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This datasheet covers the topic of using an FX3U PLC with a FX3U-485ADP card fitted to utilise the small number of I/O on the D700 Inverter drive as remote I/O for the PLC over the RS485 Network.

Assumptions

It is assumed that the reader is familiar with the FX3U PLC, the D700 Inverter and how to operate / configure it, and also GX Developer Ladder programming techniques.

It is also assumed that the reader has already configured both the FX3U PLC and the D700 Inverter drive for control over the RS485 network. This datasheet does not cover the parameterisation or configuration of the hardware for the serial communications.

Additional Useful References:

Instruction Manual Inverter FR-D700 EC (IB(NA)-0600353ENG-C)
FX3U-485ADP Users Manual (Art. No.: JY997D26201)

D700 I / O Specification

The D700 inverter has the following I / O available which can be utilised in the PLC:

5 Inputs:

STF
STR
RL
RM
RH

These are all 24VDC inputs which can be configured as Sink or Source.

24VDC is available on board the inverter for use with volt free contacts, maximum supply current is 100mA.

2 Outputs:

ABC (Relay Contact, single common, 1 NO, 1 NC change over contact)

Rating: 230VAC 0.3A or 30VDC 0.3A

RUN (Transistor output)

Rating 24VDC 100mA.

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D700 Inverter configuration

In order to free these Inputs and outputs up for monitoring and control in the PLC we must first configure the Inverter so that the inputs perform no operation and the outputs aren't affected by the inverter operation.

Parameters 178 through to 182 are the Input Terminal Function Selection are by default are:

4.10.1 Input terminal function selection (Pr. 178 to Pr. 182)

Use these parameters to select/change the input terminal functions.

Parameter Number	Name	Initial Value	Initial Signal	Setting Range
178	STF terminal function selection	60	STF (forward rotation command)	0 to 5, 7, 8, 10, 12, 14, 16, 18, 24, 25, 37, 60, 62, 65 to 67, 9999
179	STR terminal function selection	61	STR (reverse rotation command)	0 to 5, 7, 8, 10, 12, 14, 16, 18, 24, 25, 37, 61, 62, 65 to 67, 9999
180	RL terminal function selection	0	RL (low-speed operation command)	0 to 5, 7, 8, 10, 12, 14, 16, 18, 24, 25, 37, 62, 65 to 67, 9999
181	RM terminal function selection	1	RM (middle speed operation command)	
182	RH terminal function selection	2	RH (high-speed operation command)	

If we leave these parameters as default we will still be able to monitor the inputs in the PLC, but as the inputs change state this will effect the operation of the inverter.

Changing the initial values from default to the value of '9999' renders the Inputs as invalid as far as the inverters CPU is concerned:

67	X67	Command source switchover (turning on X67 makes *Pr. 338* and *Pr. 339* commands valid)	Pr. 338, Pr. 339	*171*
9999	—	No function	—	—

(Refer to page 109 of the D700 users manual for a full list of input terminal functions)

Using either the D700 Keypad or the FR Configurator software change the value of the parameters corresponding to the Input terminals you wish to use to '9999'.

So, to utilise all 5 inputs change Parameters 178 through to 182 to '9999'

We will now be able to monitor the status of the input terminals via the PLC Code using the dedicated inverter control instruction list for the FX3U.

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We now need to do the same thing for the outputs. Parameters 190 and 192 are the Output Terminal Function Selection:

The Initial default values are:

4.10.5 Output terminal function selection (Pr. 190, Pr. 192)

You can change the functions of the open collector output terminal and relay output terminal.

Parameter Number	Name		Initial Value	Initial Signal	Setting Range
190	RUN terminal function selection	Open collector output terminal	0	RUN (inverter running)	0, 1, 3, 4, 7, 8, 11 to 16, 25, 26, 46, 47, 64, 70, 90, 91, 93*, 95, 96, 98, 99, 100, 101, 103, 104, 107, 108, 111 to 116, 125, 126, 146, 147, 164, 170, 190, 191, 193*, 195, 196, 198, 199, 9999
192	A,B,C terminal function selection	Relay output terminal	99	ALM (fault output)	

This time we need to configure these terminals so that they get they're status reference from a dedicated parameter that can be manipulated from the PLC.

