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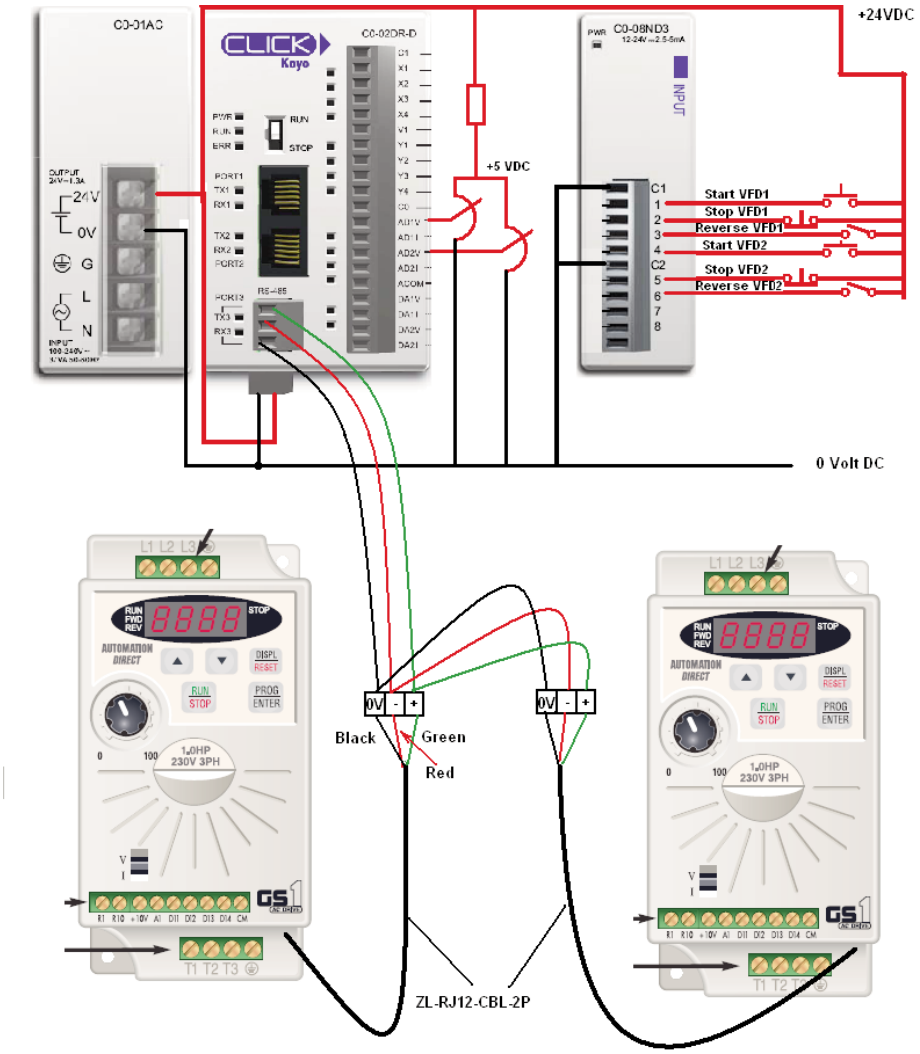
PRODUCT FAMILY: GS drives
Subject: GS1 AC drive with MODBUS from Click

Number: AN-GS-018
Date issued: Sep-23-2010
Revision: 1st edition

GS1 drive control using MODBUS with a Click PLC

The following ladder program show one example on how to control 2 GS1 VFDs with MODBUS RTU.

This simple example will consider 2 slaves (GS1 AC drives) connected in chain connection to the Click PLC type C0-02DR-D, which is the master. The operator will start and stop the motors by pushbuttons connected to the Click PLC, the speed by potentiometers and will be able to run forward or reverse with a 2-position selector switch, as shown in the diagram below.

