   

OES

for the EasyStart: ASY-366-xxx
with MODBUS support

OPERATOR'S MANUAL

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TECHNICOLD
by NORTHERN LIGHTS

   

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Connections: Follow the included wiring diagram and connect EasyStart as shown. Connect L1 and L2 to a current protected control device such as a thermostat and contactor on a circuit breaker.

Learning: When a compressor is first connected, EasyStart will learn for the first seven to eleven starts of the compressor. After the learning process is complete, EasyStart chooses the best starting characteristic for the compressor. No action is required and the compressor can be used normally during the process.

Jumper Settings: Two options can be selected using the provided board mounted header and shorting jumper. Power must be removed from EasyStart when changing jumper settings.

When the shorting jumper is placed on pins 1 and 3 in the “Fixed Start” position, EasyStart will use a factory defined short ramp on every start. This is used for diagnosing certain types of system problems and should only be used with manufacturer support.

If a compressor is replaced with a different size, manufacturer or type of compressor, relearning may be required. Place the shorting jumper on pins 4 and 6. Start a cycle with the compressor control device and terminate the cycle. Remove the jumper from the relearn position and return it to the normal position. The learning process will occur as described above. **The re-learn jumper position also returns the MODBUS communications settings to the default values.

Faults: Three LED lights are provided to help diagnose detected faults. All repairs and tests must be done with power removed. The actual LED indications for the following faults are shown in table in the wiring diagram at the end of this document.

SC to RC Terminal Short: A short was detected between the SC and RC terminals that could indicate improper wiring or a stuck start relay. The relay can be checked by removing the connections and testing continuity between the terminals. If a short exists, the board must be replaced. If this condition is detected, power should be removed quickly to prevent failure of the start capacitor.

High compressor current: Compressor running current is limited to a maximum of 38 amps. EasyStart will shut down and indicate this fault if current exceeds this value.

Open overload protector: An improper operating condition exists that is consistent with an overload protector opening during operation. Any condition that causes the connection to the compressor to be broken can cause this fault.

Compressor stalled: An improper operating condition exists that is consistent with a stalled compressor. This condition is triggered by an improper signal on the start winding of the compressor and can be caused by a broken start winding wire connection, a failed start capacitor, as well as a locked compressor rotor – which can be due to a lack of pressure equalization at startup, low voltage at startup, and other causes.

Power Interrupted: A temporary power loss was detected and EasyStart shut down the compressor. If power is restored before EasyStart completely loses power, EasyStart will restore operation after two minutes and log a fault.

MODBUS SUPPORT

Features:

Fault history access for last 32 events.
Adjustable MODBUS addressing
Changeable baud rate and parity
Compressor RMS running current available during operation
Start current profile available after compressor starts
Operation status
Firmware revision

Conventions within this document:

0x Values with this prefix are hexadecimal.
0b Values with this prefix are binary.

Specifications:

Interface: RS485
Protocol: MODBUS RTU
RTU protocol default: 11 bits
- Coding system: 8 bit binary
- Start bits: 1
- Data bits: 8, least significant bit sent first.
- Parity: Even
- Stop bits: 1

Device address range: 1 to 247
Baud: 1200, 2400, 4800, 9600, 19200, 38400
Parity: Even, Odd, None
Stop bits: Automatically selected based on parity.
Default baud: 19200
Minimum silent interval time: 30mS

Data Frames:

Data frames from master to slave and from slave to master follow the MODBUS.ORG: MODBUS over serial line specification as follows:

Address (1byte)	Function Code (1 byte)	Data (0 to 252 bytes)	CRC (16 bits)

Function Codes:

Function Code	Definition	Parameter Range	Access Type	Response Bytes
1 (0x41)	Read byte(s)	0x0000 to 0xFFFF	Byte	Variable
2 (0x42)	Write byte(s)	0x0000 to 0xFFFF	Byte	Variable

Read byte(s):

This function code is used to read specific data values from the control. Valid parameter entries are listed in the Read Parameter Table. Values requested outside the ranges provided in the Read Parameter Table will generate an error. Byte counts should match the counts used in the table.