96	196	REM	Remote output	Output to the terminal when a value is set to the parameter.	Pr. 495, Pr. 496	*121*
98	198	LF	Alarm output	Output when an alarm (fan failure or communication error warning) occurs.	Pr. 121, Pr. 244	*178, 225*
99	199	ALM	Fault output	Output when the fault occurs. The signal output is stopped when the fault is reset.	—	*117*
9999		—	No function	—	—	—

(Refer to page 114 of the D700 users manual, table for a full list of output terminal functions)

Using either the D700 Keypad or the FR Configurator software change the value of the parameters corresponding to the output terminals you wish to use to '96'.

So, to utilise both outputs change Parameters 190 and 192 to '96'

The output terminals will now be controlled by the status of an array of bits in Parameter 496 which can be manipulated using the dedicated inverter control instruction list for the FX3U.

Monitoring the D700 Inputs in the PLC using GX Developer

The D700 Inverter has a Special Monitor Selection command which allows many different items to be monitored over the users chosen network. Multiplexing these commands allows a large amount of data to be collected.

On the following page is a table of items which can be monitored:

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Data	Description	Unit	Data	Description	Unit
H01	Output frequency/speed ①	0.01Hz 0.001	H14	Cumulative energization time	1h
H02	Output current	0.01A	H17	Actual operation time	1h
H03	Output voltage	0.1V	H18	Motor load factor	0.1%
H05	Frequency setting/speed setting ①	0.01Hz 0.001	H19	Cumulative power	1kWh
H07	Motor torque	0.1%	H34	PID set point	0.1%
H08	Converter output voltage	0.1V	H35	PID measured value	0.1%
H09	Regenerative brake duty	0.1%	H36	PID deviation	0.1%
H0A	Electronic thermal relay function load factor	0.1%	H3A	Option input terminal status 1 ④	—
H0B	Output current peak value	0.01A	H3B	Option input terminal status 2 ⑤	—
H0C	Converter output voltage peak value	0.1V	H3C	Option output terminal status ⑥	—
H0E	Output power	0.01kW	H3D	Motor thermal load factor	0.1%
H0F	Input terminal status ②	—	H3E	Inverter thermal load factor	0.1%
H10	Output terminal status ③	—	—	—	—

Tab. 6-70: *Special monitor selection numbers*

In this case we want to monitor the Input Terminal status, so we need use the Special Monitor Data H0F.

This is a two stage operation:

(1) We need to tell the inverter we want the Input Terminal Status whenever we request the Special Monitor by sending the H0F Data Command.

(2) We then need to request that the inverter send the selected data by executing a Special Monitor Read.

As can be seen from the table below, we need to use the Special Monitor selection instruction to send the data H0F to the inverter:

2	Monitor	Special monitor	Read	H72	H0000 to HFFFF: Monitor data selected in instruction code HF3	4 6 (B, E, E'/D)
		Special monitor selection No.	Read	H73	H01 to H3C: Monitor selection data (Refer to Tab. 6-70 on page 6-246.)	2 (B, E'/D)
			Write	HF3		2 (A', C/D)

(1). The following command is used in the PLC:

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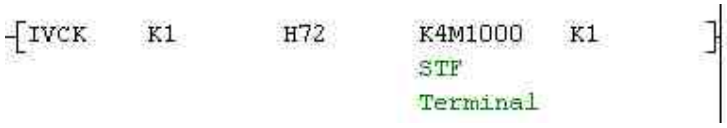
Where:

IVDR	is the Dedicated Instruction for Controlling the operation of the Inverter
K1	is the Station Number of the target Inverter
H73	is the command to configure the Special Monitor to Read
H0F	is the data for the above command referring it to the input terminals
K1	is the Serial Channel number in use in the PLC for this task