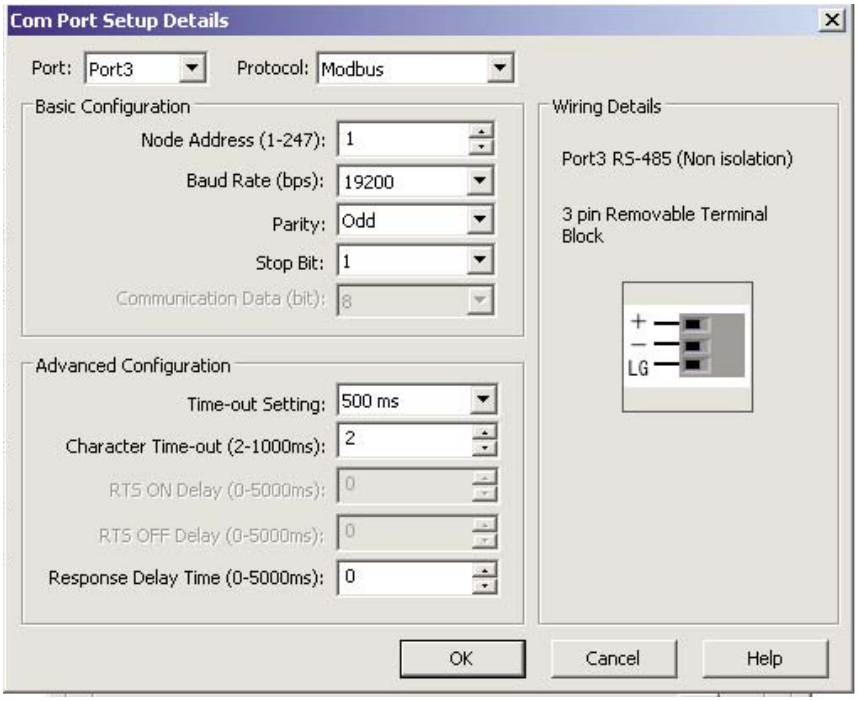


The drives will be programmed in the following way:

Parameter	Description	Slave A	Slave B	Notes
P3-00	Source of operation	3	3	Using RS-485 and keypad stop enabled
P4-00	Source freq setpoint	5	5	Using RS-485
P9-00	Node number	2	3	Identification of slave
P9-01	Baud rate	2	2	192000 Baud
P9-02	MODBUS mode	5	5	MODBUS RTU, 8 data bits, odd, 1 stop bit

The PLC program will read data continuously from both slaves. The writing will be done only when necessary. See explanation of the logic in the rung comments.

Wire the pushbuttons and selector switches as well as the potentiometers to the PLC and connect the communication cables to the port 3 of the CPU, as shown in the diagram of previous page. The diagram shows the use of 24 Volt to power the potentiometers, with a resistor as voltage divider. You could optionally use a 5 Volt power supply.



The set up of the Port 3 on the PLC will be done by connecting the PLC with the programming software and the go to the menu **Setup**, then **Comm port set up** and in the dialog box select port 3 **Setup** button. Fill the data as shown in the adjacent figure.

The ideal environment for PLC programming is to have the PLC already connected and operating.

The VFDs may be tested without the need to connect them to the motor. We warn you to plan a design to minimize the noise that may affect the communication.

In the next pages we show the code. There is a need to write only when necessary, to allow to stop the VFD from the keypad when the parameter P3-00=3. If the parameter P3-00=4, there is not need to limit to this action and you can write continuously.

One way to interlock the SEND and RECEIVE instructions is use a SET and RESET set of instructions.. Another way would be to use a counter. We will show here only the option with bits. In any case, the low baud rate of the GS1 does not allow to add too many slaves.

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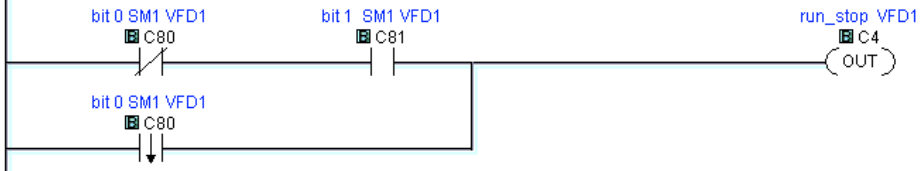
PLC INPUT SECTION
==========

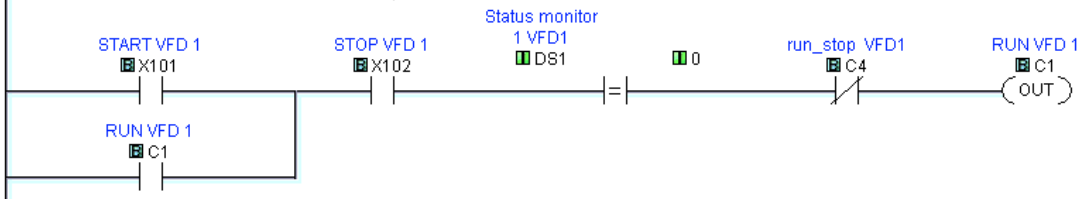
If the drive operation stopped or there is a Run to Stop transition, C4 turns ON.

