Application Note

Substation Automation and Protection Division

Using the Level Detector Functions LLDA and HLDA in the TPU2000R to Supervise Breaker Tripping Based upon the Fault Current Level

Introduction

A user of the TPU2000R transformer protection relay has a switch with limited short-circuit interrupting capability on the high side of the transformer. He desires that operation of the switch be blocked for fault currents above a certain level, and the trip signal be re-routed to a remote high voltage circuit breaker.

The TPU2000R provides a high-speed current-level detector for each winding. For winding #1, the detector is LDA-1, and its threshold setting is made as a multiple of the 51P-1 phase-time-overcurrent setting. The setting range is 0.5 to 20 multiples in increments of 0.1. The associated logical output functions are LLDA1 (asserted when the winding #1 current is below the set threshold) and HLDA1 (asserted when the current is above the set threshold).

The flexibility provided in the TPU2000R in the input and output programmable logic settings makes it easy to set up the logic to supervise the two fault interrupting devices. This application will make use of the Feedbacks and User Logical Functions to implement the required scheme.

Assumptions for this Example

The following assumptions will be used in our example: Switch A1 on the high voltage side of the transformer is to operate for all differential and overcurrent faults below the set threshold of LDA-1. For faults above the set threshold, operation of Switch A1 is to be blocked, and a trip signal sent to the upstream high voltage circuit breaker B2. Back-up protection for through-faults on the medium voltage side of the transformer (winding 2) will send a trip signal to medium voltage Circuit Breaker C3.

Implementation

Figure 1 shows the screen capture from the Programmable Outputs settings, Feedbacks. OR logic is selected for FBO1 at the top of its column. Feedback Ouput #1 is asserted when one or more of the following high-side protective elements operate: Differential (87T or 87H), Phase Instantaneous Overcurrent (50P-1), Phase Time-Overcurrent (51P-1), Ground Instantaneous Overcurrent (50N-1), Ground Time-Overcurrent (51N-1).

Figure 2 shows the Programmable Input screen, where the Feedback #1 is programmed to assert User Logical Input #1 when one or more of the high side protective elements operate.

Figure 3 shows the User Logical Input/User Logical Output configuration screen, showing that a direct connection has been set between ULI1 and ULO1. Therefore, when ULI1 is asserted, ULO1 becomes asserted.

Figure 4 shows the Programmable Output screen. Physical Output #1 has been assigned to trip Switch A1. Output #2 has been assigned to trip the high-voltage circuit breaker B1. Physical Output #3 has been assigned to trip the medium voltage breaker C3 on the winding 2 side of the transformer.

AND logic is set at the top of the columns for Out 1 and Out 2. Therefore, to obtain a contact closure from output 1, it takes the assertion of both ULO1 and LLDA-1 (winding 1 current below set threshold). And for output 2, the assertion of ULO1 and HLDA-1 (winding 1 current above set threshold).
The overcurrent functions for the medium voltage winding 2 side are programmed with OR logic to directly assert Output #3 and trip breaker C3.

Settings Considerations

In order to prevent a race between the instantaneous overcurrent functions (50P-1 and 50N-1) and the level detectors, the definite time curve selection should be chosen and 0.03 or 0.04 seconds delay set for each of 50P-1 and 50N-1.

