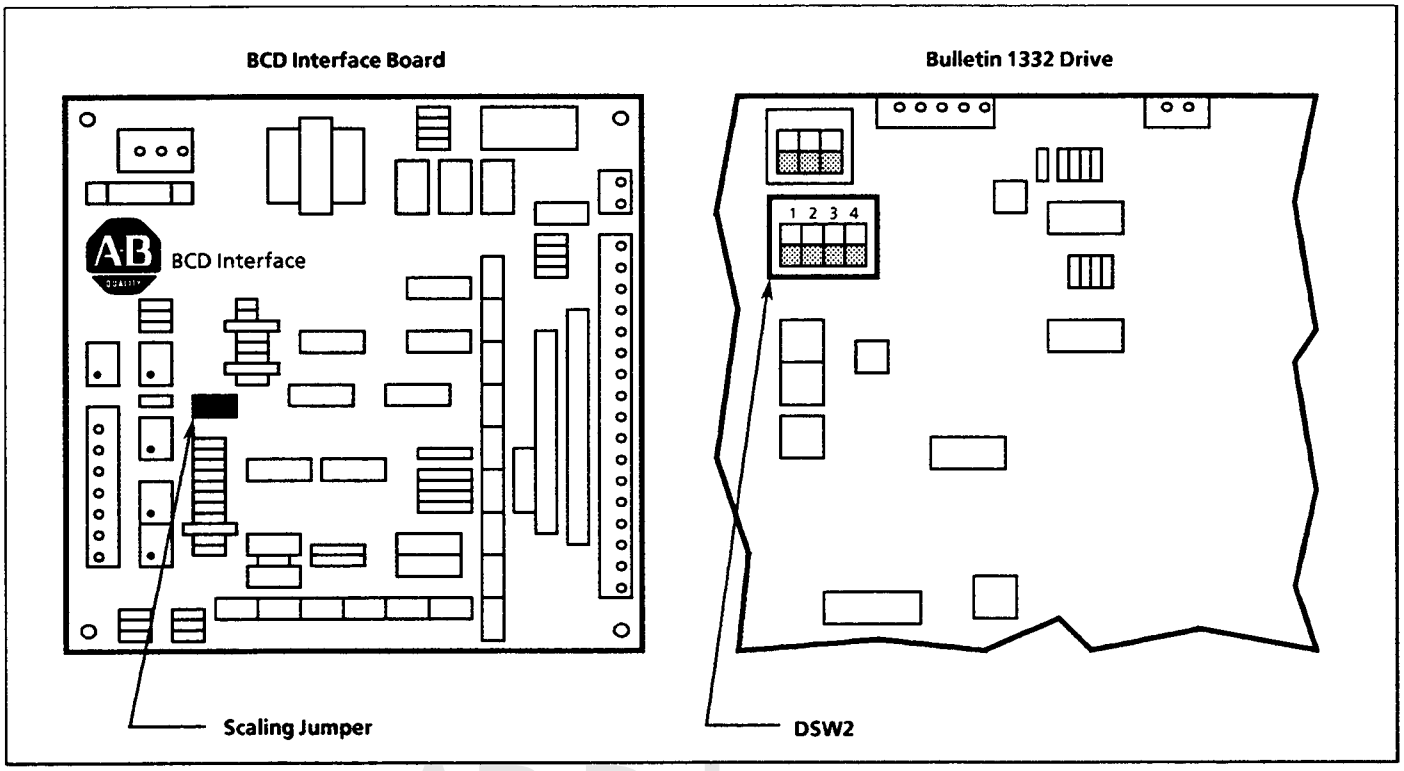

Figure 5 – Jumper and Switch Locations

Adjustments
(Continued)

Potentiometers

Each of the three frequency ranges has an associated "maximum" frequency calibration potentiometer to permit calibration of the BCD Interface Board output signal to the Drive. In addition, there is one "minimum" frequency potentiometer used for calibrating the common minimum speed for all three ranges. A +10V potentiometer is also available to set a precision voltage reference on the BCD Interface Board. Refer to the potentiometer listing below.

