



Application Note

Using Programmable Logic Functions in the PCD

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The programmable logic function in the PCD enables users to tailor their control to their particular needs. Several common applications involving programmable logic are under/over voltage trip, under/over frequency trip, remote SCADA control using hardwired contacts, and input contact configuration for local auxiliary switches. Though most programming features in the PCD can be set by either the front panel of the control or WinPCD software, the programmable logic functions can only be set up by the WinPCD software.

When elements other than the overcurrent trip functions (51P, 50P, 51N, 50N, 46, 67P & 67N) are set, the unit will not perform any operation other than provide a logical alarm, which can be read by SCADA through the serial communication port using DNP or Modbus protocol. To make the unit trip or take another action, the programmable I/O must be set up. This application note provides the basics and tips on using the programmable logic functions in the PCD.

All PCDs have 16 physical outputs and inputs, some externally available, and some which are internal. The typical PCD used with the VR-3S has one card with physical outputs and is shown here in Figure 1.

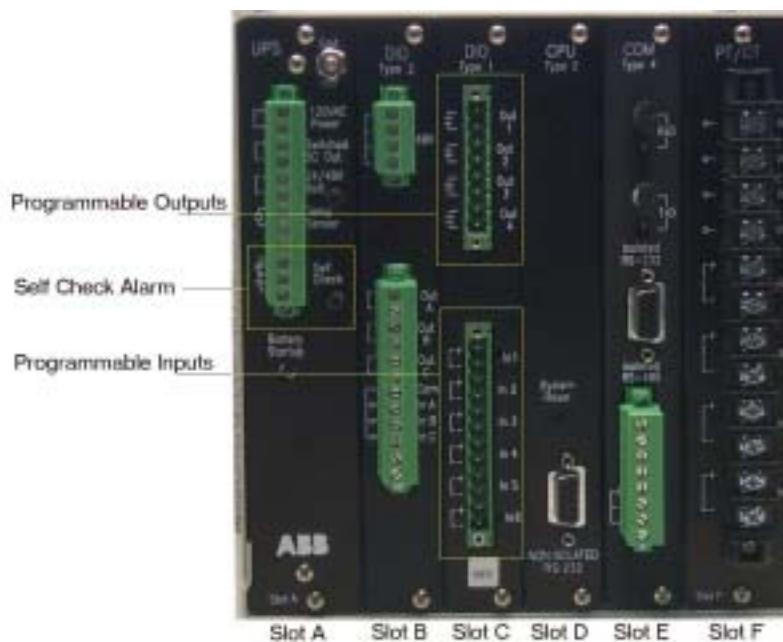


Figure 1 – Rear View of PCD

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The PCD in Figure 1 has four external outputs and six external inputs, plus one self-check alarm. The outputs are dry. The wetting voltage may be AC or DC, and must not exceed the ratings listed for output contacts in the ratings section of the PCD Instruction Book. The physical inputs, however, must be wetted by same voltage as listed at the bottom of the DIO Type 1 card, and the DC output voltage of the UPS/ Power Supply card. This is typically 48 VDC in VR applications, 24 VDC in recloser retrofit applications.

Looking at the Typical Programmable I/O Designations in Figure 2, the contact IDs at the top correspond to contacts on the PCD. Notice the contact IDs start with Out1b and In1b. The letter designation “b” represents the PCD Module slot number that these contacts are in. The next slot, if included with your unit, is the “c” slot where contacts start with Out1c and In1c.

Moving to the right, the contacts switch to “FBx”. These are called feedback contacts and are used to pass logical outputs to logical inputs. The number of feedbacks available depends on how many contacts are taken up by the external contacts. However, some of the external contacts can be switched over to feedback contacts using the Feedback Allocation Mask menu in the Settings menu.