Request:

Name	Length	Range
Parameter Address	1 byte	0x01 to 0xF7
Function Code	1 byte	0x41
Parameter Number	2 bytes	0x0000 to 0xFFFF
Byte count	1 byte	N = 0x01 to 0xF0
CRC	2 bytes	0x0000to 0xFFFF

Response:

Name	Length	Range
Parameter Address	1 byte	0x01 to 0xF7
Function Code	1 byte	0x41
Parameter Number	2 bytes	0x0000 to 0xFFFF
Byte count	1 byte	N* = 0x01 to 0xF0
Response bytes	N* bytes	0x01 to 0xF0
CRC	2 bytes	0x0000 to 0xFFFF

N= Quantity of bytes requested

Error (exception response:)

Name	Length	Range
Parameter Address	1 byte	0x01 to 0xF7
Error Code	1 byte	0xC1
Exception Code	1 byte	Codes 1,2,3,or 4
CRC	2 bytes	0x0000 to 0xFFFF

Read ParameterTable

Parameter Address	Contents	Byte Count	Values	Response
0x8000	Baud rate	2	0x01A0 = 2400 baud 0x00CF = 4800 baud 0x0067 = 9600 baud 0x0033= 19200 baud 0x0019 = 38400 baud	9 bytes
0x8002	Parity	1	0x08 = no parity 0x20 = even parity 0x30 = odd parity	8 bytes
0x8003	Slave Address	1	0x01 to 0xF7	8 bytes
0x8004	Fault history pointer	1	0x00 to 0x19	8 bytes
0x8005	RMS Current	1	0x00 to 0x64	8 bytes
0x8006**	Fault history	5	0x00 to 0xFF	12 bytes
0x80C0	Status	1	0x00 to 0xFF	8 bytes
0x80C1	Revision	2	0x00 to0xFF	9 bytes
0x8100	Compressor current data	200	0x00 to 0xFF	207 bytes

** Starting address, see description.

Reading Baud, Parity, and Slave Address:

This data should be read for change verification by sending the device an appropriately formed data frame containing the device address, a read data function code, an address from the read data table, number of data bytes and the CRC.

Reading RMS Current:

This address provides the instantaneous RMS running current for the compressor. The value can be read any time.

Reading the Fault History:

History is stored in 32 - five byte intervals indexed by the fault history pointer. The Fault History Pointer return value is the index to the oldest fault in the history. When a fault occurs, the fault information in the oldest fault location is replaced by the current fault and the pointer is incremented. If the pointer value exceeds thirty one, the pointer will be reset to zero. Reading the address at 0x8006 + ((history fault pointer – 1)*5) will return the most recent fault.

Example:

If the history pointer returns a 5, the most recent fault is stored at address 4:

(History read address + (4*5)) = (0x8006 + 0x14) = 0x801A

Reading the information stored at parameter address 0x801A returns the most recent fault information. Note: A special case exists if the fault pointer returns a 0 then the most recent fault information is located at Parameter address 0x80A1.

Fault History Table

Byte #	Value type	Definition
0	Undefined	Undefined
1	Bit field (see Fault Bit Field Table)	Fault type
2	8 bit	Line frequency (Hz)
3,4	16 bit: 3 = MSB, 4 = LSB	Current(Amps)

Fault Bit Field Table

Decimal	Binary***	Hex	Fault
0	0b00000000	0x00	Normal operation
8	0b00001000	0x08	Open Overload Protector
16	0b00010000	0x10	High Compressor Current
24	0b00011000	0x18	SC to RC Terminal Short
32	0b00100000	0x20	Compressor stalled while starting
40	0b00101000	0x28	Compressor stalled after starting
48	0b00110000	0x30	Power interrupted
56	0b00111000	0x38	Normal operation

Compressor Current Data

RMS current data for the compressor start is available once the compressor is running. This data is organized in byte values representing the actual RMS current in amps for a specific time interval. One byte is sent for each zero crossing event that occurs. For a 60 Hz line, each data byte represents the RMS current over an 8.33 millisecond period. This data can be retrieved as shown in Frame Usage Example 2.

Status

Operating status may be polled at any time while power is supplied. Response bit field definitions can be found in the Status Response Table. Faults are defined in the Fault Bit Field a stuck compressor relay is indicated, EasyStart is in lock out and no restart attempts ade. If any other fault is indicated, EasyStart will wait two minutes and attempt a restart. tart bit is set, EasyStart is in the process of starting the compressor. Start bits will remain active when set even after the compressor has started. Once the running bit is set, EasyStart has successfully started the compressor and is monitoring run current and other conditions.

Status Response Table

Bit	Hex	Definition
0	0x01	Not defined
1	0x02	Starting
2	0x04	Starting
3	0x08	Fault
4	0x10	Fault
5	0x20	Fault
6	0x40	Running
7	0x80	Not defined

Two bytes are returned containing the software revision. The first byte is an ASCII representation letter code. The second byte is the numerical decimal code for the revision. Revision A30 would return a 0x65 and 0x1E for the fifth and sixth return bytes respectively.

Write Byte(s):

This function is used to set parameters defined in the Write Address Table. Parameter addresses or data values outside the values provided in the table will cause an exception response.