1



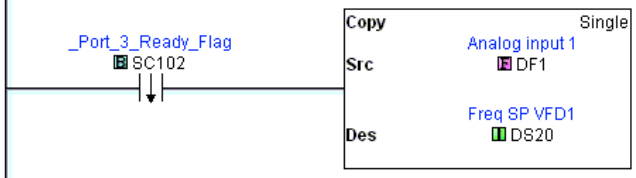
Bit C1 will turn ON if the rung is true, that is, if not stop pushbutton pressed, no fault in VFD 1 and C4 is not ON.
The contact C1 will latch the command to keep C1 ON

2



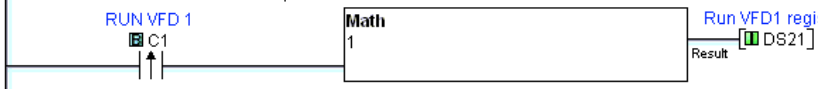
When port 3 transitions from busy to ready, the frequency value in DF1 is changed from floating point to decimal integer value into DS300. DS300 now has the value ready to be sent to the VFD2

3



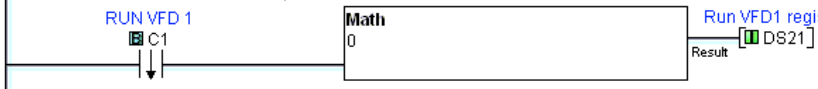
If C1 transitions from OFF to ON, the content of DS301 will be 1. To be used with the MODBUS communications later

4



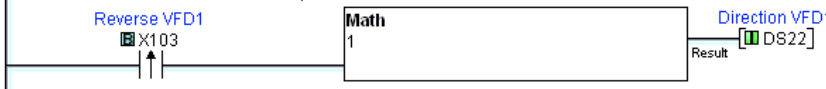
If C1 transitions from ON to OFF, the content of DS301 will be 0. To be used with the MODBUS communications later

5



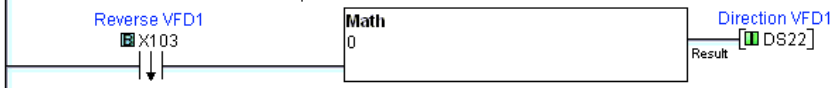
If X103 transitions from OFF to ON, the content of DS302 will be 1. To be used with the MODBUS communications later

6



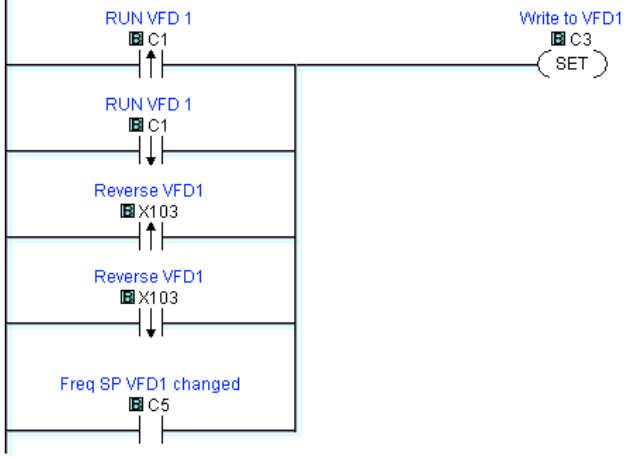
If X103 transitions from ON to OFF, the content of DS302 will be 0. To be used with the MODBUS communications later