Designation	Description
R28	+10V DC
R32	Minimum Speed, 60 Hz
R27	Maximum Speed, 120 Hz
R30	Maximum Speed, 200 Hz
R31	Maximum Speed, 200 Hz

Adjustment and Calibration Procedure

The following procedure provides the required steps to properly adjust and calibrate the BCD Interface.

Required Test Equipment:

- Precision voltmeter (digital) capable of reading a 0-10V DC range with 1% accuracy.
- Frequency meter (or oscilloscope) capable of reading 0-240 Hz, +15V DC square wave pulse train

  or

  An alternate means of determining Drive output frequency (motor tach, strobe, etc.).

1. Ensure that power to the Drive and the BCD Interface is OFF.
2. Remove the front cover of the Drive.

If a frequency meter (or oscilloscope) is to be used, connect the meter leads to the Drive as described in step 3.

If an alternate means of determining Drive output frequency is to be used, proceed to step 4.

WARNING: If an oscilloscope is used during this procedure, it Must be properly grounded. The oscilloscope chassis may be at a potentially fatal voltage if not properly grounded. Always connect the oscilloscope chassis to earth ground.

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3. Locate the following test points on the left hand side of the Drive.
   - P4 = +15V square wave, proportioned to frequency.
   - PG = Drive logic common.

   Carefully connect the frequency meter (or oscilloscope) to these terminals, observing polarity. These terminals will permit reading the Drive output frequency directly in Hertz.

Adjustments *(Continued)*

4. Locate the following components on the BCD Interface Board.
   - Terminal Block TB3
   - R28, +10V DC Adjust
   - R32, Minimum Speed Adjust
   - R27, Maximum Speed - 60 Hz
   - R30, Maximum Speed - 120 Hz
   - R31, Maximum Speed - 200 Hz

   IMPORTANT: If the Drive output frequency can be monitored without the motor connected, adjustment of the BCD Interface Board may also be accomplished without the motor connected. In some cases this method may be more convenient.

5. Connect the "+" lead of the voltmeter to terminal 3 of TB3 (+10V reference). Connect the "–" lead to terminal 1 of TB3 (common). Select a meter range that will permit an accurate reading of +10V DC.

6. Apply power to the Drive and the BCD Interface Board. With power applied, verify a meter reading of +10V DC, ±0.1V. If necessary, adjust R28 until a reading of +10V DC is achieved.

7. Remove all power and disconnect the voltmeter.

8. Verify that the Drive and BCD Interface Board are set up to respond to BCD inputs. Settings should be as follows:

Drive

Component	Setting
SW3	Local or Remote for desired Start/Stop operation.
SW4	Remote - to accept BCD signal.
DSW2	Set for desired frequency range.

Frequency	SW1	SW2	SW3
3-50 Hz	ON	OFF	OFF
3-60 Hz	OFF	OFF	OFF
6-120 Hz	OFF	ON	OFF
12-240 Hz	OFF	OFF	ON

BCD Interface Board

Component	Setting
S1	Manual/Auto Switch set for Auto
TB2	Remote Manual/Auto Signal (if used) - Auto position
Scaling Jumper	Set to the corresponding Drive frequency range and record jumper position. 60 Hz (for 3-50 or 3-60 Hz on Drive) 120 Hz (for 120 Hz on Drive) 200 Hz (for 240 Hz on Drive)

Verify that the proper BCD inputs are connected and the external source is operational to send BCD data to the board.

IMPORTANT: The greatest accuracy will be obtained if the Bulletin 1332 is operated prior to calibration. It should be operated a sufficient amount of time to allow it to warm up to a stable operating temperature. This will minimize the effects of temperature drift.

