SD037 Mains Frequency Monitor

User Instructions

SD037/3-NAM
RS485 ASCII & Modbus

Rev 25/07/18

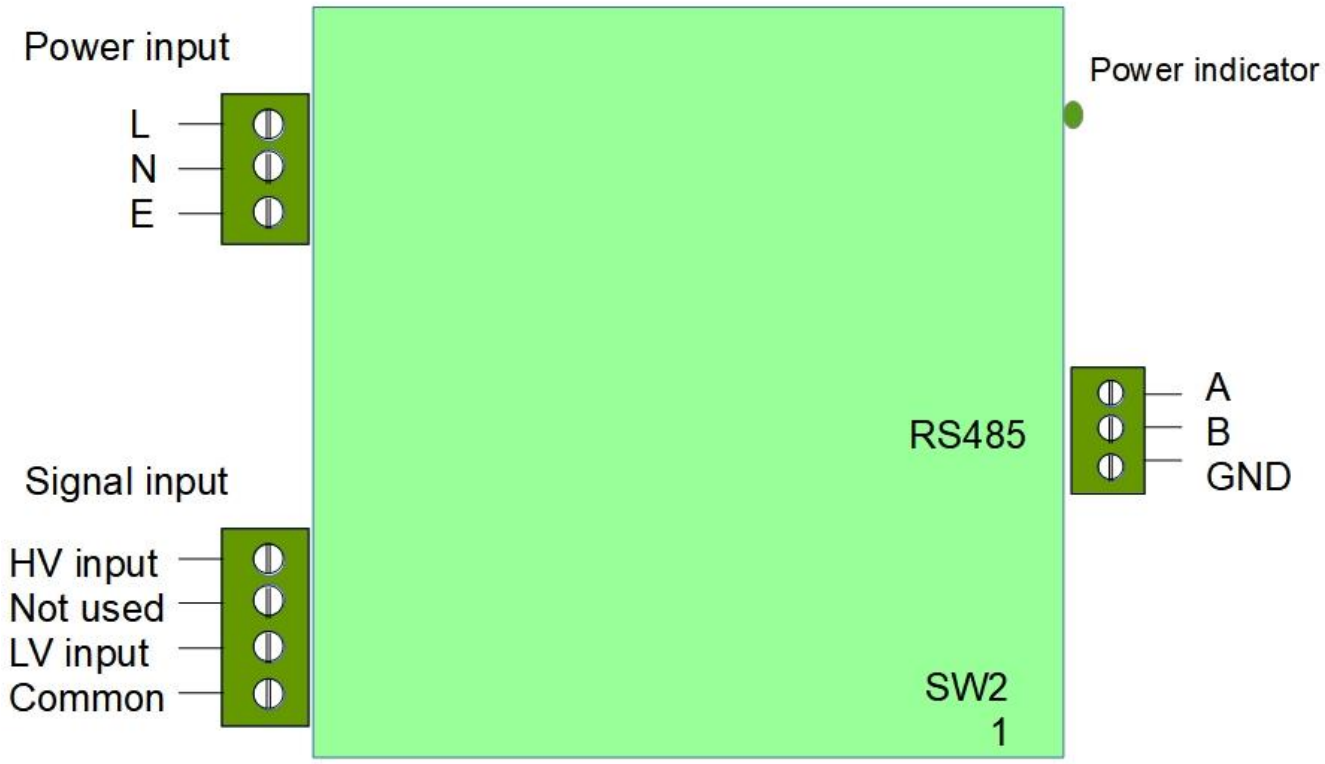
Relates to firmware version 1.81 & 2.82

Description

The SD037 is designed to monitor the frequency of a mains voltage signal and report the value, on demand, via an half duplex RS485 serial interface. This version has a selectable ASCII or Modbus RTU protocols

It features a 3 pole low pass Bessel filter with a -3dB frequency of 75Hz. This removes unwanted harmonics from the input signal. It is housed in a DIN rail mount case and powered from a universal input mains supply.

