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Title: **Modbus Specification for STS Controller**			

STS Controller
Modbus Specification

TABLE OF CONTENTS

The information provided in this specification is intended as a service to our customers. Sullair assumes no responsibility for any errors that may occur in this document with regard to the Modbus protocol standard. The information contained herein may change without notice.

Visit the Modbus-IDA website at www.modbus.org for the latest update to the Modbus protocol.

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1 Overview

Modbus is the protocol standard being used to handle communication for the Controller. A PC running a monitoring program (e.g. SCADA, DCS) uses Modbus to communicate with the Controller which controls and monitors the compressor operation. This specification describes the Modbus functions used specifically for the Sullair Controller. For details on the use and application of the Modbus protocol access the Modbus website at **http://www.modbus.org/specs.php**.

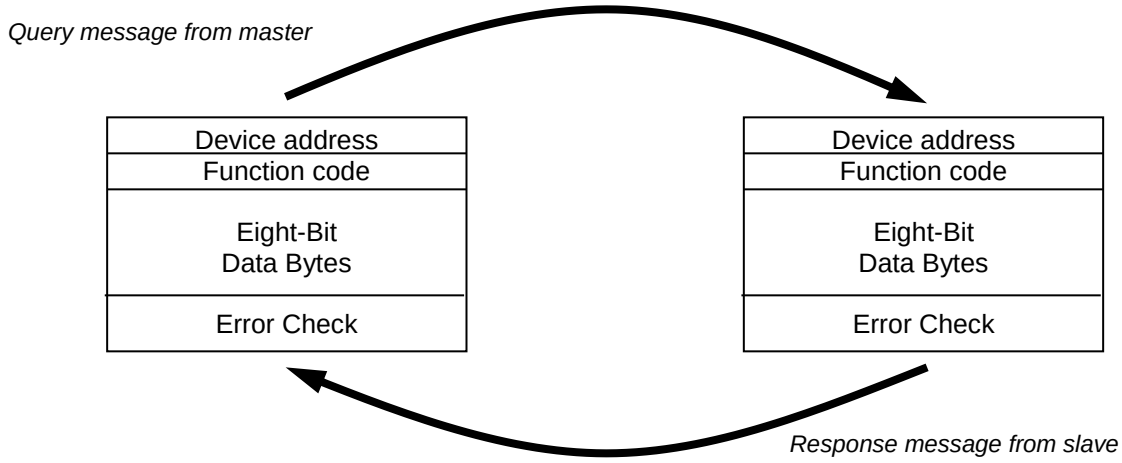
Modbus devices communicate using a client-server technique in which only one device (the client) can initiate transactions (called queries). The other devices (servers) respond by supplying the requested data to the client, or by taking the action requested in the query. A server is any peripheral device (I/O transducer, valve, network drive, or other measuring device) which processes information and sends its output to the client using Modbus. The Sullair Controllers are server devices, while a typical client device is a host computer running application software. Clients can address individual servers, or can initiate a broadcast message to all servers. Servers return a response to all queries addressed to them individually, but do not respond to broadcast queries. The Modbus protocol defines function codes and the encoding scheme for transferring data using RS232/RS485 serial interfaces or via network (Ethernet or TCP/IP) channels. With the RS232 interface, Modbus can be used to send messages between individual devices. With the RS485 interface, transactions can be made through a network of devices.

The protocol is a client/server arrangement, meaning a device operating as a client will poll for response from one or more devices operating as a server. The controller, operating as a server, is a passive member of the Modbus network simply waiting for the client device to read or write data. In this case, the PC is the active member of the Modbus network, operating as the client. The PC initiates data transfers to the controller which functions as the server device.

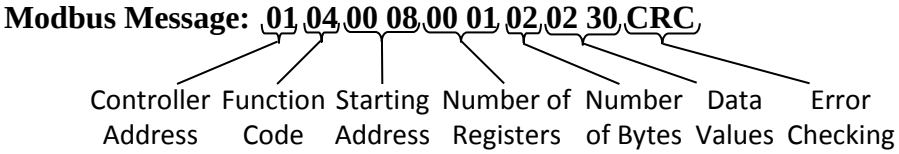
2 Message Structure

The Modbus communication interface uses a defined message structure to address commands from a client device to the server devices. Modbus enables a client device to communicate with several Modbus nodes at once. Each Modbus message has the same basic structure consisting of the same basic elements in each message. The order in which these elements appear in the message is the same for all messages. A message is always started by a client in the Modbus network and a server, depending on the contents of the message, takes action and responds to it. Each server device is assigned an address which distinguishes it from the other devices in the system. The address is contained in the message header and is used to define which device should respond (or react) to the message. All other nodes on the Modbus network ignore the message if the address field doesn't match their own address. The Modbus message used with the controller includes the Device address, Function code, Starting address, Number of registers, Number of data bytes, Data values, Error check code.

A Modbus transaction typically comprises a single query from a client device and a single response from a server device. When a query is broadcast from a client to all servers, no response is transmitted. The following figure illustrates the transactions between a client and a server.



Shown below is a typical Modbus message structure. The values of the Modbus message are expressed as hexadecimal with certain values paired as shown. The Modbus message elements are defined in the following chart.



Modbus Message Field Descriptions

Field	Description
Device address	Address of the receiver device (server)
Function code	Code defining the message type (see chart in next section)
Starting Address	Starting address of the register(s) to receive the message
Number of Registers	Number of registers being addressed at the controller. Some Modbus messages can address multiple registers.
Number of Bytes	Number of data bytes in the message. A message can include multiple bytes of data information
Data	Data block of information to which the controller responds
Error check	Numeric check value to test for communication errors

3 Modbus/RTU Serial Transmission Mode

Serial Modbus connections recognize two basic transmission modes, ASCII or RTU, remote terminal unit. The transmission mode used with the Sullair controller is Modbus/RTU only. With Modbus/RTU the data is exchanged in a binary format, where each byte of information is coded in one communication-byte.

A Modbus/RTU message is framed between time gaps of silence on the communication line. Each message must be preceded by a time gap with a minimum length of 3.5 characters. A receiver detecting a gap of at least 1.5 characters will assume that a new message is following and the receive buffer is cleared to prepare to receive the message.

Modbus/RTU Message Elements (typical)

	Modbus/RTU	
Characters	Binary 0...255	
Error check type	CRC Cyclic Redundancy Check	
Frame start	3.5 chars silence	
Frame end	3.5 chars silence	
Gaps in message	1.5 times char length	
Start bit	1	
Data bits	8	
Parity	even/odd	none
Stop bits	1	2

4 Modbus Device Addressing

The first information in each Modbus message is the address of the receiver. This parameter contains one byte of information. Valid addresses are in the range 0..247. The values 1..247 are assigned to individual Modbus devices in the system. The 0 value is used as a broadcast address to send communication all server devices at once. A server device, when responding, identifies itself by returning the same address as the client in the request. The controller allows independent selection of addresses for its RS232 port (generally used only for local connection) and its RS485 port (suitable for multi-drop networks). When using optional Modbus TCP/IP connections to a controller, the addressing is by the controller's IP address only.

5 Modbus Register Addressing and types

The third and fourth byte of a typical Modbus message indicate a register address. A register is a memory location with a piece of data about the control system. The Modbus message addresses a register with an address value between 0 and 65535. Within a Modbus device, the registers (inputs and outputs used to read or set values) are assigned a number between 1 and 65536. This difference causes the register and I/O addresses used in the Modbus messages to be offset from the device address by a value of -1. In other words, if the value of register 18 is to be read, the number 17 must be specified in the Modbus query message. Because of these offset address values, care should be taken to avoid common mistakes when designing applications or sending commands using Modbus communication.