Request:

Name	Length	Range
Address	1 byte	0x01 to 0xF7
Function Code	1 byte	0x42
Starting Address	2 bytes	0x0000 to 0xFFFF
Byte count	1 byte	N = 0x01 to 0xF0
Data Bytes	N bytes	0x00 to 0xFF
CRC	2 bytes	0x0000 to 0xFFFF

N = Quantity of bytes to be written

Response:

Name	Length	Range
Address	1 byte	0x01 to 0xF7
Function Code	1 byte	0x42
Starting Address	2 bytes	0x0000 to 0xFFFF
Byte count	1 byte	N* = 0x01 to 0xF0
Response bytes	N* bytes	0x01 to 0xFF
CRC	2 bytes	0x0000 to 0xFFFF

N= Quantity of bytes written

Error (exception response)

Name	Length	Range
Address	1 byte	0x01 to 0xF7
Error Code	1 byte	0xC2
Exception Code	1 byte	Codes 1,2,or 3
CRC	2 bytes	0x0000 to 0xFFFF

Write Address Table

Parameter Address	Contents	Byte Count	Values	Response
0x8000	Baud rate	2	0x01A0 = 2400 baud 0x00CF = 4800 baud 0x0067 = 9600 baud 0x0033 = 19200 baud 0x0019 = 38400 baud	9 bytes
0x8002	Parity	1	0x08 = no parity 0x20 = even parity 0x30 = odd parity	8 bytes
0x8003	Slave Address	1	0x01 to 0xF7	8 bytes

Setting Baud and Parity:

Changes are made to the register addresses assigned to Baud or Parity should be set then verified by reading the contents. Power must then be removed from the device and reapplied to complete the change. Master communications settings must then be matched to the changed communications parameter settings for communication to occur. A parity change to "none" will result in a change to two stop bits in keeping with the 11 bit RTU MODBUS protocol.

Changing the Slave Address:

Changes made to the register address assigned to the Slave Address are active as soon as the response is received from the device.

Exception Responses:

Exception	Definition
0x01	Illegal function
0x02	Illegal data address
0x03	Illegal data value

Message Frame Usage Example 1

Action: Write new baud

Command: Master – Slave

Address		0x01	Slave address = 01
Function		0x42	Function is write
Data	Parameter High Byte	0x80	High byte parameter number to be written
	Parameter Low Byte	0x00	Low byte parameter number to be written
	Byte Count	0x02	Number of bytes to be written = 2
	First Byte	0x00	Value for 9600 baud (0x0067)
	Second byte	0x67	
	CRC Low byte	0xE5	Low byte of CRC check
	CRC High byte	0x16	High byte of CRC check

Message Frame:

01	42	80	00	02	00	67	E5	16

Answer Slave- Master:

Address		0x01	Slave address=1
Function		0x42	Function sent
Data	Parameter High Byte	0x00	High byteparameter number written
	Parameter Low Byte	0xF0	Low byteparameter number written
	Byte Count	0x02	Number of bytes written
	First Byte	0x00	Value for 9600 baud (0x0067)
	Second byte	0x67	
	CRC Low byte	0xE5	Low byte of CRC
	CRC High byte	0x16	High byte of CRC

Reply frame:

01	42	80	00	02	00	67	E5	16

Message Frame Usage Example 2
Action: Read StartCurrent

Command: Master- Slave

Address		0x01	Slave address = 1
Function		0x41	Function is read
Data	ParameterHighByte	0x81	High byteparameter number for start current
	ParameterLow Byte	0x00	Low byteparameter number for start current
	Byte Count	0xC8	200 bytes returned
	CRC Low byte	0x5C	Low byte of CRC check
	CRC High byte	0x42	High byte of CRC check

Message Frame:

01	41	81	00	C8	5C	42

Answer. Slave– Master

Address		0x01	Slave address= 1
Function		0x41	Function sent
Data	Parameter High Byte	0x81	High byte parameter number written
	ParameterLow Byte	0x00	Low byte parameter number written
	Byte Count	0xC8	Number of bytes written
	** 200 bytes returned with last start data		
	CRC Low byte	0x11	Low byte of CRC
	CRC High byte	0x22	High byte of CRC

Reply frame:

01	41	81	00	C8	200 bytes returned here containing data*	F0	1E

*CRC example uses 0x00 for all 200 bytes.