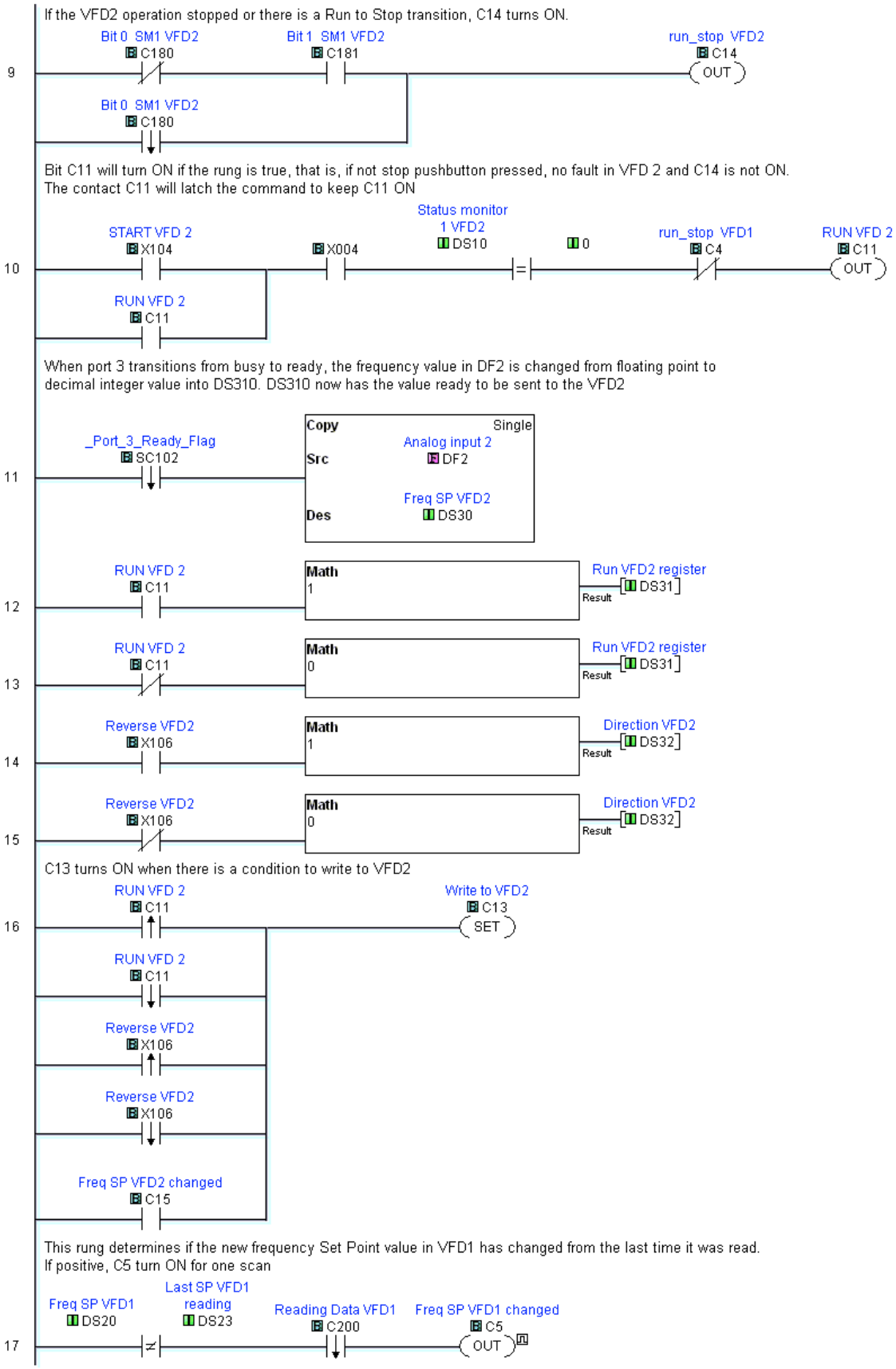
7

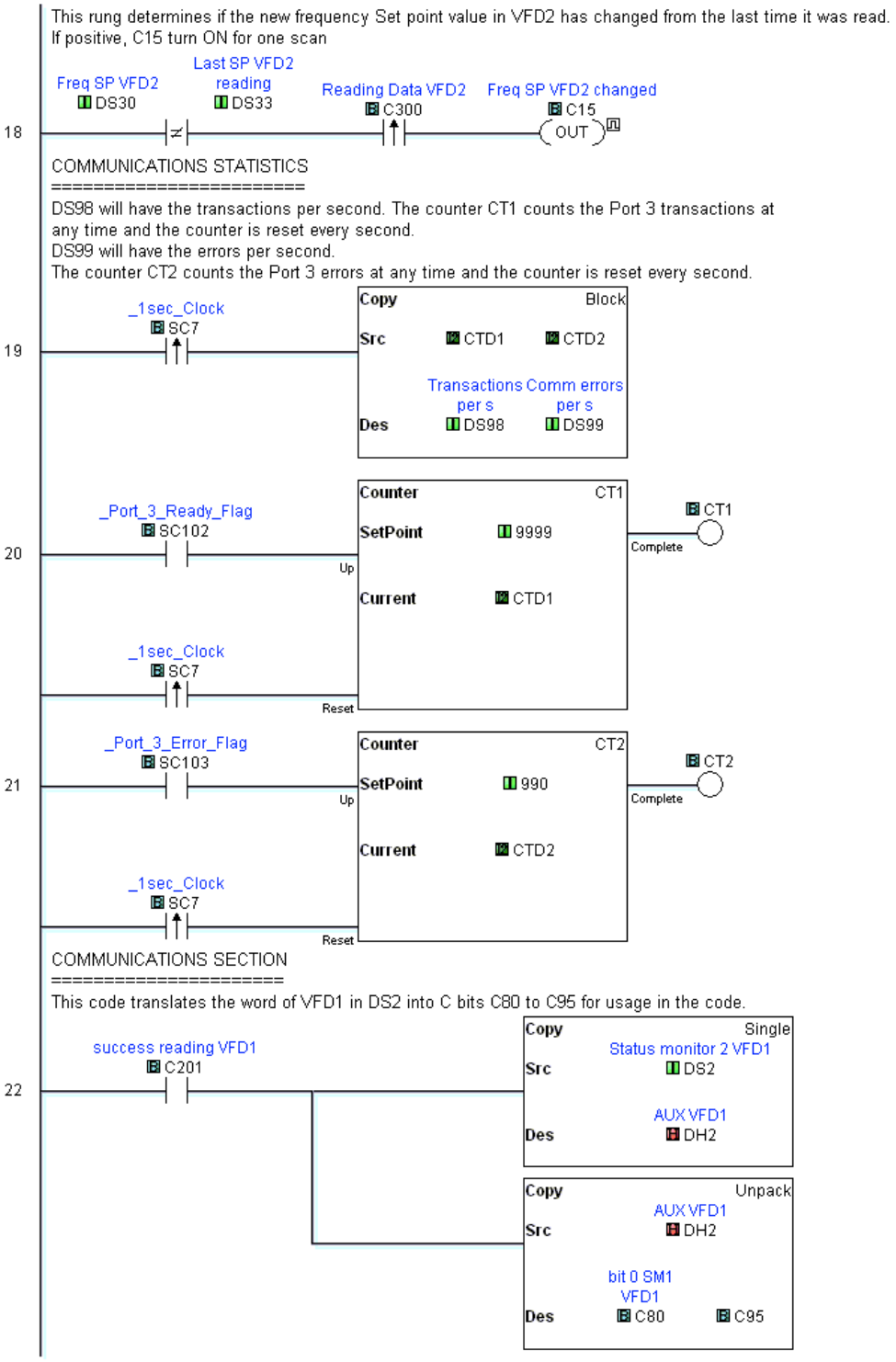