Input and Holding registers are used with the Sullair controller for communications with external Modbus devices. Input registers are 16 bit registers. Holding registers are read/write. Input registers are generated by the device and therefore are read only. Each type of register may have addresses anywhere in the range of 1-65536.

6 Modbus Function Codes

The second value in each Modbus message is the function code. This defines the message type and the type of action required by the server. The function code parameter contains one byte of information. Valid function codes are in the range 1..255. Not all Modbus devices recognize all the same function codes. Only the codes used with the Sullair Controller are discussed in this document.

Normally, when the Modbus server (controller) answers a response, it returns the same function code as in the request. This is true except when an error is detected. In this case, the highest bit of the function code is turned on. This allows the client (PC or other initiating device) to easily recognize the difference between a successful response and a failure. The following table lists function codes used with the Controller.

Modbus function codes

Code	Description
03	Read holding registers
04	Read input registers
06	Write Single Register
16	Preset multiple registers

6.1 Function 03: Read Holding Registers

Internal values in a Modbus device are stored in holding registers. These registers are two bytes wide and can be used for various purposes. Some registers contain configuration parameters where others are used to return measured values (temperatures etc.) to a host. Registers in a Modbus compatible device start counting at 1. They are addressed in the Modbus message structure with addresses starting at 0. Modbus function 03 is used to request one or more holding register values from a device. Only one server device can be addressed in a single query. Broadcast queries with function 03 are not supported.

Function 03 query structure

Byte	Value	Description
1	1...247	Server device address
2	3	Function code
3	0...255	Starting address, high byte
4	0...255	Starting address, low byte
5	0...255	Number of registers, high byte
6	0...255	Number of registers, low byte
7(...8)	CRC	Error check value

After receiving a query message with Modbus function 03, the server puts the requested input values in a message structure and sends this message back to the Modbus client. The length of the message depends on the number of input values returned. This causes the length of the output message to vary. The Modbus answer message starts with the controller address and the function code 03. The next byte is the number of data bytes that follow. This value is two times the number of registers returned. The data follow. Because of the size of the holding registers, every register is coded with two bytes in the answering message. The first data byte contains the high byte, and the second the low byte of the register. An error check is appended for the client program to check if a communication error occurred. Each Modbus answering message has the following general structure.

Function 03 answer structure

Byte	Value	Description
1	1...247	Server device address
2	3	Function code
3	0...255	Number of data bytes N
4...N+3	0...255	Bit pattern of input values

N+4(...N+5)	CRC	Error check value

Example:

[01][03][00][02][00][06][64][08]

[01][03][0C][00][01][06][E0][06][40][06][40][06][40][02][58][7F][D6]

6.2 Function 04: Read Input Registers

Modbus function 04 is used to read input registers. Broadcast addressing mode is not supported. You can only query the value of inputs of one device at a time. The address of the first input and the number of inputs to read must be put in the data field of the query message. Inputs on devices start numbering at 1. This address value is equivalent to address 0 in the Modbus message.

Function 04 query structure

Byte	Value	Description
1	1...247	Server device address
2	4	Function code
3	0...255	Starting address, high byte
4	0...255	Starting address, low byte
5	0...255	Number of inputs, high byte
6	0...255	Number of inputs, low byte
7(...8)	CRC	Error check value

After receiving a query message with Modbus function 04, the server puts the requested input values in a message structure and sends this message back to the Modbus client. The length of the message depends on the number of input values returned. This causes the length of the output message to vary. The Modbus answer message starts with the controller address and the function code 04. The next byte is the number of data bytes that follow. This value is two times the number of registers returned. The data follow. Because of the size of the holding registers, every register is coded with two bytes in the answering message. The first data byte contains the high byte, and the second the low byte of the register. An error check is appended for the client program to check if a communication error occurred. Each Modbus answering message has the following general structure.

Function 04 answer structure

Byte	Value	Description
1	1...247	Server device address
2	4	Function code
3	0...255	Number of data bytes **N**
4...**N**+3	0...255	Bit pattern of input values
N+4(...**N**+5)	CRC	Error check value

Example:

[01][04][00][02][00][06][D1][C8]

[01][04][0C][00][00][00][00][00][4D][00][00][00][03][09][E3][BF][6A]

6.3 Function 6: Write Single Register

Modbus function 6 is used to set values into a single holding register. When broadcast, the function presets the same register reference in all attached servers. The query message from the client specifies the register to be preset. The requested preset value is specified in the request data field.

Function 6 query structure

Byte	Value	Description
1	1...247	Server device address
2	6	Function code
3	0...255	Starting address, high byte
4	0...255	Starting address, low byte
5	0...255	Register data, high byte
6	0...255	Register data, low byte
7(..8)	CRC	Error check value

The reply to this command is simply an echo of the first six bytes of the request. The Modbus response message has the following general structure.

Function 6 response structure

Byte	Value	Description
1	1...247	Server device address
2	6	Function code
3	0...255	Starting address, high byte
4	0...255	Starting address, low byte
5	0...255	Register data, high byte
6	0...255	Register data, low byte
7(...**8**)	CRC	Error check value

Example:

[01][06][00][10][00][02][09][CE]

[01][06][00][10][00][02][09][CE]

6.4 Function 16: Preset Multiple Registers

Modbus function 16 is used to preset values into a sequence of holding registers. When broadcast, the function presets the same register references in all attached servers. The query message from the client specifies the registers to be preset. The requested preset values are specified in the request data field. This function code is supported, but only the first value is written to the controller.

Function 16 query structure

Byte	Value	Description
1	1...247	Server device address
2	16	Function code
3	0...255	Starting address, high byte
4	0...255	Starting address, low byte
5	0...255	Number of Registers, high byte
6	0...255	Number of Registers, low byte
7	0...255	Byte count N
8	0...255	Registers data, high byte
9	0...255	Registers data, low byte
...	0...255	Additional High / Low pairs of Register Data
N+8(...N+9)	CRC	Error check value

The reply to this command is simply an echo of the first six bytes of the request. The Modbus response message has the following general structure.

Function 16 response structure

Byte	Value	Description
1	1...247	Server device address
2	16	Function code
3	0...255	Starting address, high byte
4	0...255	Starting address, low byte
5	0...255	Number of registers, high byte
6	0...255	Number of registers, low byte
7(...**8**)	CRC	Error check value

Example:

[01][10][00][03][00][01][02][06][40][A4][33]

[01][10][00][03][00][01][F1][C9]

6.5 Modbus Exception Codes

If the server receives the query without a communication error, but cannot handle it, the server will return an exception response informing the client of the nature of the error. The exception response codes are described in the table below.

Code Name	Description
01 Illegal Function	The message function requested is not recognized by the server.
02 Illegal Data Address	The received data address is not an allowable address for the server.
03 Illegal Data Value	The received data value is not an allowable value for the server.
04 Server Device Error	An unrecoverable error occurred while the server was attempting to perform the requested action.
05 Acknowledge	The server has accepted the request and is processing it, but a long duration of time is required to do so. This response is returned to prevent a timeout error from occurring at the client.
06 Server Device Busy	The message was received without error, but the server was already engaged in processing a long duration program command.
07 Negative Acknowledge	The server cannot perform the program function received in the query. This code is returned for an unsuccessful programming request using function code 13 or 14 (codes not supported by Sullair Controller).
08 Memory Parity Error	The server attempted to read extended memory, but detected a parity error in memory.

In an exception response, the server sets a most-significant bit (MSB) of the function code to 1. The server then returns the exception code in the data field of the response message.

7 Wiring Specifications

The Sullair controller is configured to be connected to the computer running the client program using RS-232 or RS-485 serial interfaces. Other connections via modem or Ethernet interfaces are capable when the necessary equipment is installed. Modbus ports are independent, and may be connected with different networks.