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	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Outputs	Out1b	Out2b	Out1c	Out2c	Out3c	Out4c	N/A	N/A	FB8	FB7	FB6	FB5	FB4	FB3	FB2	FB1
TRIP	X															
CLOSE		X														
Customer Logical Output selections ▼									▼	▼	▼	▼	▼	▼	▼	▼
Inputs	In1b	In2b	In1c	In2c	In3c	In4c	In5c	In6c	FB8	FB7	FB6	FB5	FB4	FB3	FB2	FB1
52a	C															
52b		C														
Customer Logical Input selections ▼																




-  Contacts used for operating breaker and should not be modified (Reserved).
-  Available contacts for customer configuration (can be reassigned as feedbacks by "Feedback Allocation Mask" menu).
-  FBx Available contacts for feedback logic.

Figure 2 – Typical Programmable I/O Designations

To view or modify programmable logic, run WinPCD, select the appropriate unit (online or offline mode), and from the main menu choose Settings > Programmable Outputs or Programmable Inputs.

For the PCD used with the VR-3S recloser, the external contacts on the “b” slot module are special MOSFET contacts and are not available for customer use. A DIO Type 2 label at the top of the module identifies this module. The “c” slot contacts are available for customer use. Section 6.6 of the PCD Instruction book shows the available configurations of I/O modules depending on the PCD style number. Two common configurations are given in Figure 3 (three phase tripping) and Figure 4 (single phase tripping). Note that the single phase version

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uses more of the physical contacts than the three phase version. This is because in single phase mode, the processor looks at each of the three phases individually, while in three phase mode, the processor “gangs” all phases.

The figure shows two screenshots of the software interface. The top window is titled "Programmable Inputs - Source: Local (Changed)". It features a table with columns for Logic, In1b, In2b, In1c, In2c, In3c, In4c, In5c, In6c, FB8, FB7, FB6, FB5, FB4, FB3, FB2, and FB1. The first two rows show logic configurations: 50A (AND, C) and 50B (AND, C). Below the table are two diagrams: one for 'C' (Enable = Closed, Disable = Opened) and one for 'O' (Enable = Opened, Disable = Closed). The bottom window is titled "Programmable Outputs - Source: Local (Unchanged) (Not Connected)". It has a table with columns for Out1b, Out2b, Out1c, Out2c, Out3c, Out4c, N/A, N/A, FB8, FB7, FB6, FB5, FB4, FB3, FB2, and FB1. The first row shows timer values (0.00). The second row shows logic configurations (OR). The third row shows checkboxes for TRIP and CLOSE.

Figure 3 – 3 Phase Programmable I/O

The screenshot shows the "Programmable Inputs - Source: Local (Unchanged) (Not Connected)" window. The table has columns for Logic, In1b, In2b, In3b, In4b, In5b, In6b, In7b, In8b, In1c, In2c, In3c, In4c, In5c, In6c, FB2, and FB1. The first eight rows show logic configurations for 50aA, 50aB, 50aC, 50bA, 50bB, 50bC, 50A, and 50B, with 'C' indicating closed contacts. Below the table are two diagrams: one for 'C' (Enable = Closed, Disable = Opened) and one for 'O' (Enable = Opened, Disable = Closed). The bottom window has buttons for "Receive Data from Database", "Receive Data from Unit", "Send Data to Unit", "Send Data to Database", "Print...", and "Back".

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	Out1b	Out2b	Out3b	Out4b	Out5b	Out6b	Out7b	Out8b	Out9b	Out10c	Out11c	Out12c	N/A	N/A	FB2	FB1
Timers:	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Names:																
Logic:	OR	OR	OR	OR	OR	OR	OR	OR	OR	OR	OR	OR	OR	OR	OR	OR
TRIPA	<input checked="" type="checkbox"/>															
CLOSEA		<input checked="" type="checkbox"/>														
TRIPB			<input checked="" type="checkbox"/>													
CLOSEB				<input checked="" type="checkbox"/>												
TRIPC					<input checked="" type="checkbox"/>											
CLOSEC						<input checked="" type="checkbox"/>										
TRIP							<input checked="" type="checkbox"/>									
CLOSE								<input checked="" type="checkbox"/>								