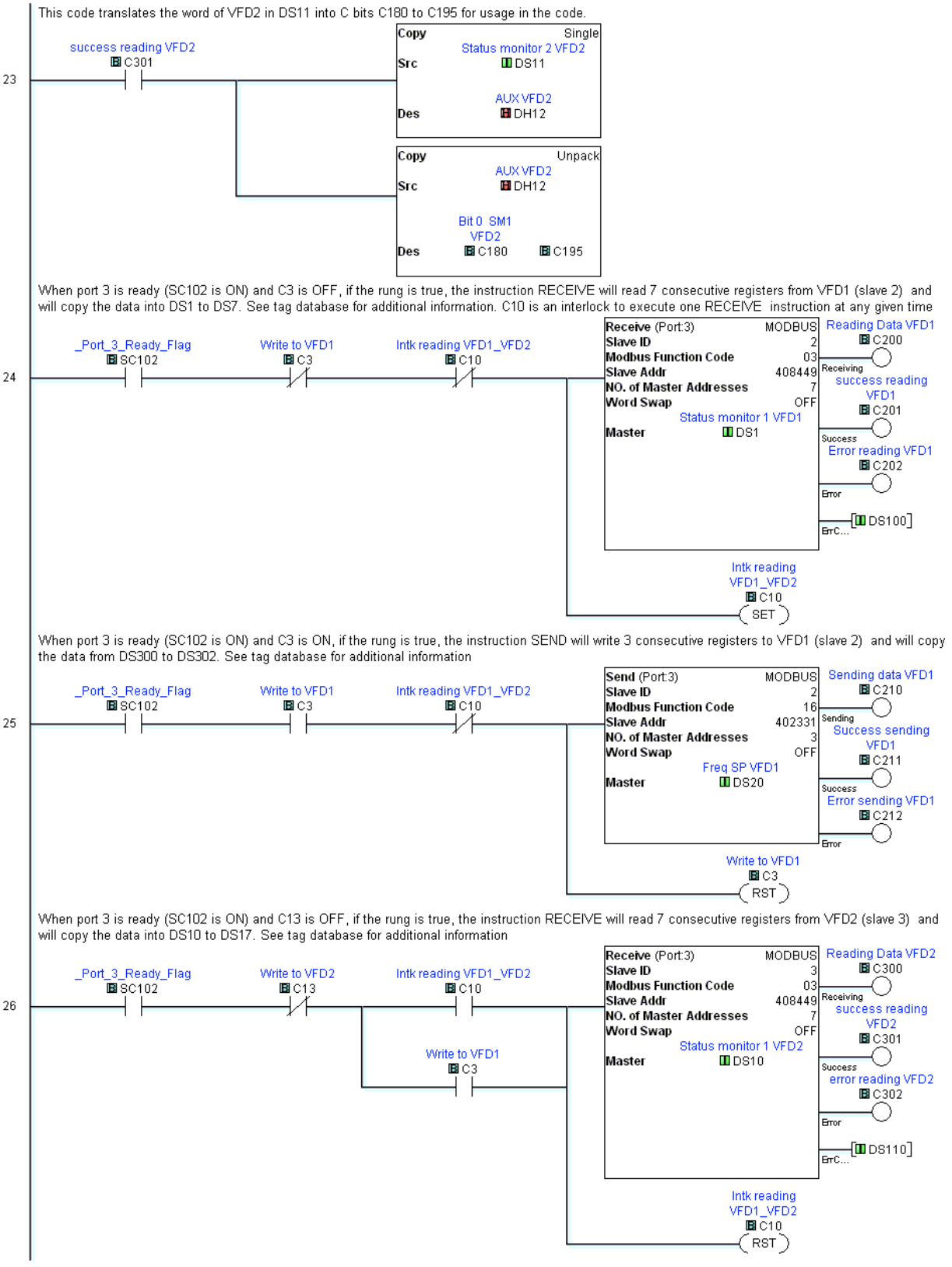
C3 turns ON when there is a condition to write to VFD1

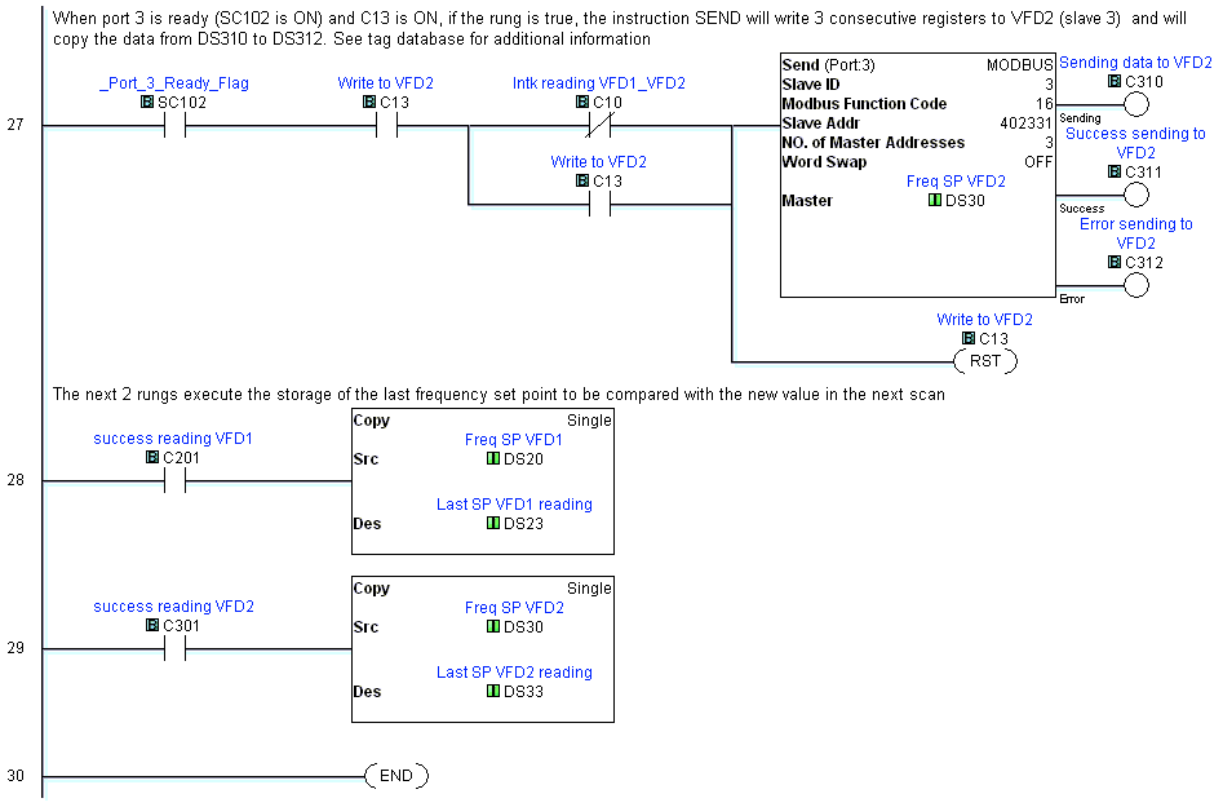
8




If the VFD2 operation stopped or there is a Run to Stop transition, C14 turns ON.
Bit 0 SM1 VFD2
C180
Bit 1 SM1 VFD2
C181
run_stop VFD2
C14
OUT
9
Bit 0 SM1 VFD2
C180
Bit C11 will turn ON if the rung is true, that is, if not stop pushbutton pressed, no fault in VFD 2 and C14 is not ON.
The contact C11 will latch the command to keep C11 ON
START VFD 2
X104
X004
Status monitor 1 VFD2
DS10
=
0
run_stop VFD1
C4
RUN VFD 2
C11
OUT
10
RUN VFD 2
C11
When port 3 transitions from busy to ready, the frequency value in DF2 is changed from floating point to decimal integer value into DS310. DS310 now has the value ready to be sent to the VFD2
_Port_3_Ready_Flag
SC102
Copy
Single
Src
Analog input 2
DF2
Des
Freq SP VFD2
DS30
11
RUN VFD 2
C11
Math
1
Run VFD2 register
DS31
Result
12
RUN VFD 2
C11
Math
0
Run VFD2 register
DS31
Result
13
Reverse VFD2
X106
Math
1
Direction VFD2
DS32
Result
14
Reverse VFD2
X106
Math
0
Direction VFD2
DS32
Result
15
C13 turns ON when there is a condition to write to VFD2
RUN VFD 2
C11
Write to VFD2
C13
SET
16
RUN VFD 2
C11
Reverse VFD2
X106
Reverse VFD2
X106
Freq SP VFD2 changed
C15
This rung determines if the new frequency Set Point value in VFD1 has changed from the last time it was read.
If positive, C5 turn ON for one scan
Freq SP VFD1
DS20
Last SP VFD1 reading
DS23
Reading Data VFD1
C200
Freq SP VFD1 changed
C5
OUT
17


This rung determines if the new frequency Set point value in VFD2 has changed from the last time it was read.
If positive, C15 turn ON for one scan
Freq SP VFD2
DS30
Last SP VFD2 reading
DS33
Reading Data VFD2
C300
Freq SP VFD2 changed
C15
OUT
18
COMMUNICATIONS STATISTICS
DS98 will have the transactions per second. The counter CT1 counts the Port 3 transactions at any time and the counter is reset every second.
DS99 will have the errors per second.
The counter CT2 counts the Port 3 errors at any time and the counter is reset every second.
_1sec_Clock
SC7
19
Copy
Block
Src
CTD1
CTD2
Transactions per s
Comm errors per s
Des
DS98
DS99
_Port_3_Ready_Flag
SC102
20
Up
Counter
CT1
SetPoint
9999
Current
CTD1
Complete
Reset
_Port_3_Error_Flag
SC103
21
CT2
990
CTD2
COMMUNICATIONS SECTION
This code translates the word of VFD1 in DS2 into C bits C80 to C95 for usage in the code.
success reading VFD1
C201
22
Copy