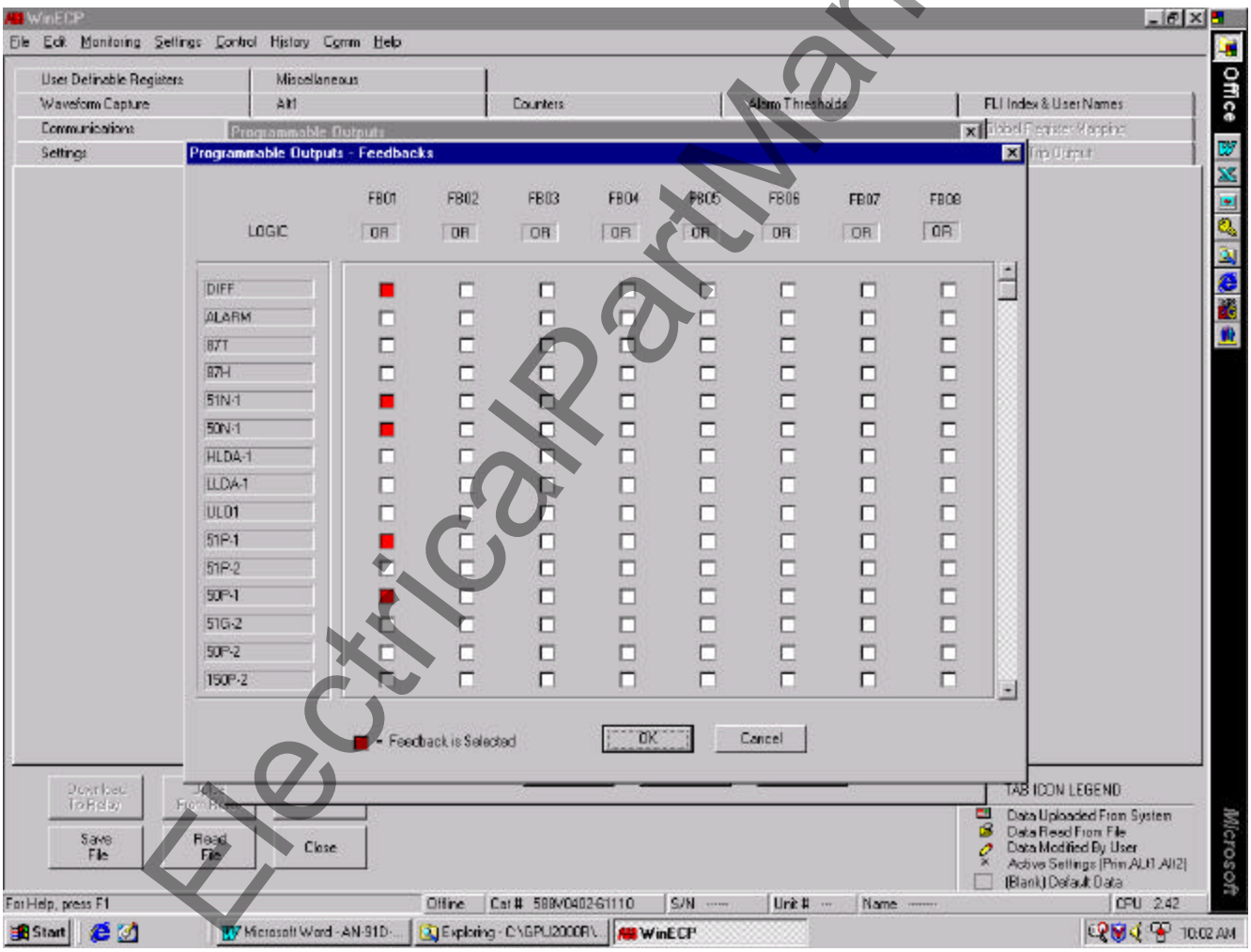

Figure 1 - Programmable Outputs - Feedbacks Screen

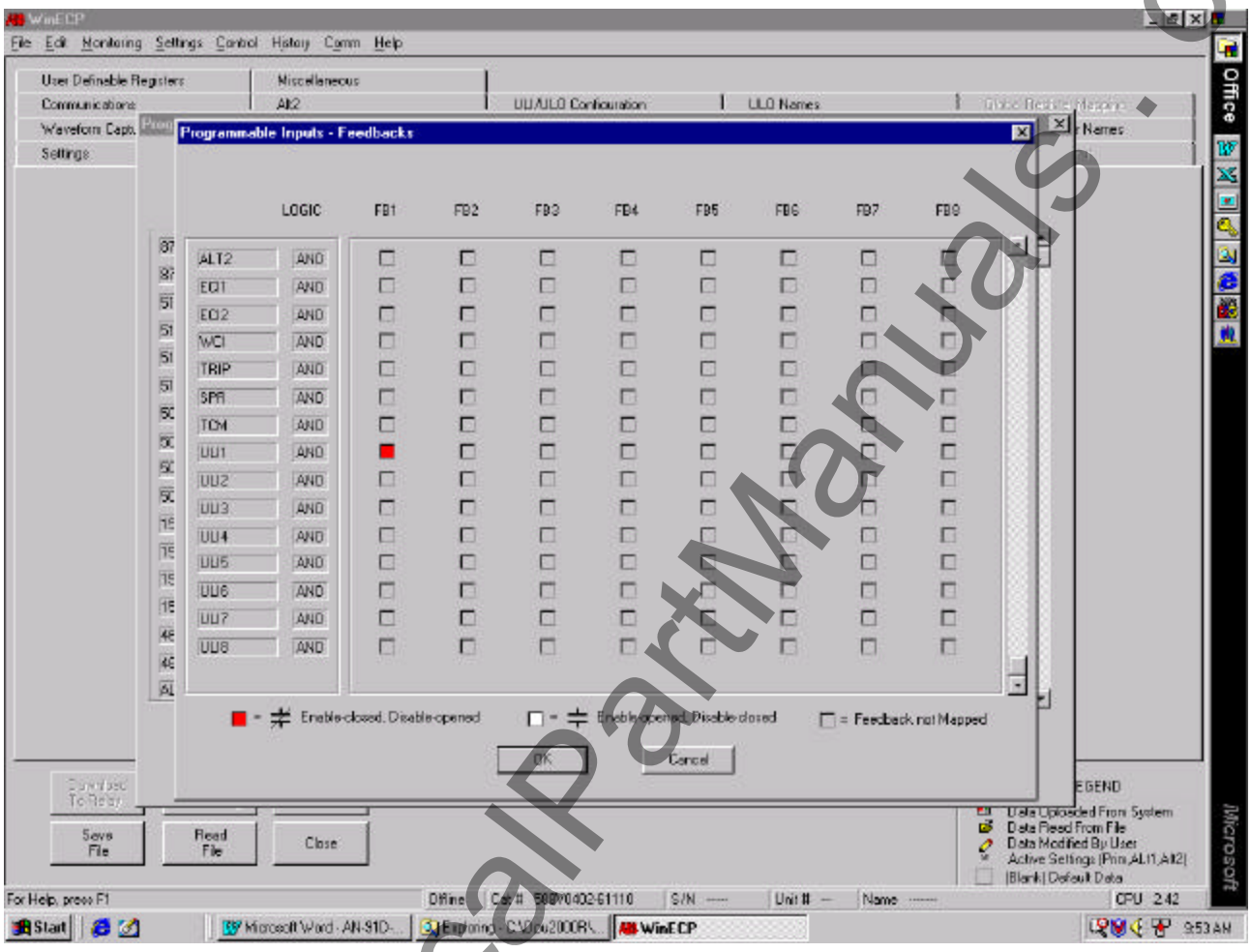

Figure 2 - Programmable Inputs Screen

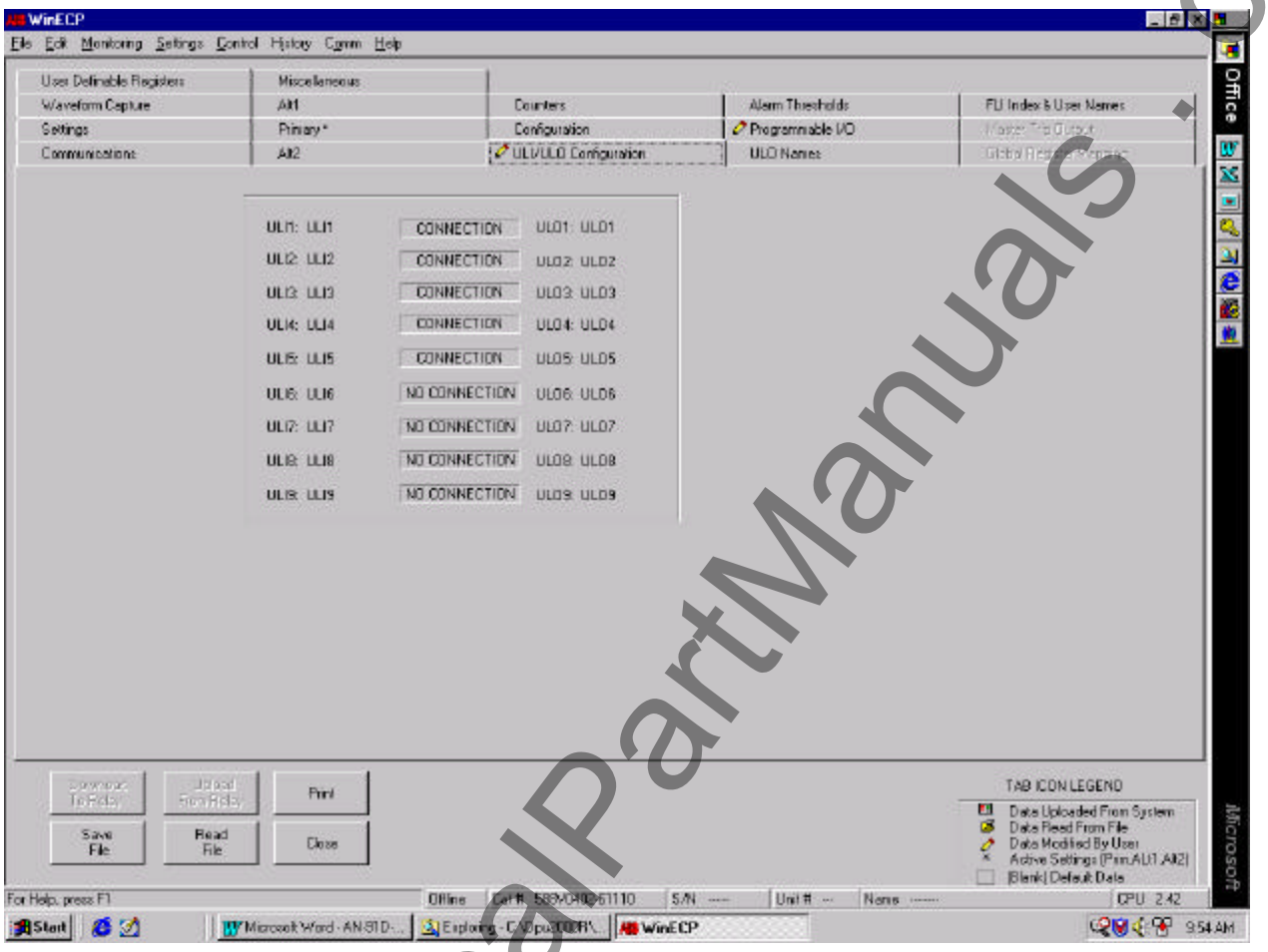

Figure 3 - ULI / ULO Configuration Screen

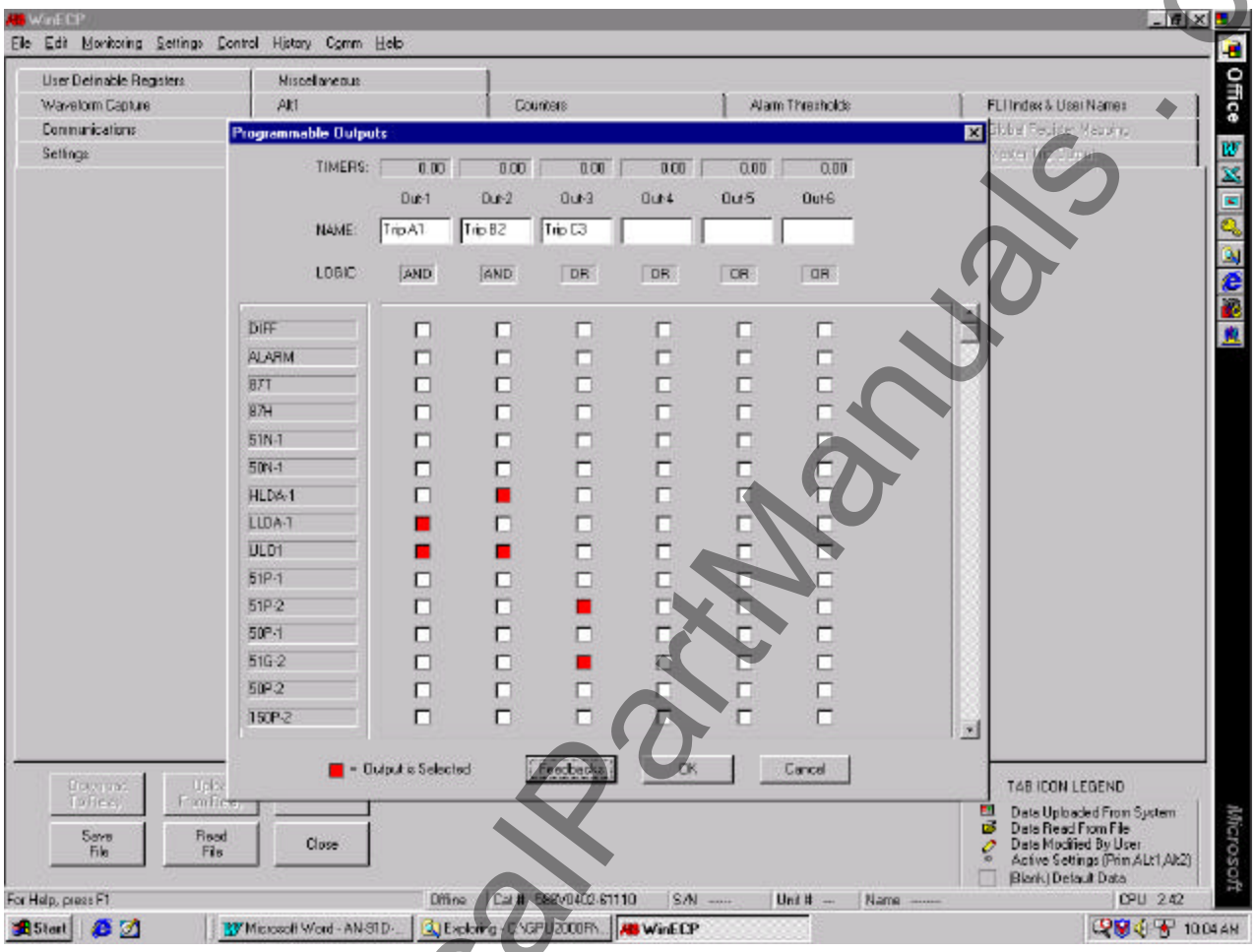

Figure 4 - Programmable Outputs Screen

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