RS-485 may be used for industrial networks and connecting multiple compressors. Each port has a red RX indicator which lights when data are received and a green TX indicator which lights when data are sent. These indicators may be used when setting up communications to verify connections have been established.

RS232 would normally be used with a local PC or connected to a modem. Each port has a red RX indicator which lights when data are received and a green TX indicator which lights when data are sent. These indicators may be used when setting up communications to verify connections have been established.

An Ethernet port is provided for connection to a local-area-network (LAN). This supports Modbus TCP/IP. Addressing is by IP address only, set in registers. This may easily be configured for a compressor-room LAN or direct link-local connection.

8 Modbus Definition

This section defines the Modbus registers assigned to operations of the STS Controller. All registers are assigned addresses consisting of integer values. Many of these values are converted into user readable terms that appear on the STS Controller interface panel. All of the registers can be accessed using a Modbus communication method. Independent ports are provided for RS232 and RS485 connections. Baud rates, Parity, Stop bits, and Device number are field-alterable.

The function of each Modbus register used with the STS Controller is described in the following sections. The table lists the name of the register, the Modbus Tag address, and a brief description. Default value, and the minimum and maximum limits are shown for each holding register.

The units of measure for pressure registers is a factor of 1/16 psig. When reading or setting a pressure value, divide the value by 16 to display as psig, divide by 232 to display as bar, or divide by 2.32 to display as kPascal.

The Units of measure for temperature registers is 1/16 degree Fahrenheit. When reading a temperature value, divide the value by 16 to display as degrees Fahrenheit. Subtract 512, then divide the value by 28.8 to display as degrees Celsius.

Holding registers are usually read/write access. Values in holding registers are typically settings that control the machine operation. A Modbus command can be communicated to read the registry value or write to the registry at any time. Invalid values will not be accepted. Unused registers are set to 0 by default, but may hold any integer from 0 to 65535. Input Registers are read-only and contain machine and controller operation data.

8.1 User Read Only Registers

8.1.1. Vital Machine Parameter Registers

These register holds the vital machine parameters like operating mode[1], or State[2] of the machine and other preliminary parameters. ***Appendix A and B show the corresponding codes.***

Tag Name	Tag Address	Description
PARAM_COUNT	53002	Count the number of flash writes
FAULT	53003	Active fault code
MODE	53004	Operating mode of the machine
SUPERSEQ_STATE	53005	ID compatible with supervisor sequencing
MSTATE	53006	Main state of the machine
CLOCK_YMD	53007	Now, in format YYYY YYYM MMMD DDDD
CLOCK_HM	53008	Now, in format 0000 0hhh hhmm mmmm
CLOCK_SF	53009	Now, in format ssss ssff ffff ffff
SYSTICKS	53010	1260 ticks/second
LOOP_COUNT	53011	70 counts/second
WHILE_COUNT	53012	Running count of trips through the main loop

[1] Refer to Appendix A.

[2] Refer to Appendix B.

8.1.2. Parameter Change Data

When a parameter is changed by the user, these registers are updated as listed below.

Tag Name	Tag Address	Description
PARAM_DATE	53013	Parameter change requested date
PARAM_TIME	53014	Parameter change requested time
PARAM_ERROR	53015	Parameter change requested error 0=no error
PARAM_NUMB	53016	Parameter change requested param number
PARAM_DATA	53017	Parameter change requested present data
PARAM_PORT	53018	Parameter changed requested by port

8.1.3. Digital I/O

These registers show digital input and output values.

Tag Name	Tag Address	Description
LOGINA	53019	Logical inputs 1-16
LOGINB	53020	Logical inputs 17-32
LOGINC	53021	Logical inputs 33-48
LOGIND	53022	Logical inputs 49-64
LOGOUTA	53023	Logical outputs 1-16
LOGOUTB	53024	Logical outputs 17-32
LOGOUTC	53025	Logical outputs 33-48
LOGOUTD	53026	Logical outputs 49-64

8.1.4. Analog Input

These registers hold the analog values. The values are raw values and calculations must be applied as follows:

Voltage in Volts= raw value / 100.
Pressure in psig = raw value / 16.
Temperature in Fahrenheit t= raw value / 16.

Tag Name	Tag Address	Description
AND_VOLT_BUI	53027	Analog Display: copy of MG1_BUI_BoardVolt in centivolts
AND_VOLT_BATTERY	53028	Analog Display: clock & memory battery in centivolts
AND_VOLT_CE	53029	Analog Display: voltage at on-board sensor in centivolts
AND_PRES_SUMP	53030	Analog Display: signal wet side pressure

AND_PRES_PKG	53031	Analog Display: signal package discharge pressure
AND_PRES_OIL	53032	Analog Display: signal oil pressure
AND_PRES_HI	53033	Analog Display: signal diff pressure high
AND_PRES_LO	53034	Analog Display: signal diff pressure low
AND_PRES_DP2	53035	Analog Display: (PHI - PLO)
AND_PRES_DP3	53036	Analog Display: (OIL - LIMIT)
AND_PRES_DP3_OIL	53037	Analog Display: oil pressure
AND_PRES_DRY	53038	Analog Display: signal dry side pressure
AND_PRES_INT	53039	Analog Display: signal interstage pressure
AND_PRES_NET	53040	Analog Display: signal plant network pressure
AND_TMPR_COMPR	53041	Analog Display: Compressor discharge
AND_TMPR_SEPARATOR	53042	Analog Display: Separator
AND_TMPR_INTERSTAGE	53043	Analog Display: first stage discharge
AND_TMPR_INTERCOOLR	53044	Analog Display: second stage inlet
AND_TMPR_DRYER	53045	Analog Display: dryer temp
AND_TMPR_OIL_IN	53046	Analog Display: oil injection
AND_KW_PKG	53047	Analog Display: Package KW
AND_AMP_PKG	53048	Analog Display: Package Current in Amps
AND_PCT_CFM	53049	Analog Display: delivery in percent
AND_CFM	53050	Analog Display: delivery in cfm
UIFLAGS	53151	User-level setup flag bits CE -> UI

8.1.5. Sequencing

Sequencing parameters hold in these registers. For more information on sequencing, please refer to Sullair sequencing manual.

8.1.5.1. Capacity

Tag Name	Tag Address	Description
SEQ_CAPACITY01	53153	Sequence capacity by machine#
SEQ_CAPACITY02	53154	Sequence capacity by machine#
SEQ_CAPACITY03	53155	Sequence capacity by machine#
SEQ_CAPACITY04	53156	Sequence capacity by machine#
SEQ_CAPACITY05	53157	Sequence capacity by machine#
SEQ_CAPACITY06	53158	Sequence capacity by machine#

SEQ_CAPACITY07	53159	Sequence capacity by machine#
SEQ_CAPACITY08	53160	Sequence capacity by machine#
SEQ_CAPACITY09	53161	Sequence capacity by machine#
SEQ_CAPACITY10	53162	Sequence capacity by machine#
SEQ_CAPACITY11	53163	Sequence capacity by machine#
SEQ_CAPACITY12	53164	Sequence capacity by machine#
SEQ_CAPACITY13	53165	Sequence capacity by machine#
SEQ_CAPACITY14	53166	Sequence capacity by machine#
SEQ_CAPACITY15	53167	Sequence capacity by machine#
SEQ_CAPACITY16	53168	Sequence capacity by machine#

