

H-BRIDGE PULSE WIDTH MODULATION MOTOR DRIVE CONTROL

NOTICE

This application note is provided for use as a general example and a guide. Divelbiss assumes no responsibility, liability or warranty regarding this application, its use, functionality or reliability to meet application needs. User assumes all responsibility to ensure all safety precautions are taken when using this application note. This application must not be used alone in applications which would be hazardous to personnel in the event of a failure. Precautions must be taken by the user to provide mechanical and/or electrical safeguards external to this application and controllers shown.

Application Description

This application provides a fully functional H-Bridge DC Motor Drive Control using Pulse Width Modulation (PWM). This includes the basic software and interface circuitry for the Divelbiss PCS Controller and the PLC on a Chip Integrated Circuit and Module. This motor drive control provides control over Direction (Forward / Reverse), Speed and Duty Cycle.

For best results, the frequency is default set for 24KHz to reduce the amount of high frequency noise being generated by the motor. This frequency is adjustable and should be configured for optimal performance for the selected manufacturer of the motor.

The speed is controlled by changing the duty cycle of the PWM signal (0-100%).

If feedback for speed control is desired, the controllers can easily accept a pulse signal.

Equipment Used

PLC on a Chip		PCS Controllers	
Controller P/N:	PLCHIP-M2-256XX or PLCMOD-M2-256XXX	Controller P/N:	PCS-XX1 or PCS-XX2
Programming Software:	Divelbiss EZ LADDER	Programming Software:	Divelbiss EZ LADDER
Application Program Filename:	AN110_PLC.dld	Application Program Filename:	AN110_PCS.dld
Connection Diagram:	Figure 1	Programming Cable:	ICM-CA-34
		Connection Diagram:	Figure 2