Figure 4 – 1 Phase Programmable I/O

Rules and tips for the use of the programmable logic function:

- The Inputs & Outputs listed on the top line (Out1b, In1b, etc) are the *physical input and output contacts*.
- The Inputs & Outputs listed on the vertical line (52a, Trip) are the *logical input and outputs*.
- *Feedbacks (FBx)* pass logical outputs to the logical inputs.
- When changing Feedbacks in the Feedback Allocation Mask, start at the bottom, freeing up the necessary number of contacts as feedbacks. Do not change those contacts associated with the trip/close outputs and 52a/52b inputs.
- User *User Logical Inputs (ULIx)* pass input contact status to physical outputs via *User Logical Outputs (ULOx)*. See exception in Table 2 below.
- You may not program any contact more than once in a column, i.e. if you use OPEN once in the programmable inputs, it may not be used again.
- If you have a unit that is capable of doing single phase tripping, the following logical elements (Table 1) will apply specifically to the Trip Mode Setting in the Configuration Settings.

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Trip Mode: 3 Phase		Trip Mode: 1 Phase	
Logical Inputs	Logical Outputs	Logical Inputs	Logical Outputs
52a	TRIP	52aA	TRIPA
52b	CLOSE	52aB	TRIPB
OPEN	TRIP*	52aC	TRIPC
CLOSE	CLOSE*	52bA	CLOSEA
		52bB	CLOSEB
		52bC	CLOSEC
		TRIPA	TRIPA*
		TRIPB	TRIPB*
		TRIPC	TRIPC*
		CLOSEA	CLOSEA*
		CLOSEB	CLOSEB*
		CLOSEC	CLOSEC*

Note that the logical element seal-ins are noted with an asterisk.

Table 1

Some Logical Elements only apply to specific Configurations of the PCD, as follows in Table 2:

LCM Trip & LCM Trip*	For units with Loop Control Option only
LCM Close & LCM Close*	For units with Loop Control Option only
TAGBTN	For units beyond firmware version 2.5 and with the front panel that includes the hot line tag button.
ULI8	Activates the USER 1 LED for firmware version 2.5 and with the front panel that includes USER LED's
ULI8	Activates the USER 2 LED for firmware version 2.5 and with the front panel that includes USER LED's

Table 2

Self Check Alarm contact is provided on the back of the PCD, and is hard coded and does not require any programmable mapping. If you are using hardwire SCADA, wire as desired to the Form C contact on the UPS/PS card. Note that when the unit is energized and healthy, the contacts are held in the OPPOSITE from normal (as shown on the module) state. This way, if power is lost or the unit has a problem, this contact will fall out.

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A *Loss of AC Alarm* contact is provided via a Form C contact on the top of the Capacitor Assist Module for VR reclosers. Note that when the AC is applied and the battery voltage is above 40 VDC, the contacts are held in the OPPOSITE from normal (as shown on the module) state. This way if power is lost or the unit has a problem, this contact will fall out.

Testing programmable logic schemes:

There are several tools to verify that the desired programming has been achieved before placing the unit into service. From the HMI, input contacts can be forced to the closed state without a voltage source. In the Main Menu, select Operations – Force Physical Input. To force a contact, select the appropriate contact and select Forcing State of “C”. Reset this back to “N” to remove the forcing of the contact, and move to the next Force Physical Input. Alternatively, WinPCD allows you to force physical inputs through its Operation Menu, as well as monitor the contact status from its Test Menu.

Important: When activating contacts through the Force Physical Output function, remember to reset the contact to the Normal “N” state, or it will remain activated. However, cycling power to the unit will also reset the contacts to the normal state.

The latest information on the PCD control can be found at our website at www.abb.com/mediumvoltage. (Select PCD from the dropdown Shortcuts menu.)

For additional support or information please call ABB Inc. at 1-800-929-7947 Ext. 5 or +1-407-732-2000 Ext. 5.

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