8.1.5.2. Hours

Tag Name	Tag Address	Description
SEQ_HOURS00	53169	Sequence hours by machine#
SEQ_HOURS01	53170	Sequence hours by machine#
SEQ_HOURS02	53171	Sequence hours by machine#
SEQ_HOURS03	53172	Sequence hours by machine#
SEQ_HOURS04	53173	Sequence hours by machine#
SEQ_HOURS05	53174	Sequence hours by machine#
SEQ_HOURS06	53175	Sequence hours by machine#
SEQ_HOURS07	53176	Sequence hours by machine#
SEQ_HOURS08	53177	Sequence hours by machine#
SEQ_HOURS09	53178	Sequence hours by machine#
SEQ_HOURS10	53179	Sequence hours by machine#
SEQ_HOURS11	53180	Sequence hours by machine#
SEQ_HOURS12	53181	Sequence hours by machine#
SEQ_HOURS13	53182	Sequence hours by machine#
SEQ_HOURS14	53183	Sequence hours by machine#
SEQ_HOURS15	53184	Sequence hours by machine#
SEQ_HOURS16	53185	Sequence hours by machine#

8.1.5.3. Mode

Tag Name	Tag Address	Description
SEQ_MODE00	53186	Sequence mode by machine#
SEQ_MODE01	53187	Sequence mode by machine#
SEQ_MODE02	53188	Sequence mode by machine#
SEQ_MODE03	53189	Sequence mode by machine#
SEQ_MODE04	53190	Sequence mode by machine#
SEQ_MODE05	53191	Sequence mode by machine#
SEQ_MODE06	53192	Sequence mode by machine#
SEQ_MODE07	53193	Sequence mode by machine#
SEQ_MODE08	53194	Sequence mode by machine#
SEQ_MODE09	53195	Sequence mode by machine#
SEQ_MODE10	53196	Sequence mode by machine#
SEQ_MODE11	53197	Sequence mode by machine#
SEQ_MODE12	53198	Sequence mode by machine#
SEQ_MODE13	53199	Sequence mode by machine#
SEQ_MODE14	53200	Sequence mode by machine#
SEQ_MODE15	53201	Sequence mode by machine#
SEQ_MODE16	53202	Sequence mode by machine#

8.1.5.4. Supervisor

Tag Name	Tag Address	Description
SEQ_NEXT2LOAD	53203	Supervisor sequencing
SEQ_NEXT2START	53204	Supervisor sequencing
SEQ_NEXT2UNLOAD	53205	Supervisor sequencing
SEQ_NOMACHRUNNING	53206	Supervisor sequencing
SEQ_NUMBERLOADED	53207	Supervisor sequencing, for VFD min speed
SEQ_SYSTEMPRES	53258	Supervisor sequencing

8.1.5.5. Pressure

Tag Name	Tag Address	Description
SEQ_PRESS01	53209	Sequence pressure by machine#
SEQ_PRESS02	53210	Sequence pressure by machine#
SEQ_PRESS03	53211	Sequence pressure by machine#
SEQ_PRESS04	53212	Sequence pressure by machine#
SEQ_PRESS05	53213	Sequence pressure by machine#
SEQ_PRESS06	53214	Sequence pressure by machine#
SEQ_PRESS07	53215	Sequence pressure by machine#
SEQ_PRESS08	53216	Sequence pressure by machine#
SEQ_PRESS09	53217	Sequence pressure by machine#
SEQ_PRESS10	53218	Sequence pressure by machine#
SEQ_PRESS11	53219	Sequence pressure by machine#
SEQ_PRESS12	53220	Sequence pressure by machine#
SEQ_PRESS13	53221	Sequence pressure by machine#
SEQ_PRESS14	53222	Sequence pressure by machine#
SEQ_PRESS15	53223	Sequence pressure by machine#
SEQ_PRESS16	53224	Sequence pressure by machine#

8.1.5.6. Sequence Operating Status

Tag Name	Tag Address	Description
SEQ_STATUS00	53225	Sequence status by machine#
SEQ_STATUS01	53226	Sequence status by machine#
SEQ_STATUS02	53227	Sequence status by machine#
SEQ_STATUS03	53228	Sequence status by machine#
SEQ_STATUS04	53229	Sequence status by machine#
SEQ_STATUS05	53230	Sequence status by machine#
SEQ_STATUS06	53231	Sequence status by machine#
SEQ_STATUS07	53232	Sequence status by machine#
SEQ_STATUS08	53233	Sequence status by machine#
SEQ_STATUS09	53234	Sequence status by machine#

SEQ_STATUS10	53235	Sequence status by machine#
SEQ_STATUS11	53236	Sequence status by machine#
SEQ_STATUS12	53237	Sequence status by machine#
SEQ_STATUS13	53238	Sequence status by machine#
SEQ_STATUS14	53239	Sequence status by machine#
SEQ_STATUS15	53240	Sequence status by machine#
SEQ_STATUS16	53241	Sequence status by machine#

8.1.6. Minute Meter and Counter

For any two-word registers, Hi*65536 + LO must be calculated.

Tag Name	Tag Address	Description
COUNT_STARTS_HI	50002	Counter starts
COUNT_STARTS_LO	50003	Counter starts
COUNT_LOAD_HI	50004	Counter loads
COUNT_LOAD_LO	50005	Counter loads
MIN_CONT_HI	50015	Minutes that the controller has been energized
MIN_CONT_LO	50016	Minutes that the controller has been energized
MIN_ENABLED_HI	50017	Minutes that the package has been enabled to operate
MIN_ENABLED_LO	50018	Minutes that the package has been enabled to operate
MIN_RUN_HI	50019	Minutes that the compressor has run
MIN_RUN_LO	50020	Minutes that the compressor has run
MIN_LOADED_HI	50021	Minutes that the compressor has been delivering air
MIN_LOADED_LO	50022	Minutes that the compressor has been delivering air
MIN_FULLLOAD_HI	50023	Minutes that the compressor has been fully loaded
MIN_FULLLOAD_LO	50024	Minutes that the compressor has been fully loaded

8.1.7. Warnings

Active warnings are listed below. Please refer to Appendix C for warnings codes.

Tag Name	Tag Address	Description
WARNA	50006	Service, maintenance 1-16
WARNB	50007	Service, warning 17-32
WARNC	50008	Service, warning 33-48
WARND	50009	Service, warning 49-64
WARNE	50010	Service, warning 65-80
WARNF	50011	Service, warning 81-96
WARNG	50012	Service, warning 97-112
WARNH	50013	Service, warning 113-128
DRYER_CODEF	50014	Dryer fault code

8.1.8. VFD

VFD registers and descriptions are listed below. Both recent value and lifetime value registers are included.

8.1.8.1. Recent

Tag Name	Tag Address	Description
VFD_R_PCT_00_HI	50025	Minutes 0%
VFD_R_PCT_00_LO	50026	Minutes 0%
VFD_R_PCT_05_HI	50027	Minutes 5%
VFD_R_PCT_05_LO	50028	Minutes 5%
VFD_R_PCT_10_HI	50029	Minutes 10%
VFD_R_PCT_10_LO	50030	Minutes 10%
VFD_R_PCT_15_HI	50031	Minutes 15%
VFD_R_PCT_15_LO	50032	Minutes 15%
VFD_R_PCT_20_HI	50033	Minutes 20%
VFD_R_PCT_20_LO	50034	Minutes 20%
VFD_R_PCT_25_HI	50035	Minutes 25%
VFD_R_PCT_25_LO	50036	Minutes 25%
VFD_R_PCT_30_HI	50037	Minutes 30%
VFD_R_PCT_30_LO	50038	Minutes 30%