Single
Status monitor 2 VFD1
DS2
AUX VFD1
DH2
Unpack
bit 0 SM1 VFD1
C80
C95


This code translates the word of VFD2 in DS11 into C bits C180 to C195 for usage in the code.
23
success reading VFD2
C301
Copy
Single
Src
Status monitor 2 VFD2
DS11
Des
AUX VFD2
DH12
Copy
Unpack
Src
AUX VFD2
DH12
Bit 0 SM1 VFD2
Des
C180
C195
When port 3 is ready (SC102 is ON) and C3 is OFF, if the rung is true, the instruction RECEIVE will read 7 consecutive registers from VFD1 (slave 2) and will copy the data into DS1 to DS7. See tag database for additional information. C10 is an interlock to execute one RECEIVE instruction at any given time
24
_Port_3_Ready_Flag
SC102
Write to VFD1
C3
Intk reading VFD1_VFD2
C10
Receive (Port:3)
MODBUS
Slave ID
2
Modbus Function Code
03
Slave Addr
408449
NO. of Master Addresses
7
Word Swap
OFF
Status monitor 1 VFD1
Master
DS1
Reading Data VFD1
C200
Receiving
success reading VFD1
C201
Success
Error reading VFD1
C202
Error
DS100
ErrC...
Intk reading VFD1_VFD2
C10
SET
When port 3 is ready (SC102 is ON) and C3 is ON, if the rung is true, the instruction SEND will write 3 consecutive registers to VFD1 (slave 2) and will copy the data from DS300 to DS302. See tag database for additional information
25
_Port_3_Ready_Flag
SC102
Write to VFD1
C3
Intk reading VFD1_VFD2
C10
Send (Port:3)
MODBUS
Slave ID
2
Modbus Function Code
16
Slave Addr
402331
NO. of Master Addresses
3
Word Swap
OFF
Freq SP VFD1
Master
DS20
Sending data VFD1
C210
Sending
Success sending VFD1
C211
Success
Error sending VFD1
C212
Error
Write to VFD1
C3
RST
When port 3 is ready (SC102 is ON) and C13 is OFF, if the rung is true, the instruction RECEIVE will read 7 consecutive registers from VFD2 (slave 3) and will copy the data into DS10 to DS17. See tag database for additional information
26
_Port_3_Ready_Flag
SC102
Write to VFD2
C13
Intk reading VFD1_VFD2
C10
Write to VFD1
C3
Receive (Port:3)
MODBUS
Slave ID
3
Modbus Function Code
03
Slave Addr
408449
NO. of Master Addresses
7
Word Swap
OFF
Status monitor 1 VFD2
Master
DS10
Reading Data VFD2
C300
Receiving
success reading VFD2
C301
Success
error reading VFD2
C302
Error
DS110
ErrC...
Intk reading VFD1_VFD2
C10
RST



This code works with a PLC average scan time of 4 ms and about 30 communication transactions/second (and sometimes one or two errors/second).