Connection details



Power

Power input is from an AC supply of between 85 and 264V, frequency 47 – 63Hz.
Connect live to L, Neutral to N and Earth to E terminals.

Signal input

For mains frequency monitoring connect Live to HV input and Earth to common.
For low voltage test inputs connect between LV input and Common.

RS485 connections

A&B = Data signal wires. They automatically switch from receive to transmit mode when a request is received from the master controller. Connect A to A & B to B on the network.

GND = Cable screen connection. The port is fully isolated so does not have a problem with ground loops. If there are non-isolated devices on the network, only one of them should be connected to the screen.

Note: RS232 & RS485 signals are isolated from the rest of the instrument and each other.

USB to RS485 Adaptor

Synectic can supply a USB to RS485 adaptor that provides a fast, simple way to connect the SD037s RS485 interface to USB. The data signal connections and ground connection connect directly to the corresponding terminals on the SD037. The image below shows the connections from the adaptor.

Communications protocol

Communication is by RS485 serial interface. Data format is 8 data bits, 2 stop bits, no parity.
SW2 selects which protocol is used, OFF = ASCII, ON = Modbus RTU
Baud rate is determined by the setting of SW1, located next to the RS232 connector.
With SW1 off, (UP position), the baud rate is 115k2, with the switch on (DOWN) the baud rate is 19K2.

ASCII Protocol

The commands available use standard ASCII characters, all starting with * ($2A)
In the following table, <sp> indicates space ($20), <cr> indicates carriage return ($D) If a command is received that isn't recognised the response will be ?<cr>. A Longitudinal Redundancy Check (LRC) can be added to the frequency reading if required.

Command	Response
*ID?<cr>	Instruments identification. Eg <sp>SD037,v1.81,1234<cr>' SD037 is the model, v1.81 is the firmware version, and 1234 is the serial number
*F?<cr>	Reports the current frequency. Eg <sp>49.9708<cr> (from version 2.81 If nothing connected report 0.0000Hz)
*C16000000<cr>	Frequency calibration function. This allows the instrument to be calibrated. The internal reference oscillator is 16MHz. The actual frequency can be measured on TP1 using a calibrated frequency counter. Get a measurement to 8 digits then enter the value. The unit will echo back the received value. Eg assuming the measured value is 16000045Hz, transmit *C16000045, response is <sp>16000045<cr> Note: A shift of 200 counts results in a shift in reading of 1 mHz.
*C?<cr>	Read the current calibration value. Eg transmit *C?<cr>, response is <sp>16000045<cr>
*A02<cr>	Modbus slave address function. *A followed by a 2 digit hexadecimal number defines a new address. Valid addresses range from 01 to F7 (1 – 247). If a value outside this range is entered the response will be “Range 01 to F7” and no change will be made.

*A?<cr>	Read the current slave address. Eg transmit *A?<cr>, response is <sp>02<cr>
*L?<cr>	Report status of LRC option. Response is “LRC Enabled”<cr> or “LRC Disabled”<cr>
*L1<cr>	Enable LRC option.
*L0<cr>	Disable LRC option

LRC implementation

To calculate the LRC, add all bytes transmitted by the *F? Command, AND result with $FF, then XOR with $FF, add 1 and AND with $FF.
eg. for the *F? example above:
ASCII <sp> 4 9 . 9 7 0 8 <cr>
hex 20+34+39+2E+39+37+30+38+0D = 1A0
1A0 AND FF = A0, A0 XOR FF = 5F, 5F+1 = 60 = LRC

Frequency measurement accuracy

The frequency is initially calibrated to an accuracy of +/- 0.0001Hz. According to the crystal oscillator manufacturer's data, drift in the 1st year is +/- 5ppm = +/- 0.0003Hz max.
Over the following 10 year period, drift is +/-10ppm = +/-0.0005Hz

Modbus RTU Protocol

To read the measured frequency to 4 decimal places, Modbus function code 03 is used to read two 16 bit holding registers. Stored in the registers is a 24bit hexadecimal value relating to the frequency x 10000. The Communication Log below shows an example of a frequency measurement.

The transmitted sequence is

Slave address 02

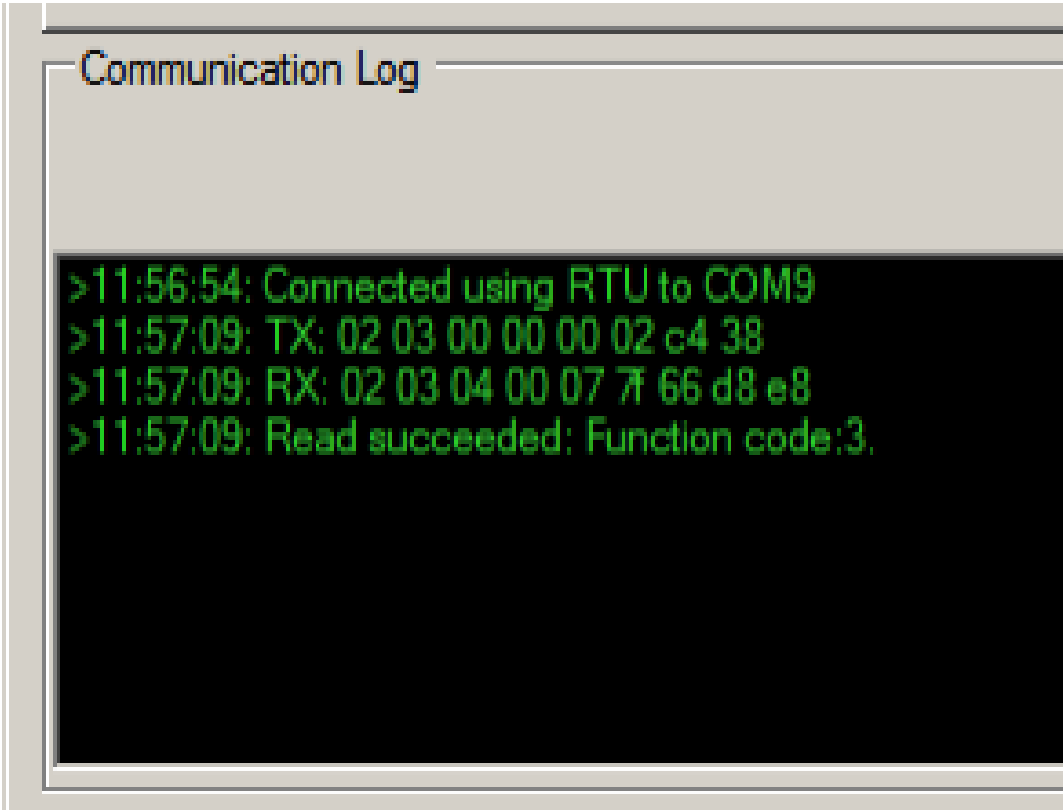
Function code 03
Starting Address 0000
No.of registers 0002
CRC check C438

Response

Slave address 02

Function code 03
Byte count 04
Frequency 077F66
CRC check C438

The frequency in hex is 077F66 = decimal 491366 /10000 = 49.1366Hz



Specifications

Parameter	Min	Typ	Max
Power supply voltage	85Vrms		264Vrms
Power consumption		1.2W	
Power supply frequency	47Hz		63Hz
HV input signal	20Vrms		250Vrms
LV input signal	2Vrms		25Vrms
Frequency measurement range	10Hz		90Hz
Low pass filter cutoff (-3dB)		75Hz	
RS232 & RS485 isolation	2500Vrms for 1min as per UL1577		
Frequency stability	+/-30ppm over temperature range -20C to 70C		
Enclosure	DIN rail 22.5x82x90mm. Green flame retardant PA 66 UL 94-V0		
CE	The CE mark confirms the compliance with European Directives, notably the Low Voltage Directive and the EMC Directive		