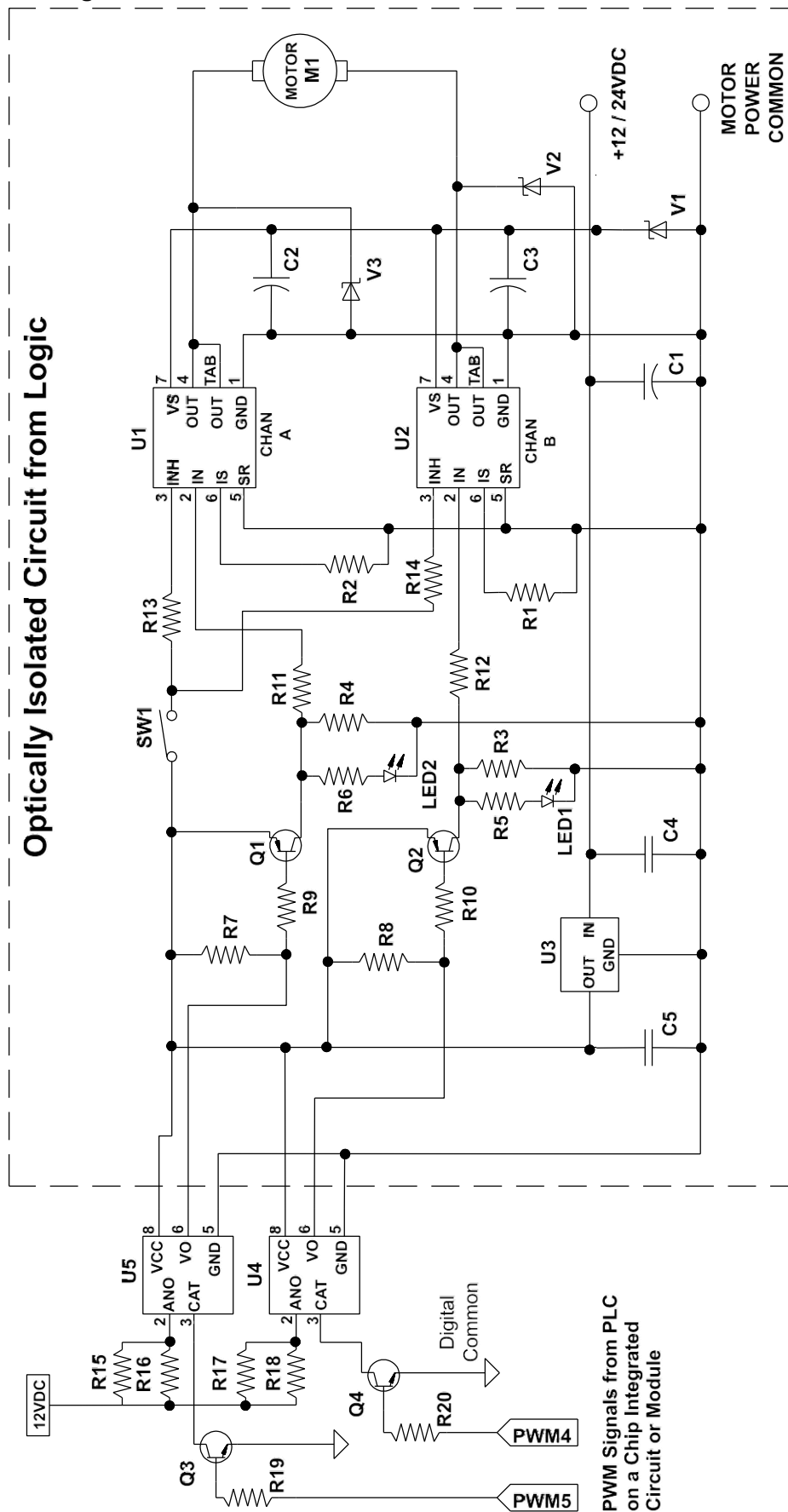


Figure 1- PLC on a Chip Interface

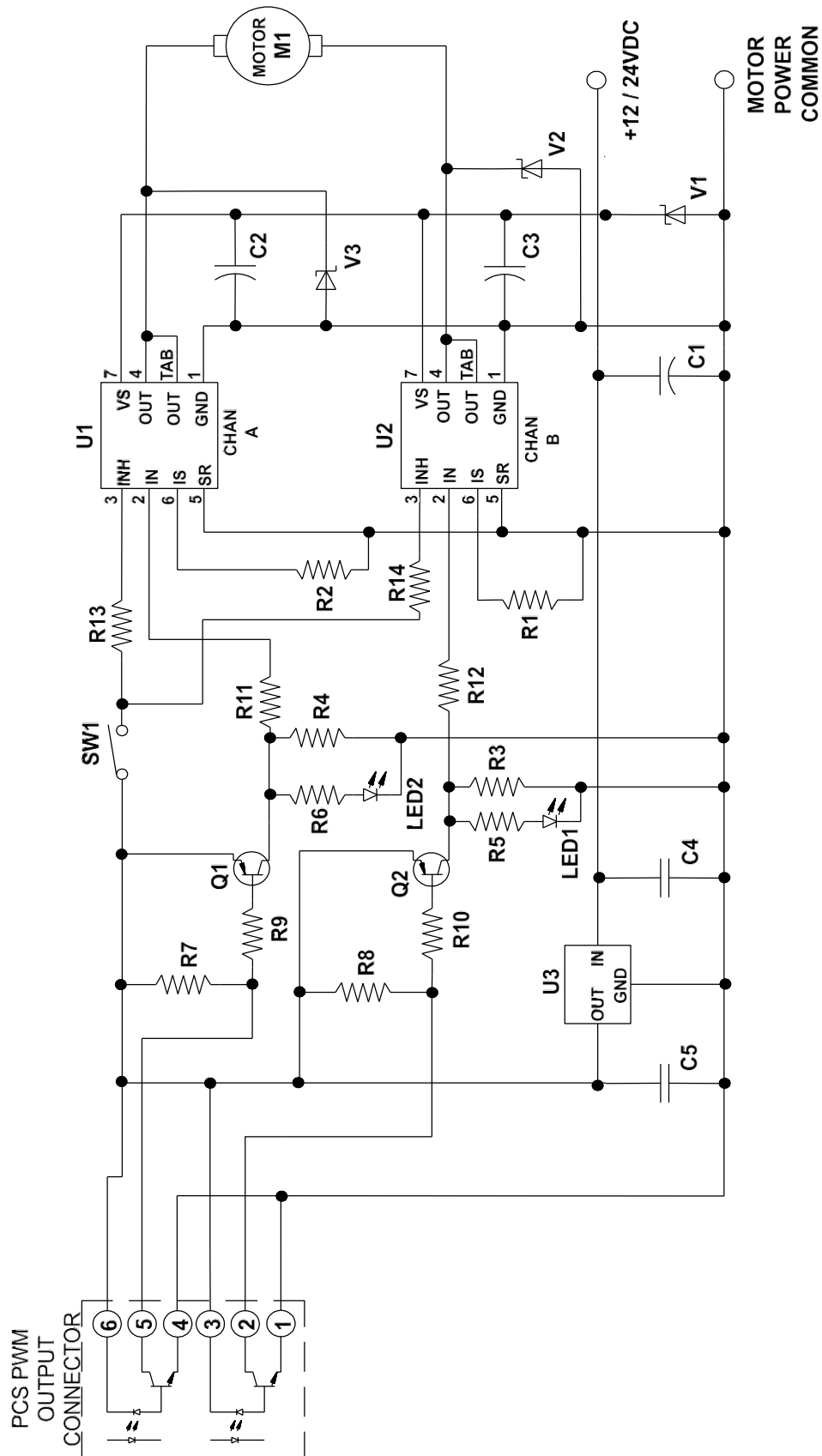


Figure 2 - PCS Controller Interface

Interface Circuit Parts List

PLC on a Chip Circuit Interface

Schematic ID	Qty	Part Number / Value	Description
V1, V2, V3	3	SMBJ30	Transorb
C1, C2	2	1 μ F, 50V	Electrolytic Capacitor
C3	1	470 μ F, 50V	Electrolytic Capacitor
C4	1	.33 μ F, 50V	Ceramic Disc. Capacitor
C5	1	.1 μ F, 25V	Ceramic Disc. Capacitor
U1, U2	2	BTS7960B	H-Bridge Motor Driver IC
U3	1	7805	5VDC Voltage Regulator, TO220 Package
SW1	1	SPST Toggle Switch	Toggle Switch, SPST, Normally Open
R1, R2, R3, R4, R19, R20	6	1K?	1K Ohm Resistor, 1/4 Watt
R5, R6	2	220?	220 Ohm Resistor, 1/4 Watt
R7, R8	2	2K?	2K Ohm Resistor, 1/4 Watt
R9, R10, R11, R12, R13, R14	6	10K?	10K Ohm Resistor, 1/4 Watt
Q1, Q2	2	2N2907A	PNP Transistor, General Purpose
U4, U5	2	HCPL-2601S	High Speed Opto-Coupler
Q3, Q4	2	2N2222A	NPN Transistor, General Purpose
R15, R16, R17, R18	4	1.5K?	1.5K Ohm Resistor, 1/4 Watt
M1	1		12 or 24VDC Motor
LED1, LED2	2		LED (Light Emitting Diode)