VFD_R_PCT_35_HI	50039	Minutes 35%
VFD_R_PCT_35_LO	50040	Minutes 35%
VFD_R_PCT_40_HI	50041	Minutes 40%
VFD_R_PCT_40_LO	50042	Minutes 40%
VFD_R_PCT_45_HI	50043	Minutes 45%
VFD_R_PCT_45_LO	50044	Minutes 45%
VFD_R_PCT_50_HI	50045	Minutes 50%
VFD_R_PCT_50_LO	50046	Minutes 50%
VFD_R_PCT_55_HI	50047	Minutes 55%
VFD_R_PCT_55_LO	50048	Minutes 55%
VFD_R_PCT_60_HI	50049	Minutes 60%
VFD_R_PCT_60_LO	50050	Minutes 60%
VFD_R_PCT_65_HI	50051	Minutes 65%
VFD_R_PCT_65_LO	50052	Minutes 65%
VFD_R_PCT_70_HI	50053	Minutes 70%
VFD_R_PCT_70_LO	50054	Minutes 70%
VFD_R_PCT_75_HI	50055	Minutes 75%
VFD_R_PCT_75_LO	50056	Minutes 75%
VFD_R_PCT_80_HI	50057	Minutes 80%
VFD_R_PCT_80_LO	50058	Minutes 80%
VFD_R_PCT_85_HI	50059	Minutes 85%
VFD_R_PCT_85_LO	50060	Minutes 85%
VFD_R_PCT_90_HI	50061	Minutes 90%
VFD_R_PCT_90_LO	50062	Minutes 90%
VFD_R_PCT_95_HI	50063	Minutes 95%
VFD_R_PCT_95_LO	50064	Minutes 95%
VFD_R_PCT_100_HI	50065	Minutes 100%
VFD_R_PCT_100_LO	50066	Minutes 100%
VFD_R_COST_HI	50067	Total cost
VFD_R_COST_LO	50068	Total cost
VFD_R_SAV_LU_HI	50069	Total added cost for load/unload
VFD_R_SAV_LU_LO	50070	Total added cost for load/unload
VFD_R_SAV_IM_HI	50071	Total added cost for inlet mod
VFD_R_SAV_IM_LO	50072	Total added cost for inlet mod
VFD_R_SAV_VD_HI	50073	Total added cost for variable displacement
VFD_R_SAV_VD_LO	50074	Total added cost for variable displacement

VFD_R_CF	50075	Total cubic feet
VFD_R_KWM	50076	Total kw minutes
VFD_R_KWM_IM	50077	Total kw minutes est inlet mod
VFD_R_KWM_LU	50078	Total kw minutes est load/unload
VFD_R_KWM_VD	50079	Total kw minutes est variable displacement
VFD_R_MINS_HI	50080	Sample period minutes
VFD_R_MINS_LO	50081	Sample period minutes
VFD_R_CFM	50082	Average cfm
VFD_R_CFMPCT	50083	Average cfm%
VFD_R_KW	50084	Average kw
VFD_R_KWPCT	50085	Average kw%
VFD_R_KCF_HI	50086	Total thousands cubic feet
VFD_R_KCF_LO	50087	Total thousands cubic feet
VFD_R_KWH_HI	50088	Total kw hours
VFD_R_KWH_LO	50089	Total kw hours
VFD_R_KWH_LU_HI	50090	Total kwh est load/unload
VFD_R_KWH_LU_LO	50091	Total kwh est load/unload
VFD_R_KWH_IM_HI	50092	Total kwh est inlet mod
VFD_R_KWH_IM_LO	50093	Total kwh est inlet mod
VFD_R_KWH_VD_HI	50094	Total kwh est variable displacement
VFD_R_KWH_VD_LO	50095	Total kwh est variable displacement

8.1.8.2. Lifetime

VFD_L_PCT_00_HI	50096	Minutes 0%
VFD_L_PCT_00_LO	50097	Minutes 0%
VFD_L_PCT_05_HI	50098	Minutes 5%
VFD_L_PCT_05_LO	50099	Minutes 5%
VFD_L_PCT_10_HI	50100	Minutes 10%
VFD_L_PCT_10_LO	50101	Minutes 10%
VFD_L_PCT_15_HI	50102	Minutes 15%
VFD_L_PCT_15_LO	50103	Minutes 15%
VFD_L_PCT_20_HI	50104	Minutes 20%
VFD_L_PCT_20_LO	50105	Minutes 20%
VFD_L_PCT_25_HI	50106	Minutes 25%

VFD_L_PCT_25_LO	50107	Minutes 25%
VFD_L_PCT_30_HI	50108	Minutes 30%
VFD_L_PCT_30_LO	50109	Minutes 30%
VFD_L_PCT_35_HI	50110	Minutes 35%
VFD_L_PCT_35_LO	50111	Minutes 35%
VFD_L_PCT_40_HI	50112	Minutes 40%
VFD_L_PCT_40_LO	50113	Minutes 40%
VFD_L_PCT_45_HI	50114	Minutes 45%
VFD_L_PCT_45_LO	50115	Minutes 45%
VFD_L_PCT_50_HI	50116	Minutes 50%
VFD_L_PCT_50_LO	50117	Minutes 50%
VFD_L_PCT_55_HI	50118	Minutes 55%
VFD_L_PCT_55_LO	50119	Minutes 55%
VFD_L_PCT_60_HI	50120	Minutes 60%
VFD_L_PCT_60_LO	50121	Minutes 60%
VFD_L_PCT_65_HI	50122	Minutes 65%
VFD_L_PCT_65_LO	50123	Minutes 65%
VFD_L_PCT_70_HI	50124	Minutes 70%
VFD_L_PCT_70_LO	50125	Minutes 70%
VFD_L_PCT_75_HI	50126	Minutes 75%
VFD_L_PCT_75_LO	50127	Minutes 75%
VFD_L_PCT_80_HI	50128	Minutes 80%
VFD_L_PCT_80_LO	50129	Minutes 80%
VFD_L_PCT_85_HI	50130	Minutes 85%
VFD_L_PCT_85_LO	50131	Minutes 85%
VFD_L_PCT_90_HI	50132	Minutes 90%
VFD_L_PCT_90_LO	50133	Minutes 90%
VFD_L_PCT_95_HI	50134	Minutes 95%
VFD_L_PCT_95_LO	50135	Minutes 95%
VFD_L_PCT_100_HI	50136	Minutes 100%
VFD_L_PCT_100_LO	50137	Minutes 100%
VFD_L_COST_HI	50138	Total cost
VFD_L_COST_LO	50139	Total cost
VFD_L_SAV_LU_HI	50140	Total added cost for load/unload
VFD_L_SAV_LU_LO	50141	Total added cost for load/unload
VFD_L_SAV_IM_HI	50142	Total added cost for inlet mod

VFD_L_SAV_IM_LO	50143	Total added cost for inlet mod
VFD_L_SAV_VD_HI	50144	Total added cost for variable displacement
VFD_L_SAV_VD_LO	50145	Total added cost for variable displacement
VFD_L_CF	50146	Total thousands cubic feet
VFD_L_KWM	50147	Total kw minutes
VFD_L_KWM_IM	50148	Total kw minutes est inlet mod
VFD_L_KWM_LU	50149	Total kw minutes est load/unload
VFD_L_KWM_VD	50150	Total kw minutes est variable displacement
VFD_L_MINS_HI	50151	Sample period minutes
VFD_L_MINS_LO	50152	Sample period minutes
VFD_L_CFM	50153	Average cfm
VFD_L_CFMPCT	50154	Average cfm%
VFD_L_KW	50155	Average kw
VFD_L_KWPCT	50156	Average kw%
VFD_L_KCF_HI	50157	Total thousands cubic feet
VFD_L_KCF_LO	50158	Total thousands cubic feet
VFD_L_KWH_HI	50159	Total kw hours
VFD_L_KWH_LO	50160	Total kw hours
VFD_L_KWH_LU_HI	50161	Total kwh est load/unload
VFD_L_KWH_LU_LO	50162	Total kwh est load/unload
VFD_L_KWH_IM_HI	50163	Total kwh est inlet mod
VFD_L_KWH_IM_LO	50164	Total kwh est inlet mod
VFD_L_KWH_VD_HI	50165	Total kwh est variable displacement
VFD_L_KWH_VD_LO	50166	Total kwh est variable displacement