9. Apply power to the Drive and the BCD Interface Board. Start the Drive. Program the BCD Interface Board for the maximum frequency desired and strobe it to load the data frequency. The Drive should ramp to maximum frequency.

Adjustments *(Continued)*

10. After allowing the Drive to ramp to full speed, determine the Drive output frequency.

    The Drive frequency should match the programmed BCD frequency ±0.1 Hz. If necessary, adjust the appropriate Maximum Frequency potentiometer to achieve the desired reading.

11. Reset the BCD data to the appropriate minimum frequency from the following table.

Maximum Range	Minimum Frequency
60 Hz	3 Hz
120 Hz	6 Hz
200 Hz	12 Hz

    Strobe the BCD Interface Board to load the minimum frequency. Allow the Drive to decelerate to the minimum frequency and read the Drive output frequency. The frequency should match the value previously listed ±0.1 Hz. If necessary, adjust R32 to achieve the appropriate minimum frequency.

12. Repeat steps 10 and 11 until further adjustment is not required.

13. Remove power from the Drive and the BCD Interface Board. Remove all test equipment and replace any covers removed. The adjustment procedure is complete and the Drive may be restored to normal operation.

Application of BCD Input

Programming should be arranged such that frequency and direction data are selected 10ms prior to the strobe signal and remain stable for 10ms after the strobe signal is initiated. This interval allows sufficient time for adequate debouncing and filtering of the data lines.

The BCD interface circuit responds to the negative going edge of the strobe signal (TTL output turning ON, pulling LOW towards common). After 10ms the frequency and direction data may be changed prior to the releasing of the strobe signal without affecting data previously stored. Refer to Figure 6.

IMPORTANT: Strobe is typically pulsed at a rate much faster than data is updated.

Application of BCD Input
(Continued)

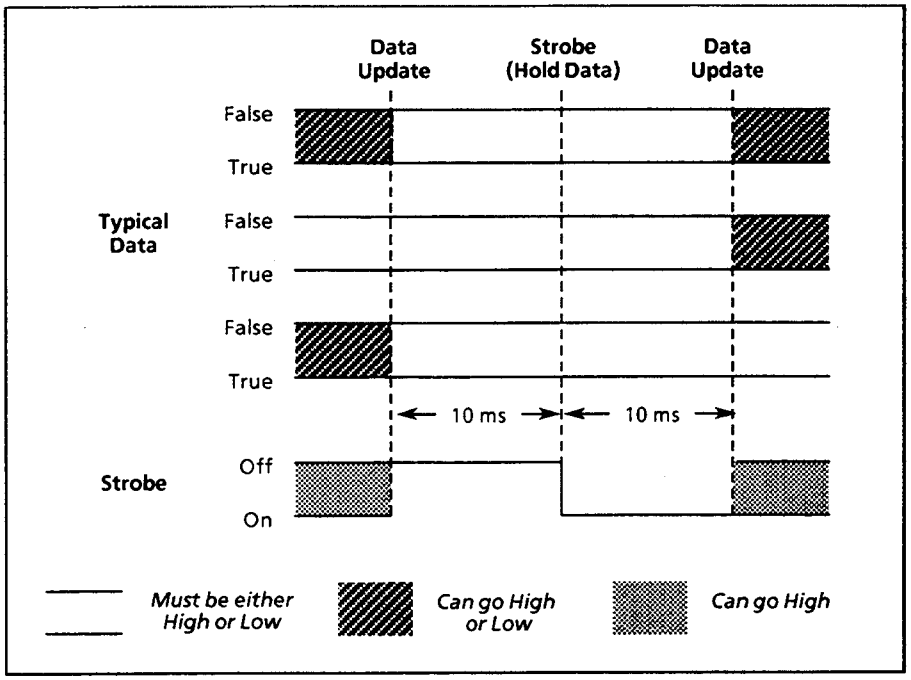


Figure 6 – Timing Diagram

Operation with an Allen-Bradley Programmable Controller

The Bulletin 1771-0G TTL Output Modules available for use in Allen-Bradley Programmable Controllers are ideal outputs for use with the BCD Interface.

Both 1771-0G TTL Modules must be set up for the LOW = True logic format by setting internal switches to the OFF position as shown in Figure 7.

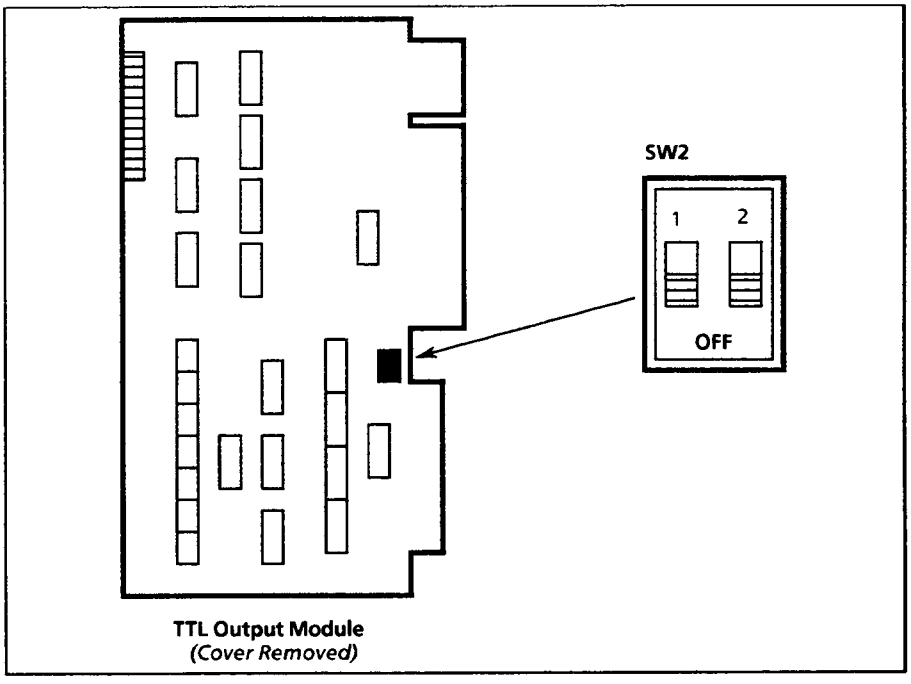


Figure 7 – Logic Switch Positions

Operation with an Allen-Bradley Programmable Controller *(Continued)*

For ease in programming, the 1771-0G TTL Output Modules should be located in the same module group of the programmable controller I/O chassis to furnish consecutive data bits from terminals 00-07 and 10-16. Drive frequency is defined from 000.0 Hz to 199.9 Hz in 0.1 Hz increments by terminals 00-07 and 10-14. Terminal 15 defines motor direction (forward/reverse) and terminal 16 is the strobe signal which triggers the time at which the frequency and direction data is read by the BCD interface circuit. Status indicator lights on the 1771-0G TTL Output Modules show LOW = True condition for each terminal.

Figure 8 shows typical connections between the BCD Interface Board and an Allen-Bradley Programmable Controller with 1771-0G, TTL Output Modules. A sample PC program follows the interconnect drawing in Figure 9.

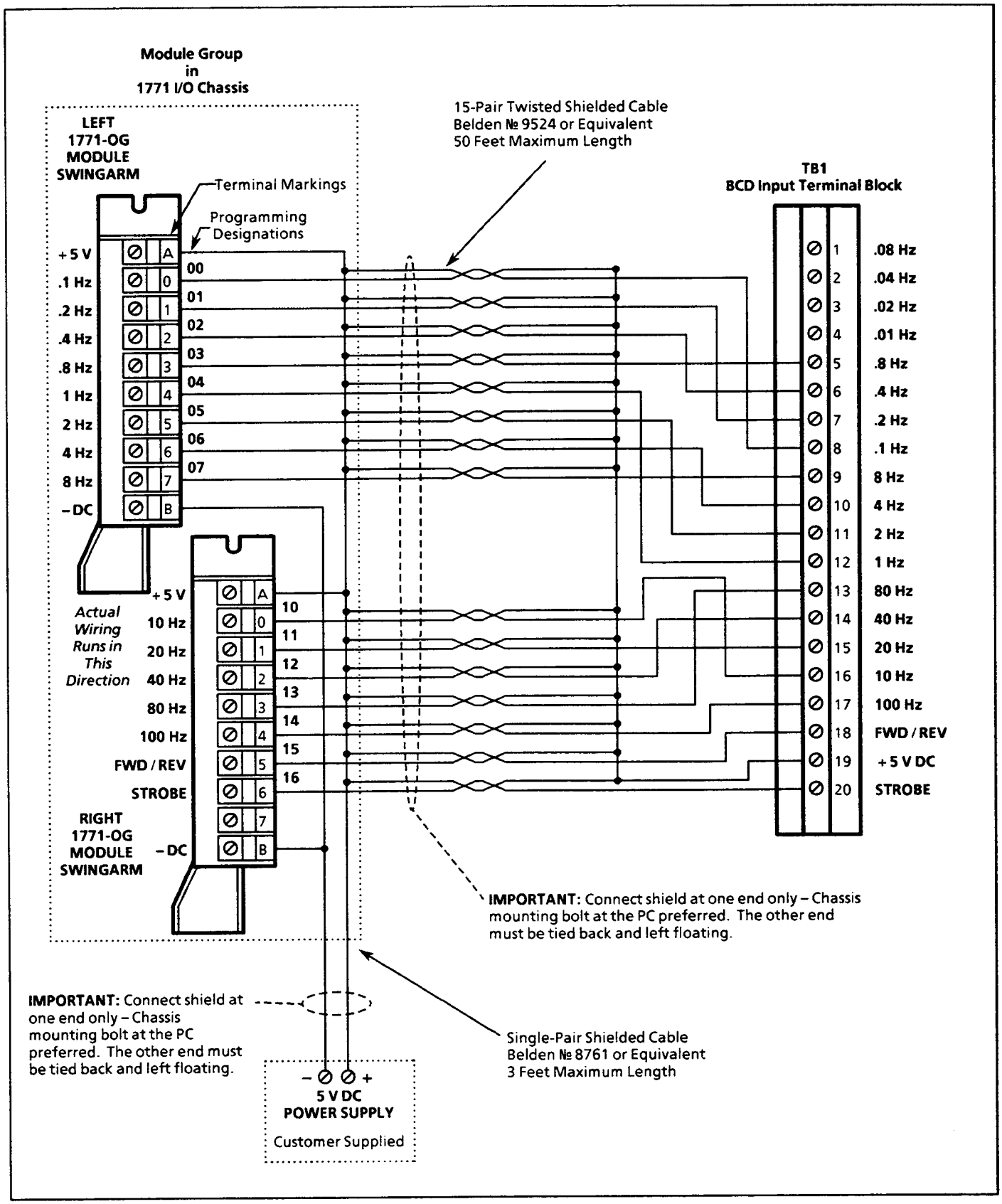
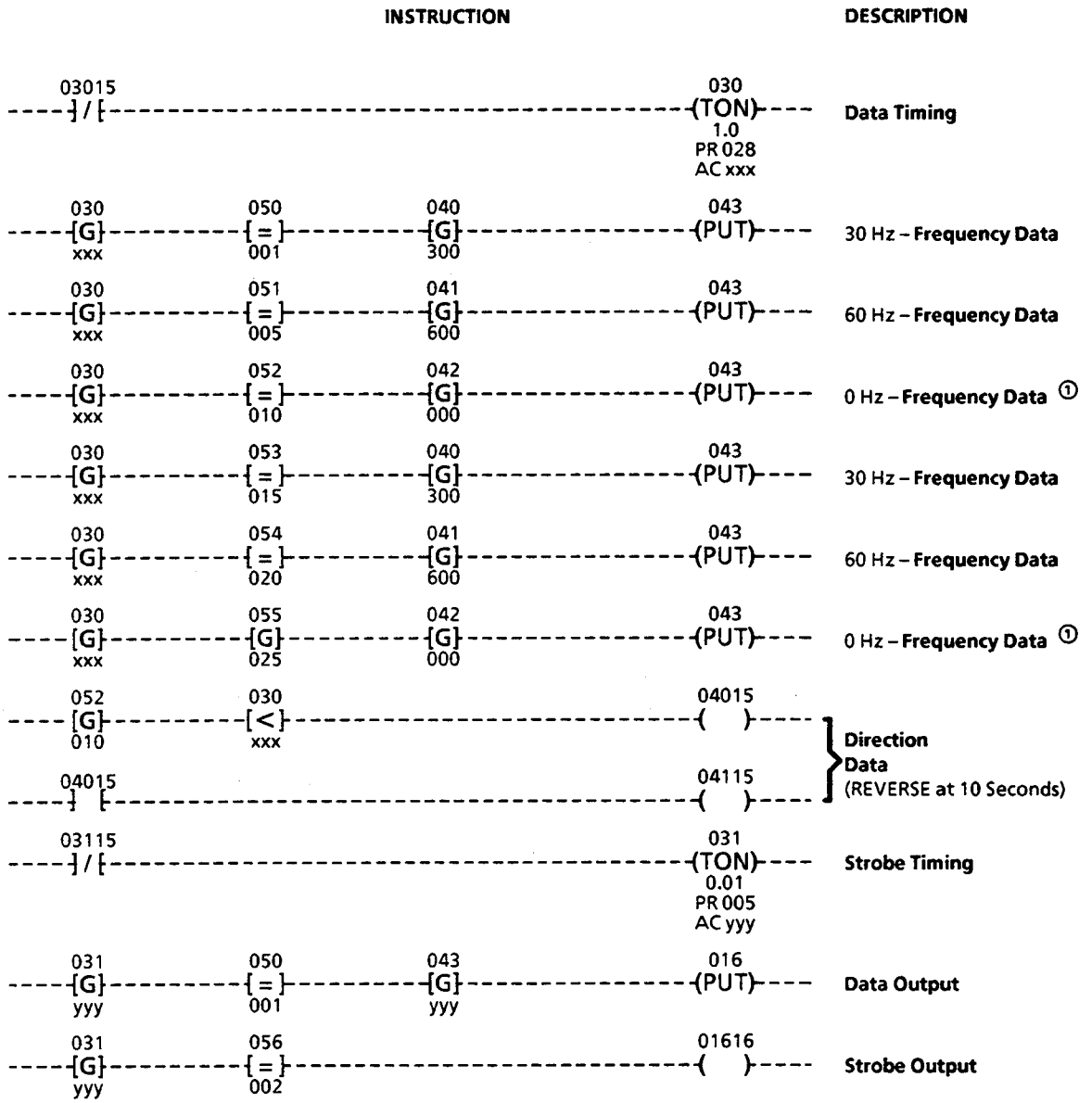


Figure 8 – Typical Interconnect Drawing with an Allen-Bradley Programmable Controller

FUNCTION: Changes data every 5 seconds, strobe for 10ms at 50ms intervals. The motor changes speed or direction every 5 seconds in the following sequence:
0 Hz, +30 Hz, +60 Hz, 0 Hz, –30 Hz, –60 Hz, 0 Hz



① A 0 Hz frequency command actually results in a typical 3 Hz Drive output frequency. See the Example presented on page 2.

Figure 9 – Sample Program

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