Exception Response Example:

Action: Change Baud

Message: same as example 2

Exception response:

Address		0x01	Slave address = 1
Function		0xC2	Exception response for function 0x42
Exception code		0x03	Illegal address error
Check	CRC Low byte	0xA0	Low byte of CRC
	CRC High byte	0xD4	High byte of CRC

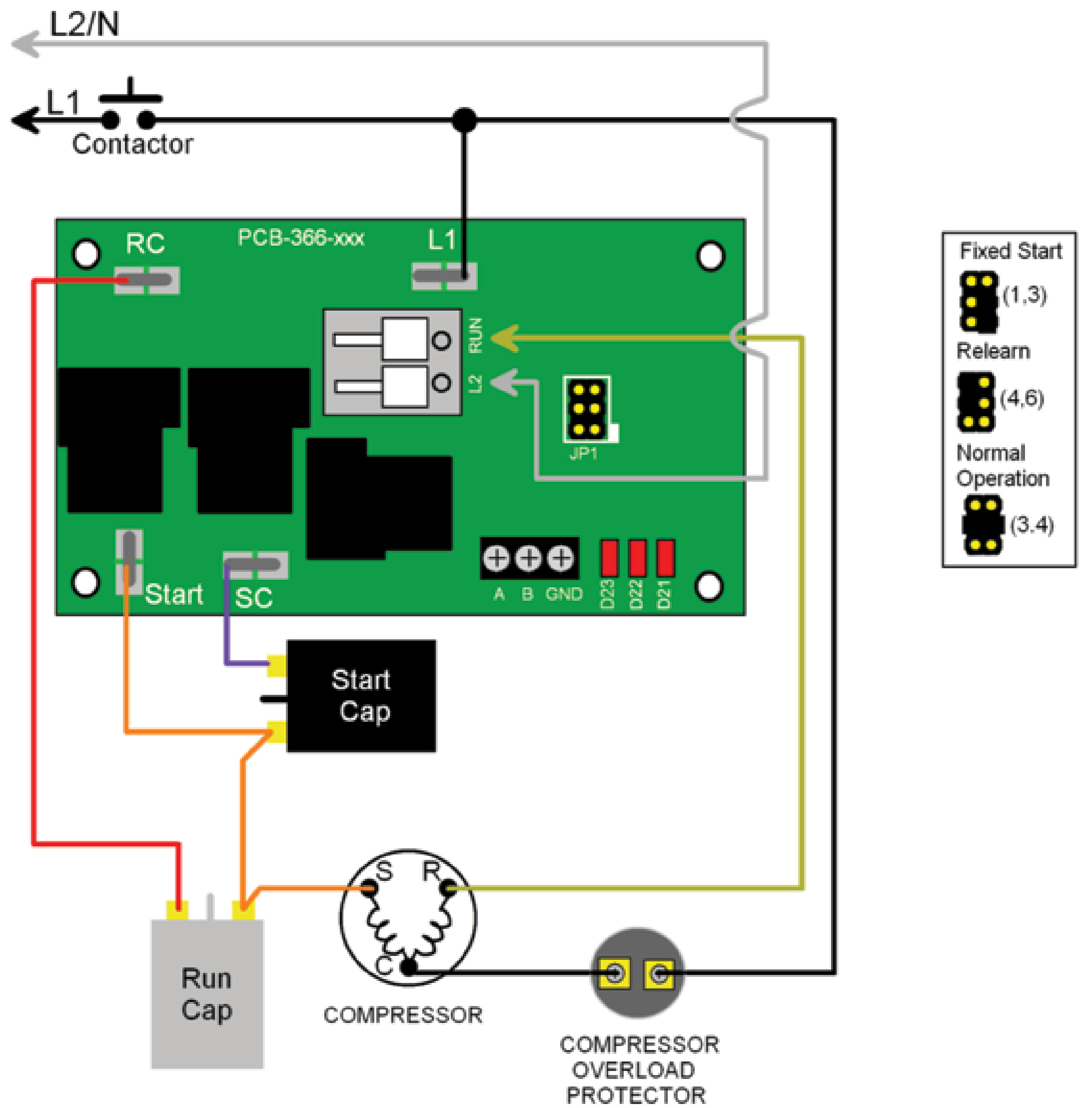
Exception frame:

01	C2	03	A0	D4

CRC Calculation:

The calculation and specification for the CRC is available from:
http://www.modbus.org/docs/Modbus_over_serial_line_V1_02.pdf

ASY-366-xxx



D23	D22	D21	Indication
■	■	□	Power Interrupted
■	□	■	Compressor Stall After Start
■	□	□	Compressor Stall While Starting
□	■	■	SC to RC Terminal Short
□	■	□	Compressor Over Current
□	□	■	Open Compressor Overload
□	□	□	Normal Operation

Phase: Single Phase
Voltage: 100 - 240 VAC
Frequency: 50 - 60 Hz
Current Trip Point: 38 Amps (FLA)

Micro Air Corp.	
Easy Start Commercial Unit Wiring	
ASY-366	
Drawn By: Roger Krinic	
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