8.2 User Read/Write Registers

8.2.1. Date & Time

Tag Name	Tag Address	Minimum	Default	Maximum	Description
CLOCK_MSEC	52516	0	0	999	Real time clock msec
CLOCK_SEC	52517	0	0	59	Real time clock Second
CLOCK_MIN	52518	0	0	59	Real time clock minutes
CLOCK_HOUR	52519	0	0	23	Real time clock Hour
CLOCK_MDAY	52520	0	0	31	Real time clock Day of the Month
CLOCK_MONTH	52521	0	0	12	Real time clock Month
CLOCK_YEAR	52522	0	0	65535	Real time clock Year

8.2.2. Control Parameters

Tag Name	Tag Address	Minimum	Default	Maximum	Description
UNLOAD	51015	640	1760	16000	Unload pressure in 1/16 psig
LOAD	51016	480	1600	15968	Load pressure in 1/16 psig
SETPOINT	51017	480	1600	16000	VFD setpoint pressure in 1/16 psig (if so equipped)
TARGET	51018	480	1600	16000	System target pressure (if so equipped)
UNLOAD_TIME	51019	0	600	1800	Unload timer in automatic, seconds
DRAIN_INTERVAL	51020	0	300	3600	Drain interval in seconds
DRAIN_TIME	51021	0	5	60	Drain time in seconds
RESTART_TIME	51022	0	0	120	Delay at power-up for auto restart in seconds
WYE_DELTA_TIME	51023	0	5	30	Duration of wye start in seconds
MODULATE	51024	0	1	1	1=modulate, 0=load/unload
CLEAR_RECENT	51025	0	0	1	1= clear recent data for vfd (if so equipped)
VFD_KWHCOST	51026	1	70	999	Cost per kwh

LANGUAGE	51027	0	1	6	0=English, 1=Chinese, 3=French, 4=German, 5=Japanese, 6=Portuguese, 7=Russian, 8=Spanish
UNITS_PRESS	51028	0	0	2	0=psig, 1=bar, 2=kpa
TEMP_UNITS	51029	0	0	1	0=degF, 1=degC
MODE_SET	51030	1	1	2	1=constant, 2=auto, (see "UM_..." for more)
SPRL_TRGT_PRS	51066	800	2000	16000	Spiral valve pressure target (osi)

8.2.3. Sequencing Settings

Tag Name	Tag Address	Minimum	Default	Maximum	Description
SEQ_MODE	51031	0	0	4	Sequence mode
SEQ_MIN_HI	51032	0	0	184	Sequence minutes, soft limit to 65535 hours (3932159 minutes)
SEQ_MIN_LO	51033	0	0	65535	Sequence minutes, increments every minute
SEQ_COM	51034	1	1	16	Sequence com number 1-16
SEQ_MACHINES	51035	1	1	16	Sequence number of machines
SEQ_LOWPRESS	51036	480	1440	7840	Sequence low pressure
SEQ_RECOVERTIME	51037	2	5	60	Sequence recover time
SEQ_ROTATEMINS	51038	0	0	32767	Sequence rotate timer in minutes
SEQ_ECONNECTID	51039	0	0	15	Econnect id number (deprecated)

8.2.4. Scheduling Settings

Tag Name	Tag Address	Minimum	Default	Maximum	Description
TC_HM_1	51043	0	0	65535	Begin time**, in format 0000 0hhh hhmm mmmm
TC_CTL_1	51044	0	0	65535	bit11:rem unload; bit10:remstop; bit 9-8: 00=norm, 01=offset1, 1-=offset2, 11=offset3; bits 0-7 day
TC_HM_2	51045	0	0	65535	begin time**, in format 0000 0hhh hhmm mmmm
TC_CTL_2	51046	0	0	65535	bit11:rem unload; bit10:remstop; bit 9-8: 00=norm, 01=offset1, 1-=offset2, 11=offset3; bits 0-7 day
TC_HM_3	51047	0	0	65535	Begin time**, in format 0000 0hhh hhmm mmmm
TC_CTL_3	51048	0	0	65535	bit11:rem unload; bit10:remstop; bit 9-8: 00=norm, 01=offset1, 1-=offset2, 11=offset3; bits 0-7 day
TC_HM_4	51049	0	0	65535	Begin time**, in format 0000 0hhh hhmm mmmm
TC_CTL_4	51050	0	0	65535	bit11:rem unload; bit10:remstop; bit 9-8: 00=norm, 01=offset1, 1-=offset2, 11=offset3; bits 0-7 day
TC_HM_5	51051	0	0	65535	Begin time**, in format 0000 0hhh hhmm mmmm
TC_CTL_5	51052	0	0	65535	bit11:rem unload; bit10:remstop; bit 9-8: 00=norm, 01=offset1, 1-=offset2, 11=offset3; bits 0-7 day
TC_HM_6	51053	0	0	65535	Begin time**, in format 0000 0hhh hhmm mmmm
TC_CTL_6	51054	0	0	65535	bit11:rem unload; bit10:remstop; bit 9-8: 00=norm, 01=offset1, 1-=offset2, 11=offset3; bits 0-7 day
TC_HM_7	51055	0	0	65535	Begin time**, in format 0000 0hhh hhmm mmmm
TC_CTL_7	51056	0	0	65535	bit11:rem unload; bit10:remstop; bit 9-8: 00=norm, 01=offset1, 1-=offset2, 11=offset3; bits 0-7 day
TC_HM_8	51057	0	0	65535	Begin time**, in format 0000 0hhh hhmm mmmm
TC_CTL_8	51058	0	0	65535	bit11:rem unload; bit10:remstop; bit 9-8: 00=norm, 01=offset1, 1-=offset2, 11=offset3; bits 0-7 day
TC_HM_9	51059	0	0	65535	Begin time**, in format 0000 0hhh hhmm mmmm
TC_CTL_9	51060	0	0	65535	bit11:rem unload; bit10:remstop; bit 9-8: 00=norm, 01=offset1, 1-=offset2, 11=offset3; bits 0-7 day
TC_HM_10	51061	0	0	65535	Begin time**, in format 0000 0hhh hhmm mmmm
TC_CTL_10	51062	0	0	65535	bit11:rem unload; bit10:remstop; bit 9-8: 00=norm, 01=offset1, 1-=offset2, 11=offset3; bits 0-7 day
TC_OFF_A	51063	0	0	65535	Pressure reduction in 1
TC_OFF_B	51064	0	0	65535	Pressure reduction in 1
TC_OFF_C	51065	0	0	65535	Pressure reduction in 1