(2). The following instruction is then used to actually read the status of the input terminals be requesting a Special Monitor Read:



Where:

IVCK	is the Dedicated Instruction for Monitoring the inverter
K1	is the Station Number of the target Inverter
H72	is the command to execute the Special Monitor Read
K4M1000	is the target area for the received data from the inverter.
K1	is the Serial Channel number in use in the PLC for this task

The returned data will be in this format:

So in the example above, M1000 – M1015 is the destination address, therefore:

Device name	Comment
M1000	STF Terminal
M1001	STR Terminal
M1002	Not Used
M1003	Not Used
M1004	RL Terminal
M1005	RM Terminal
M1006	RH Terminal
M1007	Not Used
M1008	Not Used
M1009	Not Used
M1010	Not Used
M1011	Not Used
M1012	Not Used
M1013	Not Used
M1014	Not Used
M1015	Not Used
M1016	

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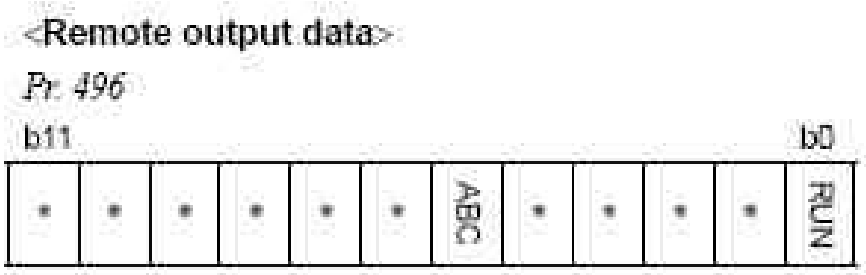
Driving the D700 Outputs from the PLC using GX Developer

The D700 Inverter has a special reserved set of parameters used for driving the 3 available outputs as remote outputs for the PLC:

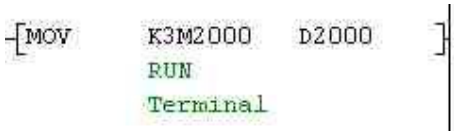
Function	Parameter (Related parameters)	Name	Increments	Initial value	Setting range	Description		Parameter copy	Parameter clear	All Parameter clear	Refer to page
								✔: enabled —: disabled			
Remote output function (REM signal)	495	Remote output selection	1	0	0	Remote output data clear at powering off	Remote output data clear at inverter reset	✔	✔	✔	6-133
					1	Remote output data retention at powering off					
					10	Remote output data clear at powering off	Remote output data retention at inverter reset				
					11	Remote output data retention at powering off					
	496	Remote output data 1	1	0	0–4095	Output terminal can be switched on and off.		—	—	—	
	497	Remote output data 2	1	0	0–4095			—	—	—	

With the parameters relating to each output terminal set to '96' as discussed earlier we can used Pr. 496 to drive the outputs on or off:



Parameter 496 is broken down into an array of bits, of which B0 & B5 control the 2 outputs.

Using the following command we can take an array of M flags and map them into a data register ready for sending to Pr. 496:



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So starting with M2000 our output flags will be:

Device name	Comment
M2000	RUN Terminal
M2001	Not Used
M2002	Not Used
M2003	Not Used
M2004	Not Used
M2005	ABC Terminals
M2006	Not Used
M2007	Not Used
M2008	Not Used
M2009	Not Used
M2010	Not Used
M2011	Not Used
M2012	

We then need to send that data to Pr.496 so it effects the outputs:

Where:

IVWR	is the Dedicated Instruction for Writing to an Inverter Parameter
K1	is the Station Number of the target Inverter
K496	is the target Parameter for the data being sent. (K=Decimal)
D2000	is the source data to be sent.
K1	is the Serial Channel number in use in the PLC for this task

Now turning on the M2000 and M2005 flags in the PLC code will result in the outputs on the Inverter turning on.

An example of the complete PLC code will look like: