Application Note

Substation Automation and Protection Division

Understanding and Applying User Logical Inputs and Outputs

All of our 2000 and 2000R products contain numerous logical inputs and logical outputs (I/O) dedicated to specific monitoring or controlling applications. Since applications are innumerable and may not be available with the specifically defined logical I/O provided, nine sets of User Logical Inputs and Logical Outputs have been incorporated into the 2000 and 2000R products. The nine user logical inputs are defined as ULI1 to ULI9, consecutively, and the nine user logical outputs similarly named as ULO1 to ULO9, consecutively.

The logic diagram for the User Logicals is shown in Figure 1. As can be seen from the logic diagram, the enabled or disabled status of the User Logical Input internally drives the energized or de-energized status of the same numbered User Logical Output when connected. The condition of "connected" is the default setting within all 2000 and 2000R products. User Logical Inputs and Outputs can be "disconnected" using the 2000R's Windows-based interface software, e.g., WinECP for the DPU2000R and TPU2000R. When a User Logical I/O set has been disconnected, the User Logical Input status still follows the asserted or de-asserted status of the element to which it is mapped, but will not drive the same numbered User Logical Output. The User Logical Outputs, when disconnected, are energized or de-energized locally through the front panel MMI Operations menu and remotely through the product's interface software or communications network. The status of the User Logical Inputs and Outputs can be read using the product's interface software, e.g., WinECP, and through its available communications network.

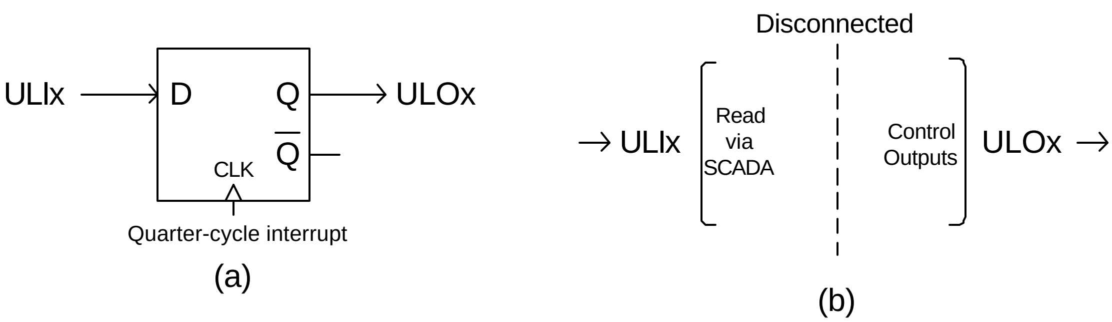
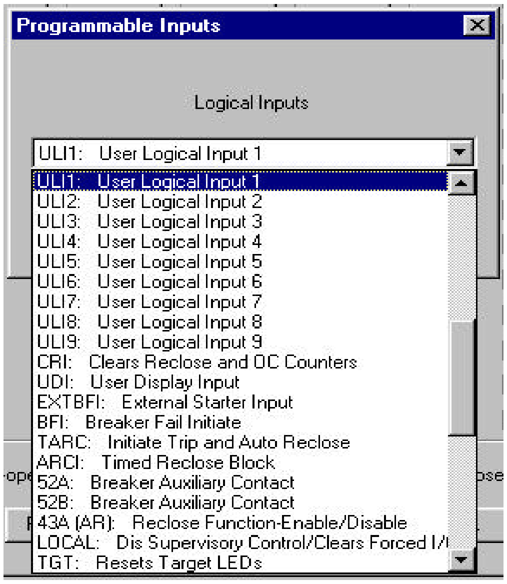


Figure 1 - Logic diagram for User Logical Inputs and Outputs: (a) connected; (b) disconnected.

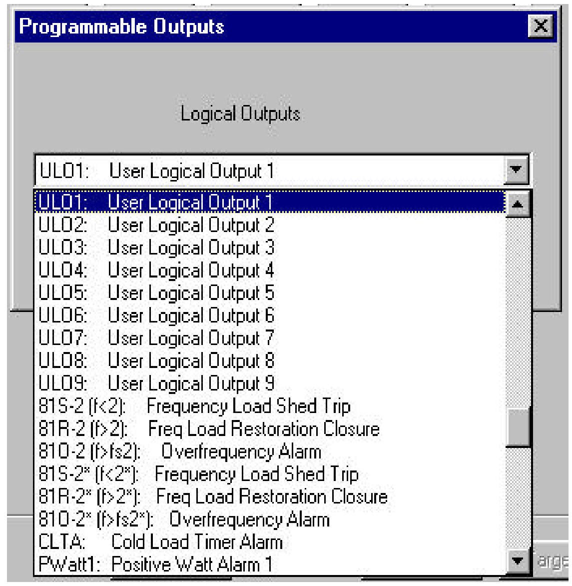
The User Logical I/O are programmed using the product's Windows-based interface software – WinECP for DPU2000, TPU2000, DPU2000R and TPU2000R and GPUECP for the GPU2000R – as shown in Figure 2. User Logical Inputs are programmed in the Programmable Inputs map selected from the list of logical inputs. User Logical Outputs are set in the Programmable Outputs map from the list of available logical outputs. User Logical Outputs can be renamed for its application purpose, e.g., BLK GND, using up to eight characters. The name appears in the MMI display when locally controlling the User Logical Outputs through the Operations menu. The status of any User Logical Input can be monitored using the interface software and defined protocol points for its communications network.

User Logical Input assertion and de-assertion transitions are logged in the Operations Records as ULIx Input Opened" and ULIx Input Closed", respectively, where "x" represents the specific User Logical Input numbered one through nine. User Logical Output energizations are not logged in the Operations Records since the enabling and disabling of the feature or function they control are logged.

Many applications are achievable using the User Logical I/O with a few examples given here not otherwise possible with the dedicated logical inputs and outputs.



(a)



(b)

Figure 2 - WinECP Programmable I/O logical list: (a) User Logical Inputs; (b) User Logical Outputs.

Example 1: *DPU2000R Trip Coil Monitoring*

The DPU2000R includes Trip Circuit Monitoring logic within its state machine driven by a dedicated logical input, *TCM*, with failure indication provided by its logical output *TCFA*. Where trip circuit failure monitoring is an important early detection feature in preventing a future breaker failure condition, it can only be applied when the breaker is in a closed position. A trip coil, and therefore circuit, that fails immediately after the breaker opens can not be monitored by the trip circuit feature until the breaker eventually closes which, for an early detection feature, is too late should the breaker close into a fault. Of course, breaker failure detection would in that case trip the necessary backup breakers, but not without dropping more load than desired. For this reason, it is often desired to monitor the trip coil in place of or in addition to the trip circuit. Monitoring the breaker trip coil can be performed whether the breaker is in an open or closed position. To perform trip coil monitoring in the DPU2000R, use a connected set of User Logical I/O mapped to an unused physical input and output, respectively. The physical inputs and outputs would be wired to the system as shown in Figure 3. The physical output and User Logical Output can be named “TRPCOIL” for clear identification of its purpose. The User Logical Output would be qualified with the master trip element before tripping the upstream or backup breaker. It can also be mapped to block auto-reclosing and manual closing of the breaker using the feedback logic – see Section 6 of the DPU2000R Instruction Booklet for details on Feedback logic. The status of the assigned User Logical Input can be monitored using the interface software and its communications network for immediate failure indication so that appropriate personnel can be dispatched to fix it maintaining high service reliability.

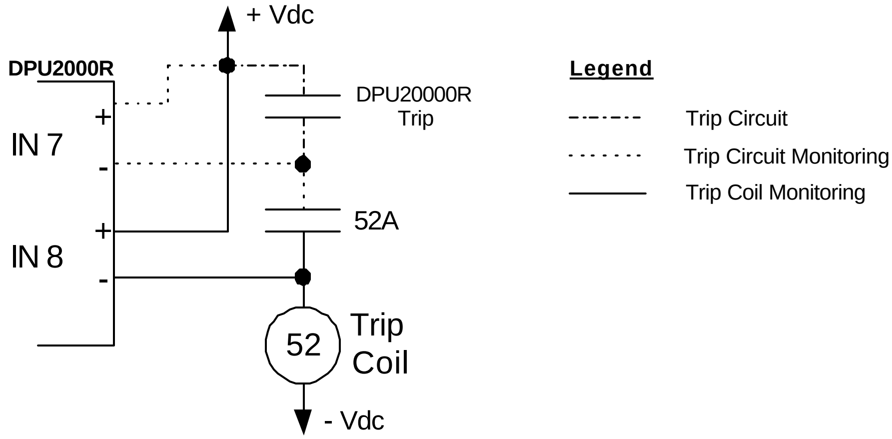


Figure 3 - DPU2000R Trip Coil Monitoring Connections.

Figure 3 shows the logic diagram of using the User Logical I/O for trip coil monitoring. Figure 4 shows the Programmable Input and Output mapping for this application applied with the DPU2000R relay system.

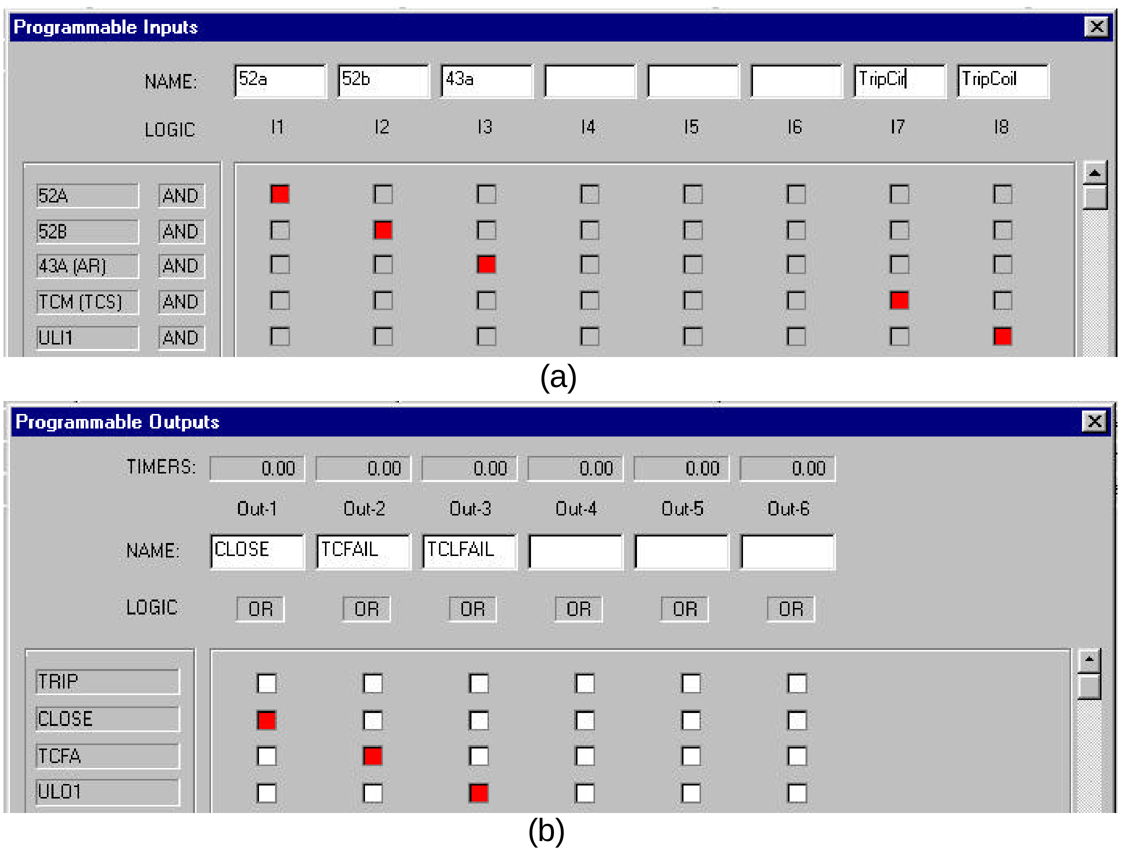
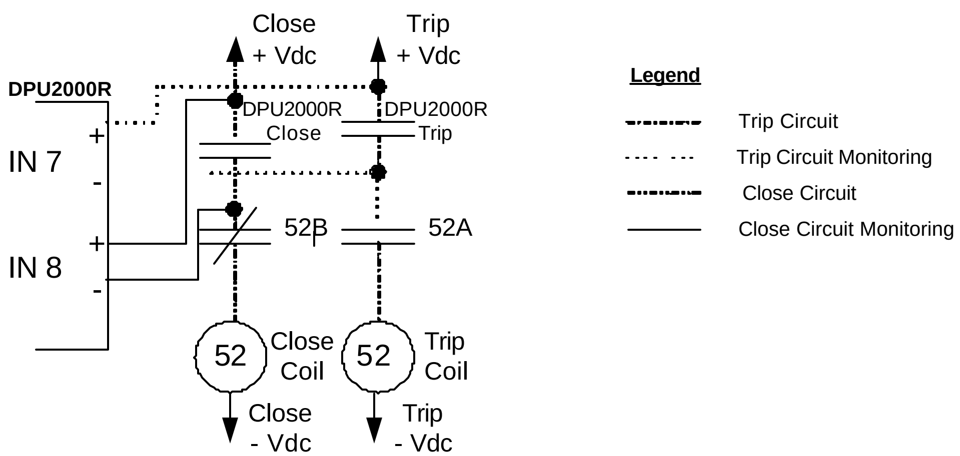


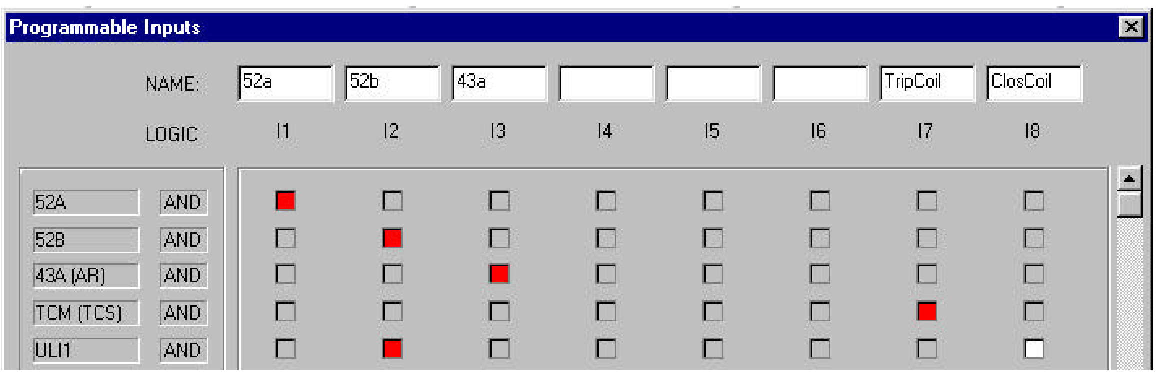
Figure 4 - Programming Mappings for Trip Coil Monitoring: (a) programmable input map; (b) programmable output map.

Example 2: *2000R Close Circuit Monitoring*

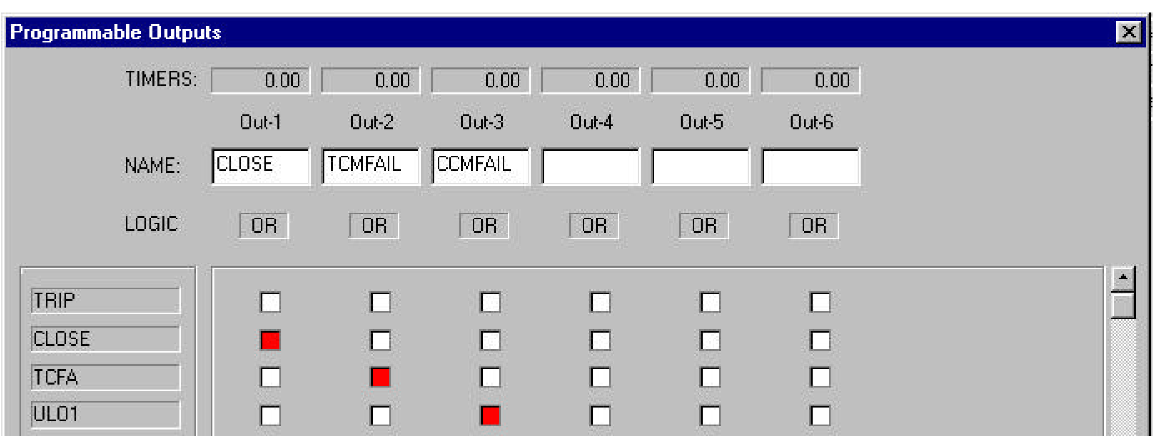
Similar to Trip Circuit Monitoring, detection of a failed close circuit is important in preventing an eventual breaker-failure-to-close condition. Similar to trip circuit monitoring, close circuit monitoring should only be performed when the breaker is in one of its two states; in this case, the open state. In any 2000R product, this can be easily accomplished using the second double-ended input provided and the breaker auxiliary contacts, 52A and 52B, already connected. Figure 5 shows the external wiring and programmable I/O mapping required implementing this feature.



(a)



(b)



(c)

Figure 5 - DPU2000R Close Circuit Monitoring: (a) connections; (b) programmable input map; (c) programmable output map.

When a close circuit failure is detected, the user logical output can be used to block all close attempts to that breaker. The status of the assigned User Logical Input can be monitored using the interface software and its communications network for immediate failure indication so that appropriate personnel can be dispatched to fix it maintaining high service reliability.

Example 3: *TPU2000R Circuit Breaker Monitoring*

The TPU2000R does not use the breaker contact status for its internal state machine logic and therefore the logical inputs 52A and 52B are not available for mapping as they are in the DPU2000R. Should the status of the breaker position be desired through, e.g., the communications network, use two disconnected User Logical Inputs for obtaining the breaker status.

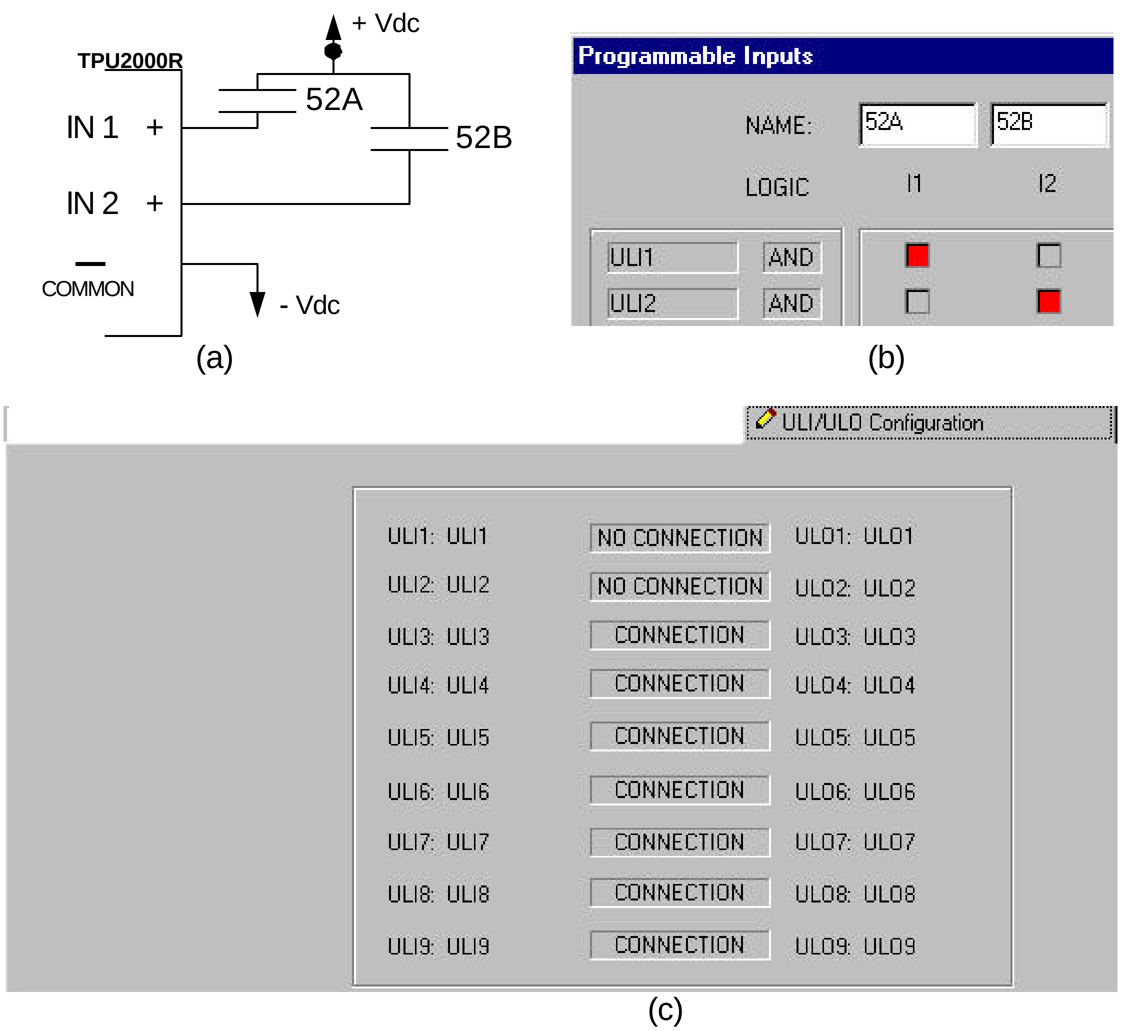
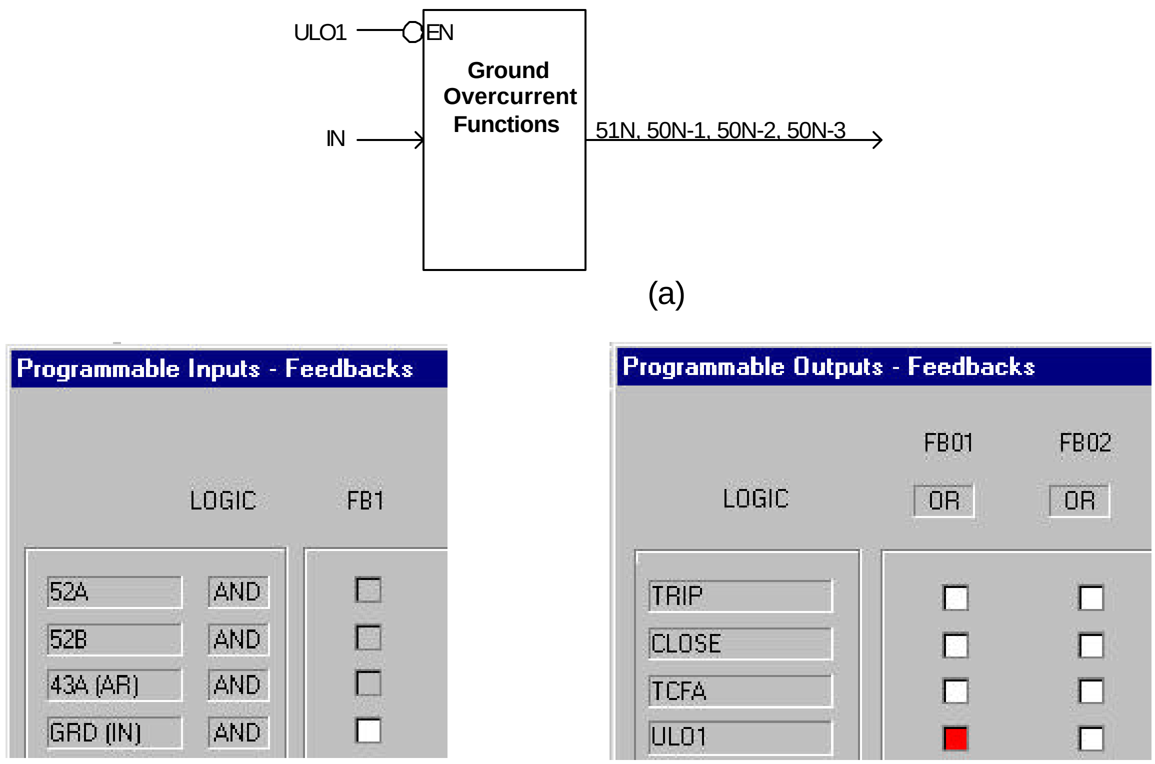


Figure 6 - TPU2000R Breaker Monitoring: (a) typical connections; (b) programmable input mapping; (c) ULI/ULO configuration.

Figure 6 shows the necessary wiring and programmable I/O mapping required invoking this monitoring feature. If the breaker position is to be utilized in some control scheme, e.g., trip circuit monitoring, then use a second disconnected User Logical Input and read its status, in addition to the breaker status using the interface software and its communications network. See Section 6 of the TPU2000R Instruction Booklet for trip coil monitoring with the TPU2000R.

Example 4: *DPU2000R Block Ground Control*

When disconnected from their same numbered User Logical Inputs, User Logical Outputs can be applied to locally and remotely control particular DPU2000R protection functions. Local control is accomplished through the Operations menu in the front panel MMI with remote control performed through set and clear ULO protocol commands via the communications network and the DPU2000R Feedback logic – see Section 6 of the DPU2000R Instruction Booklet for details on Feedback logic. Confirmation that the ground overcurrent functions have been successfully disabled is accomplished by reading the dedicated "Ground Disabled" logical output *GRD-D*. Figure 7 shows the logic diagram and programmable I/O required for local and remote blocking of the ground overcurrent function that would be desired, for example, during a switching operation.



(b) (c)

Figure 7 - Ground Control via User Logical Outputs: (a) logic diagram; (b) programmable input map; (c) programmable output map.

Contributed by:
John J. McGowan
Revision 0, 12/2001

ABB, Inc.
7036 Snowdrift Road
Allentown, PA 18106
800-634-6005 Fax 610-395-1055
Email: powerful.ideas@us.abb.com
Web: www.abb.com/substationautomation