8.3. User Data Log

Tag Name	Tag Address	Description
YMD_01	55001	Event YYYY YYYM MMMD DDDD
HM_01	55002	Event 0000 0hhh hhmm mmmm
HI_01	55003	Event minutemeter HI*65536+LO
LO_01	55004	Event minutemeter HI*65536+LO
CODE_01	55005	EVENT code
YMD_02	55006	Event YYYY YYYM MMMD DDDD
HM_02	55007	Event 0000 0hhh hhmm mmmm
HI_02	55008	Event minutemeter HI*65536+LO
LO_02	55009	Event minutemeter HI*65536+LO
CODE_02	55010	EVENT code
YMD_03	55011	Event YYYY YYYM MMMD DDDD
HM_03	55012	Event 0000 0hhh hhmm mmmm
HI_03	55013	Event minutemeter HI*65536+LO
LO_03	55014	Event minutemeter HI*65536+LO
CODE_03	55015	EVENT code
YMD_04	55016	Event YYYY YYYM MMMD DDDD
HM_04	55017	Event 0000 0hhh hhmm mmmm
HI_04	55018	Event minutemeter HI*65536+LO
LO_04	55019	Event minutemeter HI*65536+LO
CODE_04	55020	EVENT code
YMD_05	55021	Event YYYY YYYM MMMD DDDD
HM_05	55022	Event 0000 0hhh hhmm mmmm
HI_05	55023	Event minutemeter HI*65536+LO
LO_05	55024	Event minutemeter HI*65536+LO
CODE_05	55025	EVENT code
. . .	. . .	. . .
. . .	. . .	. . .
. . .	. . .	. . .
YMD_200	55996	Event YYYY YYYM MMMD DDDD
HM_200	55997	Event 0000 0hhh hhmm mmmm
HI_200	55998	Event minutemeter HI*65536+LO
LO_200	55999	Event minutemeter HI*65536+LO
CODE_200	56000	EVENT code

8.4. Adjustment Change Log

Tag Name	Tag Address	Description
COUNT_01	57001	Count the number of MG3 writes
DATE_01	57002	Parameter change requested date
TIME_01	57003	Parameter change requested time
ERROR_01	57004	Parameter change requested error 0=no error
REG_NUMB_01	57005	Parameter change requested param number
DATA_OLD_01	57006	Parameter old data
DATA_NEW_01	57007	Parameter change requested new data
PORT_01	57008	Parameter changed requested by port
COUNT_02	57009	Count the number of MG3 writes
DATE_02	57010	Parameter change requested date
TIME_02	57011	Parameter change requested time
ERROR_02	57012	Parameter change requested error 0=no error
REG_NUMB_02	57013	Parameter change requested param number
DATA_OLD_02	57014	Parameter old data
DATA_NEW_02	57015	Parameter change requested new data
PORT_02	57016	Parameter changed requested by port
COUNT_03	57017	Count the number of MG3 writes
DATE_03	57018	Parameter change requested date
TIME_03	57019	Parameter change requested time
ERROR_03	57020	Parameter change requested error 0=no error
REG_NUMB_03	57021	Parameter change requested param number
DATA_OLD_03	57022	Parameter old data
DATA_NEW_03	57023	Parameter change requested new data
PORT_03	57024	Parameter changed requested by port
COUNT_04	57025	Count the number of MG3 writes
DATE_04	57026	Parameter change requested date
TIME_04	57027	Parameter change requested time
ERROR_04	57028	Parameter change requested error 0=no error
REG_NUMB_04	57029	Parameter change requested param number
DATA_OLD_04	57030	Parameter old data

DATA_NEW_04	57031	Parameter change requested new data
PORT_04	57032	Parameter changed requested by port
COUNT_05	57033	Count the number of MG3 writes
DATE_05	57034	Parameter change requested date
TIME_05	57035	Parameter change requested time
ERROR_05	57036	Parameter change requested error 0=no error
REG_NUMB_05	57037	Parameter change requested param number
DATA_OLD_05	57038	Parameter old data
DATA_NEW_05	57039	Parameter change requested new data
PORT_05	57040	Parameter changed requested by port
. . .	. . .	. . .
. . .	. . .	. . .
. . .	. . .	. . .
COUNT_200	58593	Count the number of MG3 writes
DATE_200	58594	Parameter change requested date
TIME_200	58595	Parameter change requested time
ERROR_200	58596	Parameter change requested error 0=no error
REG_NUMB_200	58597	Parameter change requested param number
DATA_OLD_200	58598	Parameter old data
DATA_NEW_200	58599	Parameter change requested new data
PORT_200	58600	Parameter changed requested by port

Appendix A

Mode codes and associated descriptions are listed below. Any number between 256 and 4096 indicates a current fault. The current fault codes are listed below.

Code	Description
0	Manually stopped operating mode
1	Run in constant mode
2	Run in automatic mode
256	Analog input below minimum
257	Analog input below minimum
258	Analog input below minimum
259	Analog input below minimum
260	Analog input below minimum
261	Analog input below minimum
262	Analog input below minimum
263	Analog input below minimum
264	Analog input below minimum
265	Analog input below minimum
266	Analog input below minimum
267	Analog input above maximum
268	Analog input above maximum
269	Analog input above maximum
270	Analog input above maximum
271	Analog input above maximum
272	Analog input above maximum
273	Analog input above maximum
274	Analog input above maximum
275	Analog input above maximum
276	Analog input above maximum
277	Analog input above maximum
278	Invalid operating state
279	Motor 1 alarm or overload
280	Motor 2 alarm or overload
281	Emergency stop button

Code	Description
282	Water pressure switch running
283	User interface communication
284	Main vacon communication
285	Fan vacon communication
286	Low oil pressure running
287	Unused
288	High sump pressure
289	Low sump pressure running
290	High temp 1
291	Low temp 1 running
292	High temp 2
293	Low temp 2 running
294	High temp 3
295	Low temp 3 running
296	Power interruption
297	Ce watchdog timer
298	System pressure is low after 10 minutes
299	Admin assignable fault input
300	Admin assignable run fault input
301	UI voltage monitor
302	UI voltage monitor
303	Start aux contact
304	High pressure fault
305	High pressure fault
306	High pressure fault
307	High pressure fault
308	High pressure fault
309	High pressure fault
310	Phase relay

Code	Description
311	Dryer protection
312	Dryer overload
313-378	Vacon VFD faults 0-65 (refer to drive manual)
379	Controller memory fault
380	Low voltage to controller
381	High voltage to controller
382	High temperature in integrated dryer
383	Low temperature in integrated dryer
384	VFD Initialization error
385	High pressure on Spiral Valve actuator
386	High interstage pressure
387	High temp 4
388	Low temp 4 running
389	High temp 5
390	Low temp 5 running
391	High temp 6
392	Low temp 6 running
393	High temp 7
394	Low temp 7 running
395	High temp 8
396	Low temp 8 running
397	High temp 9
398	Low temp 9 running
399	High temp 0
400	Low temp 0 running
401	Oil pump overload relay
402	Oil pump starter or contact
403	Port C communication fault
404	Port E communication fault

Code	Description
405	Ethernet communication fault
406	No high voltage at remote starter
407	High pressure above unload setting
408	Low DP3 while running
409-569	Yaskawa VFD faults (refer to drive manual)
570	Brownout fault
571	Unused
572	Yaskawa drive not responding to run command
573	High humidity fault
574	Main motor overtemp switch
575	Fan motor overtemp
576	Starter did not come on (replaces F_D_STARTERAUX)
577	Starter did not go off (replaces F_D_STARTERAUX)
578	Starter did not come on (replaces F_D_STARTERAUX)
579	Starter did not go off (replaces F_D_STARTERAUX)
580	Low running temperature at COMPR
581	Low running temperature at SEP
582	Low running temperature at INTSTG
583	Low running temperature at INTCLR
584	Low running temperature at DRYER
585	Low running temperature at OIL_IN
586	Low running temperature at OILAGE
587	Low running temperature at WAT_IN
588	Low running temperature at WAT_OUT
589	Low running temperature at FAN
590	Low running temperature at PKG_OUT
591	Low running temperature at SOILLO
592	Low running temperature at 13
593	Low running temperature at 14

