RSDM1

The rotary speed and direction module will measure and report rotational velocity based on a pair of quadrature encoded digital inputs. It provides parallel digital outputs for indicating the measured speed and direction of rotation. The module also has an analogue output whose voltage is proportional to speed of rotation.

The digital speed output is presented in revolutions per minute (RPM). The analog output varies from 0 to 10V DC according to speed of rotation. The analog output is updated continuously.

What it Measures

The speed measurement is determined as the time taken to measure one complete revolution. The software in the module treats the input pulses as though they are inputs from a position sensor. Thus, each time an input pulse is received, speed is re-calculated based on the elapsed time since the rotating object was last at the same position. This technique allows jitter free speed measurement of rotating objects whose average speed is constant, but whose velocity varies with position. It also allows for jitter free speed measurement from position sensors (such as photo-sensors) measuring the rotational speed of a rotating object with non-symmetrically spaced sense points.

Digital Interface

The thirteen-bit digital output represents speeds up to 8195 RPM. Two digital outputs are used to indicate direction of rotation. The module has 5 digital inputs for selecting the pulses per revolution (up to 32 pulses/rev). The handshaking is designed to interface to a typical PLC's digital inputs and outputs. The digital outputs' supply voltage is provided from a front panel connector, allowing 24V interface with PLCs, or 5V interface to PC logic. A digital input to the module selects interface timing to be high speed for microprocessor interface or low speed for PLC interface.

The data update rate is normally free running at rate of 20 updates per second. The actual update rate of the speed calculation will vary with the speed and the number of input pulses per revolution. The lower end of the range of measurement is limited to 114 RPM. Below this speed, the module outputs 0 RPM, but direction sensing is still performed.

FEATURES

- Converts a quadrature input signal into RPM.
- Measures signal from 114 RPM to 8195 RPM to within 0.1 %FS.
- Dual-speed Digital Interface for PLC or microprocessor connection.
- Analog output indicating speed.
- Tracks rotation speed by position of rotation rather than frequency. This allows *jitter free* measurement of average speed of non-symmetrical objects (irregularly spaced input pulses).

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Table 1: Product Specifications

SPECIFICATION	VALUE
SPEED RANGE	114 to 8195 RPM
ACCURACY	0.1% F.S.
POWER SUPPLY	
Vsupply	24 Vdc, 250 mA
V I/O	5 - 24VDC, 100mA
DIGITAL INPUTS	
All input signals are active high, 24 Vdc sourcing (PNP type). Relative to supply common. Internally de-glitched	
Input Impedance	10K Ohm
Input Low Voltage	8V Max
Input High Voltage	16V Min
DIGITAL OUTPUTS	
External Power connection - 5 to 24 VDC, active high, Push/Pull. Fused internally at 100mA Internal ESD protection	
Output High Voltage	
VIO = 24V	23V with 1 mA load 19V with10 mA load
VIO = 5V	4.5V with 1 mA load 4.0V with 10 mA load
Low Voltage	0 V
Load Resistance	2K Ohms Minimum
Rise Time	300 nanoseconds
Fall Time	300 nanoseconds
ANALOG OUTPUT	
Precision 0 to 10 Vdc, 10 bits resolution, represents 0 to 8195 RPM. Analog ground isolated from Supply common.	
Update Rate	20 times per second
Load Resistance	2K minimum.

INDICATORS

LED indicators on the module's front housing provide visual status of its operation.

Ready — Flashes at 2 Hz to indicate processor functioning correctly.

Sensor A — Instantaneous logic level of input signal 'Sensor A' at speeds lower than 114 RPM. At higher speeds, indicates activity on channel.

Sensor B — Instantaneous logic level of input signal 'Sensor B' at speeds lower than 114 RPM. At higher speeds, indicates activity on channel.

CW, CCW — Indicate motion, Direction of rotation, loss of quadrature on inputs. (See table below)

Table 2: Status Indicators CW, CCW

CW	CCW	MEANING
OFF	**OFF**	Output data not valid
OFF	**ON**	Rotation in counterclockwise direction
ON	**OFF**	Rotation in clockwise direction
ON	**ON**	Direction of rotation undetermined (not moving or quadrature fault).

CUSTOM VARIATIONS

CDA Systems Ltd. can provide custom variations to all of its products. Custom variations of this device are available on request. The digital input voltages, interface protocol, speed range, steady-state accuracy, and mechanical packaging may all be modified to suit the end customer's application.

Contact our factory for details.

Data Interface to PLC

The digital outputs of the module have been designed for interface to either PLC or microprocessor. The voltage supply for the digital outputs is provided via a connector on the front panel of the module. The timing of the digital interface is also selected via a digital input to the module. The interface can be operated in a polled fashion, or left to free-run, updating the output data every 50 milliseconds.

Table 3: Digital Interface Signal Description

SIGNAL	TYPE	DESCRIPTION
DC_COMM	**Power**	Common signal for All Digital I/O, including Sensor inputs.
PPR0 - PPR4	**Input**	Active high input forms 5-digit binary number describing the number of pulses per revolution on sensor inputs. The binary number must be equal to the number of pulses/rev minus 1. Input value of '0' represents a 1 pulse/rev input, and input value of '31' represents a 32 pulse/rev input. PPR0 is the least significant bit of the number. These bits are checked on every PLC update. If the number of pulses/rev is changed while in operation, the measured speed will not become valid until one complete rotation with the new input value.
SPEED0-SPEED12	**Output**	Active high output forms a 13-bit binary number representing the speed measured in RPM. Speed value is qualified by the CW, CCW, and DATA_VALID signals.
CW	**Output**	Active High output to PLC. If high, speed value is correct and direction is either clockwise, or undetermined. (See figure 2)
CCW	**Output**	Active High output to PLC. If high, speed value is correct and direction is either counter-clockwise, or undetermined. (See figure 2)
DATA_VALID	**Output**	Active High output to PLC. If high, speed value, CW and CCW bits are valid.
DATA_HOLD	**Input**	Active High input from PLC. If high, module will not begin an update of the PLC port. If brought low (inactive) while a scheduled update is pending, the update will occur immediately. If held low, the PLC interface will update every 50 milliseconds.
READY	**Output**	The ready output toggles its level every 500 milliseconds.
IO_PROT	**Input**	When active High, selects slow timing for PLC interface. Otherwise, high speed timing.

The DATA_HOLD input to the module is the only means that the PLC has to control the interface to the module. Data is not updated while DATA HOLD is high. If data is being updated (DATA_VALID, CW, CCW are low) when data hold goes high, that data update is completed and held until data hold goes low again. Data is updated immediately when data hold goes low if a scheduled update time has passed. Data is updated every 50 milliseconds if data hold remains low.

If the PLC interface is allowed to free-run, (DATA_HOLD held low), the output is updated every 50 milliseconds. In this case, the PLC program must check for validity of the data. If the DATA_VALID bit is active (high), the data is valid. If either of the CW or CCW bits are high, the speed data is valid.

If the IO_PROT input to the module is high, then the timing for the digital outputs is set up for typical PLC inputs. In this case, the DATA VALID, CW, and CCW signals are held low for 4 milliseconds before and after the speed data lines are allowed to change to account for the PLC input response time. Four milliseconds later, the CW and CCW bits become valid, and another four milliseconds later, DATA_VALID goes high. If the IO_PROT signal is low, then the 4 millisecond delay is reduced to a one micro-second delay.

If direction cannot be determined due to lack of movement or loss of quadrature signal, then both CW and CCW will be turned on simultaneously.

Table 4: Definition of CW and CCW Bits

CW	CCW	MEANING
0	**0**	Output data not valid
0	**1**	Rotation in counterclockwise direction
1	**0**	Rotation in clockwise direction
1	**1**	Direction of rotation undetermined (not moving or quadrature fault).

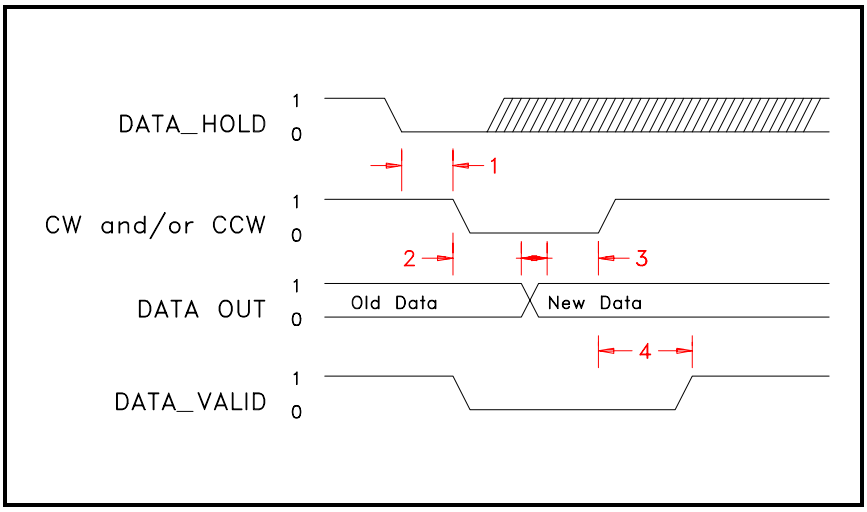

Table 5: PLC Interface Timing

SYMBOL	DESCRIPTION	TIMING FOR IO_PROT LOW	TIMING FOR IO_PROT HIGH
1	Data Hold low to start of update	500 microseconds max	500 microseconds max
2	CW, CCW, DATA_VALID low to output data change	1 microsecond minimum	4 milliseconds minimum
3	Output Data Change to CW/CCW valid	1 microsecond minimum	4 milliseconds minimum
4	CW/CCW valid to DATA_VALID	1 microsecond minimum	4 milliseconds minimum

Pinout of 25-Pin D-Shell Connector on RSDM1 Module

PIN	NAME	DESCRIPTION
1	DC COM	24V supply common
2	PPR4	MSB of Pulse/Rev input.
3	SPEED0	LSB of speed output (to PLC)
4	SPEED2	Speed output (to PLC)
5	SPEED4	Speed output (to PLC)
6	SPEED6	Speed output (to PLC)
7	SPEED8	Speed output (to PLC)
8	SPEED10	Speed output (to PLC)
9	SPEED12	MSB of speed output (to PLC)
10	CCW	Counterclockwise output - Active when motor rotation is counterclockwise or direction undetermined
11	PPR0	Input, LSB of # of Pulses/Rev
12	PPR2	Input, Bit 2 of # of Pulses/Rev
13	DATA_HOLD	Data Hold input from PLC
14	DATA_VALID	Data Valid output to PLC
15	IO_PROT	Selects high/low speed protocol. Active High results in slow timing.
16	SPEED1	Speed output (to PLC)
17	SPEED3	Speed output (to PLC)
18	SPEED5	Speed output (to PLC)
19	SPEED7	Speed output (to PLC)
20	SPEED9	Speed output (to PLC)
21	SPEED11	Speed output (to PLC)
22	CW	Clockwise output - Active when motor rotation is clockwise or direction undetermined
23	READY	Output, Active when module ready for operation
24	PPR1	Input, Bit1 of # of Pulses/Rev
25	PPR3	Input, MSB of # of Pulses/Rev

Pinout for 8 Position Combicon Connector on RSDM1 Module

PIN	NAME	DESCRIPTION
1	24VDC	24 Volt Power Supply, Fused at 1 Ampere
2	VI/O	Supply voltage for Digital Outputs. Relative to DC Com. Fused at 1 Ampere.
3	DC COM	24 Volt Supply Common
4	SENSORA	Input from Speed sensor A. This input is used to determine speed of rotation. Relative to Supply Common.
5	SENSORB	Input from Speed sensor B. This input is used to determine direction of rotation. Relative to Supply Common.
6	NC	No Connection
7	ANALOG COM	Common signal for analog output. Isolated from supply common.
8	ANALOG OUT	Analog output : 0 to 10 Volts for 0 to 8195 RPM. Output is continuously updated. Drives loads greater than 2 Kilo-ohm