Note that the 30 communications per second corresponds to a period of about 1000/30=33.3 ms on each reading, Since the program reads slave 2 first and then slave 3, consecutively, the update time on each slave is really about every 67 ms.

It is important to observe these values to determine the quality of the communications.

Communication errors can occur in the communications and are not important if the quantity is less then 10%. If more than about 10% then you have to take measures to correct the noise influence into the network.

The GS1 drives should be set up and tested for communications before it is connected to a load.

Let us see now the database. We have listed below the used tags.

We show here two Data View windows, where the elements are identified with a nickname and at the same time that status of each variable can be seen.

Data View -[DataView1]

Edit | Fill Down | Write All New Values | View Override | OVR ON | OVR OFF

No.	Address	Nickname	Current Value	New Value	Write		Viewing Format
001	I DS1	Status monitor 1 VFD1	0				Integer
002	I DS2	Status monitor 2 VFD1	160				Integer
003	I DS3	Frequency command VFD1	263				Integer
004	I DS4	Output frequency VFD1	0				Integer
005	I DS5	Output current VFD1	0				Integer
006	I DS6	DC bus voltage VFD1	3198				Integer
007	I DS7	Motor voltage VFD1	0				Integer
008							
009	I DS10	Status monitor 1 VFD2	16				Integer
010	I DS11	Status monitor 2 VFD2	160				Integer
011	I DS12	Frequency command VFD2	141				Integer
012	I DS13	Output frequency VFD2	0				Integer
013	I DS14	Output current VFD2	0				Integer
014	I DS15	DC bus voltage VFD2	753				Integer
015	I DS16	Motor voltage VFD2	0				Integer
016							
017	I DS20	Freq SP VFD1	263				Integer
018	I DS21	Run VFD1 register	0				Integer
019	I DS22	Direction VFD1	0				Integer
020	I DS23	Last SP VFD1 reading	263				Integer
021	I DS24		0				Integer
022	I DS30	Freq SP VFD2	141				Integer
023	I DS31	Run VFD2 register	0				Integer
024	I DS32	Direction VFD2	0				Integer
025	I DS33	Last SP VFD2 reading	141				Integer
026							
027							
028							
029	I DS98	Transactions per s	4				Integer
030	I DS99	Comm errors per s	2				Integer
031							
032	H DH2	AUX VFD1	00A0h				Hex
033	H DH12	AUX VFD2	00A0h				Hex
034							

Data View -[DataView2]

Edit | Fill Down | Write All New Values | View Override | OVR ON | OVR OFF

No.	Address	Nickname	Current Value	Viewing Format
001	B C1	RUN VFD 1	Off	Bit
002	B C2		Off	Bit
003	B C3	Write to VFD1	Off	Bit
004	B C4	run_stop VFD1	Off	Bit
005	B C5	Freq SP VFD1 changed	Off	Bit
006				
007	B C10	Intk reading VFD1_VFD2	Off	Bit
008	B C11	RUN VFD 2	Off	Bit
009	B C12		Off	Bit
010	B C13	Write to VFD2	Off	Bit
011	B C14	run_stop VFD2	Off	Bit
012	B C15	Freq SP VFD2 changed	Off	Bit
013	B C80	bit 0 SM1 VFD1	Off	Bit
014	B C81	bit 1 SM1 VFD1	Off	Bit
015	B C180	Bit 0 SM1 VFD2	Off	Bit
016	B C181	Bit 1 SM1 VFD2	Off	Bit
017				
018	B X101	START VFD 1	Off	Bit
019	B X102	STOP VFD 1	On	Bit
020	B X103	Reverse VFD1	Off	Bit
021	B X104	START VFD 2	Off	Bit
022	B X105	STOP VFD 2	Off	Bit
023	B X106	Reverse VFD2	Off	Bit
024				
025	F DF1	Analog input 1	263.2856	Real
026	F DF2	Analog input 2	141.5714	Real
027				
028	B C200	Reading Data VFD1	Off	Bit
029	B C201	success reading VFD1	On	Bit
030	B C202	Error reading VFD1	Off	Bit
031				
032	B C300	Reading Data VFD2	On	Bit
033	B C301	success reading VFD2	Off	Bit
034	B C302	error reading VFD2	Off	Bit
035				

It is always possible to read more information such as the fault, if there is one, or may be write more commands with the SEND instruction.