Code	Description
594	Low running temperature at 15
595	Low running temperature at 16
596	High temperature at COMPR
597	High temperature at SEP
598	High temperature at INTSTG
599	High temperature at INTCLR
600	High temperature at DRYER
601	High temperature at OIL_IN
602	High temperature at OILAGE
603	High temperature at WAT_IN
604	High temperature at WAT_OUT
605	High temperature at FAN
606	High temperature at PKG_OUT
607	High temperature at SOILLO
608	High temperature at 13
609	High temperature at 14
610	High temperature at 15
611	High temperature at 16
612	Analog input below minimum - Terminal IDs
613	Analog input below minimum - Terminal IDs
614	Analog input below minimum - Terminal IDs
615	Analog input below minimum - Terminal IDs
616	Analog input below minimum - Terminal IDs
617	Analog input below minimum - Terminal IDs
618	Analog input below minimum - Terminal IDs
619	Analog input below minimum - Terminal IDs
620	Analog input below minimum - Terminal IDs
621	Analog input below minimum - Terminal IDs
622	Analog input below minimum - Terminal IDs

Code	Description
623	Analog input above maximum - Terminal ids
624	Analog input above maximum - Terminal ids
625	Analog input above maximum - Terminal ids
626	Analog input above maximum - Terminal ids
627	Analog input above maximum - Terminal ids
628	Analog input above maximum - Terminal ids
629	Analog input above maximum - Terminal ids
630	Analog input above maximum - Terminal ids
631	Analog input above maximum - Terminal ids
632	Analog input above maximum - Terminal ids
633	Analog input above maximum - Terminal ids

Warning codes and descriptions are listed below.

Code	Description
4097	Oil filter needs change
4098	Separator needs change
4099	Air filter needs change
4100	Fluid analysis warning
4101	Oil needs change
4102	Maintenance general warning
4113	High Oil Filter dp
4114	High Separator dp
4115	High Air Filter dp
4116	High temperature 1
4117	Low temperature 1
4118	High temperature 2
4119	Low temperature 2
4120	High temperature 3
4121	Low temperature 3
4122	Power interruption
4123	Sequence comm error
4124	User option warning
4125	Replace battery

Code	Description
4126	Dryer Service
4127	VFD Overtemp
4128	Ethernet Disabled
4129	Dryer Relay Fault
4130	Dryer Overload Fault
4131	Dryer High pP Fault
4132	Dryer Low pP Fault
4133	High Dryer Dewpoint
4134	Low Dryer Dewpoint
4135	Not Commissioned
4136	Starter
4137	High Moisture
4138	Expansion Comm Error
4145	High Temperature 4
4146	Low Temperature 4
4147	High Temperature 5
4148	Low Temperature 5
4149	High Temperature 6
4150	Low Temperature 6
4151	High Temperature 7
4152	Low Temperature 7
4153	High Temperature 8
4154	Low Temperature 8
4155	High Temperature 9
4156	Low Temperature 9
4157	High Temperature 0
4158	Low Temperature 0
4159	High Oil Filter dP
4160	High Interstage Pressure
4161	HI TEMP PKG Out
4162	LO TEMP PKG Out
4177	Spiral Valve System Failure
4178	Spiral Valve Operation Failure
4179	Spiral Valve Communication Failure

Alarm codes and descriptions are listed below.

Code	Description
6145	No Alarm
6146	UnderVoltage
6147	OverVoltage
6148	Heatsink Overheat
6149	Drive Overheat
6150	Overtorque 1
6151	Overtorque 2
6152	Run commands input error
6153	Drive Baseblock
6154	External Fault 3, input terminal S3
6155	External Fault 4, input terminal S4
6156	External Fault 5, input terminal S5
6157	External Fault 6, input terminal S6
6158	External Fault 7, input terminal S7
6159	External Fault 8, input terminal S8
6160	Cooling Fan Error
6161	Overspeed
6162	Excessive Speed Deviation
6163	PG Disconnected
6165	MEMOBUS/Modbus Communication Error
6166	Option Communication Error
6167	Serial Communication Transmission Error
6168	Motor Overload
6169	Drive Overload
6171	Option Card External Fault
6172	Motor Switch command input during run
6174	Serial Communication Transmission Error
6175	Undertorque Detection 1
6176	Undertorque Detection 2
6177	MEMOBUS/Modbus Test Mode Fault
6179	Motor Overheat
6184	PID Feedback Loss (FbL)

Code	Description
6185	PID Feedback Loss (FbH)
6187	Drive Disabled
6188	PG Disconnected
6194	SI-T3 Watchdog Error
6195	SI-T3 Station Address Setting Error
6196	SI-T3 Comm. Cycle Setting Error
6197	High Current Alarm
6198	Cooling Fan Maintenance Time
6199	Capacitor Maintenance Time
6201	SI-S EEPROM Error
6202	External Fault (input terminal S1)
6203	External Fault (input terminal S2)
6204	Safe Disable Input (HbbF)
6205	Safe Disable Input (Hbb)
6206	Mechanical Weakening Detection 1 (oL5)
6207	Mechanical Weakening Detection 2 (UL5)
6208	PLC Alarm (PA1)
6209	PLC Alarm (PA2)
6210	Output Voltage Detection Fault
6211	IGBT Maintenance Time
6212	Soft Charge Bypass Relay Maintenance Time
6213	IGBT Maintenance Time
6214	Braking Transistor Overload
6216	Motor Overheat (NTC Input)
6217	DriveWorksEZ Alarm

Appendix B

States and descriptions are listed below.

State	Description
1	POWERUP
2	FAULTED
3	READY
4	ENABLED
5	AUTOENABLED
6	WAITING FOR BLOWDOWN
7	PRESTART
8	START
9	PAUSE
10	UNLOADED
11	LOADING
12	FULLLOAD
13	MODULATING
14	STOPPING
15	REMOTE UNLOAD
16	REMOTE STOPPING
17	FAULTING
18	UNLOADING
19	REMOTE UNLOADING
20	PRECOOL THE DRYER
21	FLUSH WATER
22	FILL WATER
23	JOG WATER PUMP
24	POST-RUN FLUID PUMP
25	PRE-RUN FLUID PUMP
26	POST-RUN FLUID PUMP - REMOTE
27	POST-RUN FLUID PUMP – AUTOMATIC
28	BROWNOUT

Appendix C

Bit	Warn A*	Warning B	Warning C	Warning D	Warning E	Warning F
0	Fluid filter	Fluid filter	Dryer Fault	Temp 4 high	HI Temp PKG Out	Spiral Valve System
1	Separator	Separator	Dryer Overload Fault	Temp 4 low	LO Temp PKG Out	Spiral Valve Operation
2	Air filter	Air filter	Dryer High Temp Fault	Temp 5 high	HI Temp SOILLO	Spiral Valve Comm.
3	Oil analysis	High Temp Compressor	Dryer Low Temp Fault	Temp 5 low	LO Temp SOILLO	
4	Oil change	Low Temp Compressor	Dryer High Temp Warning	Temp 6 high	HI TEMP_13	
5	Maintenance	High Temp Separator	Dryer Low Temp Warning	Temp 6 low	LO TEMP_13	
6		Low Temp Separator	Not Commissioned	Temp 7 high	HI TEMP_14	
7		High Temp Interstate	Brownout	Temp 7 low	LO TEMP_14	
8		Low Temp Interstate	Dryer high Moisture	Temp 8 high	HI TEMP_15	
9		Power int		Temp 8 low	LO TEMP_15	
10		Seq comm.		Temp 9 high	HI TEMP_16	
11		User		Temp 9 low	LO TEMP_16	
12		Battery		Temp 0 high		
13		Dryer		Temp 0 low		
14		VFD Overtemp		DP2 High		
15		Ethernet		High Interstage Press		