PCS Controller Circuit Interface

Schematic ID	Qty	Part Number / Value	Description
V1, V2, V3	3	SMBJ30	Transorb
C1, C2	2	1 μ F, 50V	Electrolytic Capacitor
C3	1	470 μ F, 50V	Electrolytic Capacitor
C4	1	.33 μ F, 50V	Ceramic Disc. Capacitor
C5	1	.1 μ F, 25V	Ceramic Disc. Capacitor
U1, U2	2	BTS7960B	H-Bridge Motor Driver IC
U3	1	7805	5VDC Voltage Regulator, TO220 Package
SW1	1	SPST Toggle Switch	Toggle Switch, SPST, Normally Open
R1, R2, R3, R4	4	1K?	1K Ohm Resistor, 1/4 Watt
R5, R6	2	220?	220 Ohm Resistor, 1/4 Watt
R7, R8	2	2K?	2K Ohm Resistor, 1/4 Watt
R9, R10, R11, R12, R13, R14	6	10K?	10K Ohm Resistor, 1/4 Watt
Q1, Q2	2	2N2907A	PNP Transistor, General Purpose
U4, U5	2	HCPL-2601S	High Speed Opto-Coupler
M1	1		12 or 24VDC Motor
LED1, LED2	2		LED (Light Emitting Diode)

Input / Output Description

The current application program uses:

PWM4: Pulse Width Modulation Output # 4. Forward or Reverse Control based on polarity of Motor connection to H-bridge. Outputs a Pulse Width Modulation signal at 24KHz. Duty Cycle is adjustable to control speed of motor.

PWM5: Pulse Width Modulation Output # 5. Forward or Reverse Control based on polarity of Motor connection to H-bridge. Outputs a Pulse Width Modulation signal at 24KHz. Duty Cycle is adjustable to control speed of motor.

* For PLC on a Chip, any PWM Channels may be used.

Additionally, an ENABLE switch (SW1) is shown in each schematic. This application does not show it, but a Digital Output Relay contact may be used to enable or disable the motor in addition to speed control.

Program Variables

DirCntrl: Boolean (Normally Open Contact). This is an internal contact to control the motor direction. This contact does not have a coil in the logic. The coil may be inserted and used to control the motor direction or a different contact may be used in place of DirCntrl.

Direction: Boolean (Contact / Coil). This actually controls the motor direction based on the DirCntrl contact.

Enable: Boolean (Normally Open Contact). This is an internal contact to control a software motor enable. This controls the PWM function blocks which control the outputs (this does not control the enable input in the interface circuit). This contact does not have a coil in the logic. The coil may be inserted and used to control the motor direction or a different contact may be used in place of Enable.

DriveEnable: Boolean (Contact / Coil). This actually enables and disables the PWM function blocks based on the Enable contact.

FreqOVR: Boolean (Normally Open Contact). This is an internal contact to allow an override of the default PWM frequency. This should be used during testing only. After entering a new frequency in 'Monitor Mode', Toggling this contact will cause the new frequency to load and be used (low to high to low transition on FreqOVR). Any changes made in 'Monitor Mode' must be made in the actual program variable or it will be lost after a power cycle (actually edit the program and change the variable Frequency default).

Frequency: Integer. This is the override frequency for the Pulse Width Modulation Outputs (PWM) when overriding the default frequency is desired.

Duty: Integer. This is the duty cycle of the Pulse Width Modulation Outputs. A range of 0-100% is available and adjusting this variable will change the motor speed. This variable should be connected to whatever process variable you are using to set and control the motor speed.

TDelay: Timer. This timer is default set for 1 second duration and is the delay prior to the motor energizing in any direction (time for the motor to completely stop prior to changing directions).

FDelayTimer: Timer. Actual elapsed time value.

RDelayTimer: Timer. Actual elapsed time value.

****For this application note, PWM Channels 4 and 5 are used. When using the PCS Controller, the PWM output channels must be 4 and 5. If using the PLC on a Chip, any PWM Channels may be used.**

Program Description

When Enable is true (Rung 1), the PWM Channels can be enabled (in software) and the PWM output for the currently selected direction will be active causing the motor to operate in the selected direction at the default frequency (unless override is used) and duty cycle set using Duty.

When DirCntrl is true, the motor direction will reverse, with a one second delay (value of DelayTime).

Controlling the Duty variable (0-100%) will adjust the motor speed accordingly.

The default frequency is set in the target's PWM properties.

Ladder Diagram

