Application Note - AN-119

Speed 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 example monitors RPM (or speed) and then controls a Pulse Width Modulation Output to drive a motor. It uses PID in a closed loop configuration to control the actual motor speed based on the set point. The set point in this example is a digital representation (integer variable) of the speed or RPM required.

Based on actual system needs; the scan time, PID parameters and more will need to be configured and tuned for proper performance and operation.

Equipment Used

Harsh Environment 1000 Series		
Controller Part #:		HEC-1000-E-R
Programming Software:		EZ LADDER Toolkit
Digital I/O:		On -Board
Application Filename:		AN119-HEC1.dld
Programming Cable:		HEC-910 & Null Modem

Other controllers may be used providing that they support high speed counting (high speed counter inputs) and Pulse Width Modulation (PWM) outputs.

Input / Output Description

PWM1: Pulse Width Modulation Channel 1. This channel is configured for 16 bit and the output signal is on the GPO1 pin

CNT 1: Counter Channel 1. This is where the sensor is connected to read the number of pulses (teeth)

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Program Variables

NumTeeth:	This variable is the actual number of teeth on the flywheel or gear. This value is defaulted to 60. To change this value, change the *Default Value* of the NumTeeth variable (using the Variable Edit Dialog).
R_NumTeeth:	This is a the converted value of the NumTeeth as a real variable type.
R_1200:	Real variable with a default of 1200. Used for calculations.
Multiplier:	Real variable that represents a multiplier needed to calculate speed based on the number of teeth and number of samples per minute.
CR1:	Boolean variable that is used to reset a high speed timer block causing it to restart timing.
TimVal1:	Integer variable used to hold the high speed timer output.
I_500:	Integer variable with a default of 500. Used for comparisons of the high speed timers.
PulseCnt:	Integer variable used to hold the actual number of teeth counted since the last counter reset.
Cnt_Store:	Real variable used to hold the actual number of teeth counted (converted from PulseCnt). This variable is only updated every 50mSec.
R_Speed:	Real variable representing the calculated speed.
Speed:	Integer (converted from Real) variable representing the speed (RPM).
Setpoint	This is a real variable that holds the current value of the desired set point (speed)
PWMout	The PWMout real variable drives the PWM function block and is the actual PWM control signal. It is calculated based on the PID function, inputs and set point.
Error	This real variable is an output of the PID function. It is the amount of error between the desired set point and the actual output (coil current).
Kp	Proportional PID input process variable (real variable).
Ki	Integral PID input process variable (real variable). Generally, the larger Ki, the slower the output changes to set point changes.
Kd	Derivative PID input process variable (real variable). This is generally zero.
IO	This is the default I/O setting for the output when the PID function first starts.

Program Description

Rungs 6-8:	The number of teeth (integer) is converted to a real variable and then the Multiplier is calculated by dividing the number of samples per minute (1200) by the number of teeth. The Multiplier will be used to calculate the Speed.
Rungs 10-12:	The High Speed Timer function will begin timing (free runs) and when it reaches 500 (50mSec), on the rising edge, the PulseCnt is stored into Cnt_Store and CR1 is set true (for one scan)..
Rungs 13-14:	When CR1 is TRUE this High Speed Timer is reset to zero.
Rungs 15-17:	The speed is calculated by multiplying the stored counts in the last 50mSec time the multiiplier calculated earlier.
Rungs 19-25	The PID function block with it's inputs and outputs calculates the actual PWMout which is used to drive the PWM0 output (motor speed).
Rungs 26-27	The PWM0 is enabled with the PWM function block. The Duty Cycle is the PWMout calculated value.

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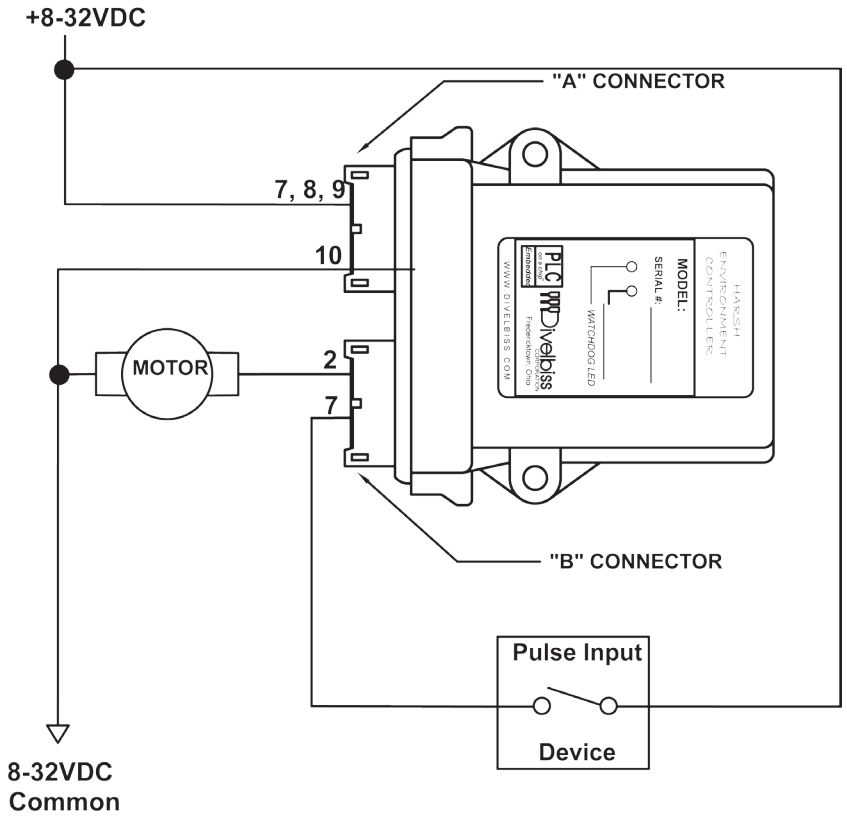
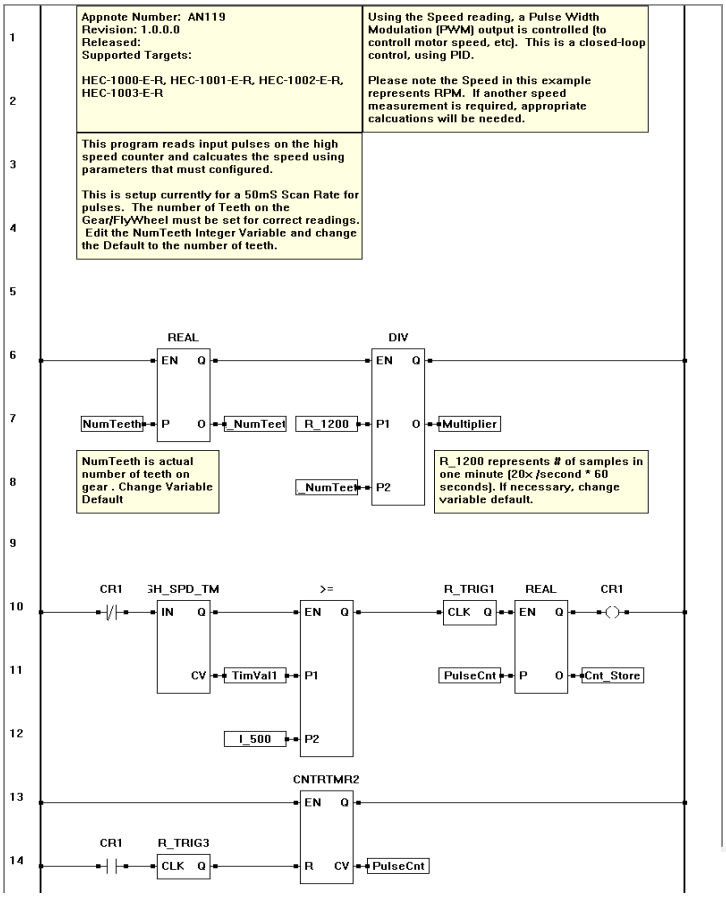
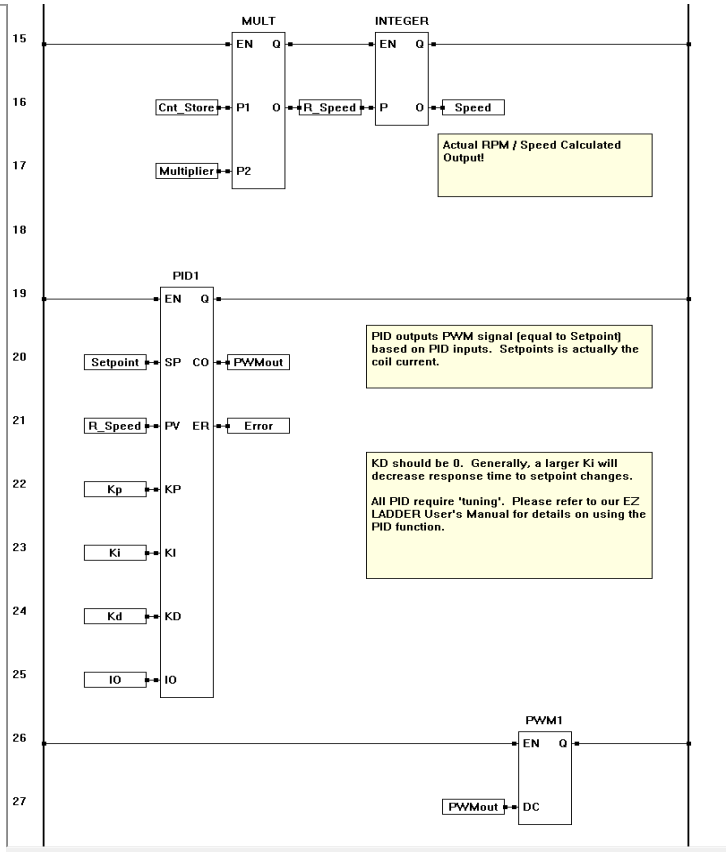
Connection Diagrams



Ladder Diagram





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