



Relion<sup>®</sup> Protection and Control

# REF615R

# DPU2000R DNP3 Point List Mitigation Manual





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This product complies with the directive of the Council of the European Communities on the approximation of the laws of the Member States relating to electromagnetic compatibility (EMC Directive 2004/108/EC) and concerning electrical equipment for use within specified voltage limits (Low-voltage directive 2006/95/EC). This conformity is the result of tests conducted by ABB in accordance with the product standards EN 50263 and EN 60255-26 for the EMC directive, and with the product standards EN 60255-6 and EN 60255-27 for the low voltage directive. The protection relay is designed in accordance with the international standards of the IEC 60255 series and ANSI C37.90. The DNP3 protocol implementation in the protection relay conforms to "DNP3 Intelligent Electronic Device (protection relay) Certification Procedure Subset Level 2", available at [www.dnp.org](http://www.dnp.org).

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## Section 1 Introduction

### 1.1 This manual

DPU2000R was developed by ABB in the 1990s and has served industry successfully for over a decade. As time went by, some of its hardware components and software design became obsolete which restrict it to fit into the picture of the future power grid network communication system. REF615R, as a new generation of ABB protection relay, offers much broader network communication capabilities as it implements the state of the art IEC61850 protocol as its primary substation communication protocol.

IEC61850 is an object oriented communication protocol. It models a SCADA system interests into its associated logical device, logical node, function names and instances, etc. In this way, it presents every raw data from the field as a unique data attribute represented by an IEC61850 path.

On top of the basic IEC61850 protocol, the REF615R supports other well respected digital communication protocols such as modbus and DNP3. However, because of the changes of the functionality, the data presentation and the hardware structure, the previously defined DNP3 data points are not one on one translated to the existing IEC61850 data attributes. Also the evolution of DNP3 protocol to level 2+, offers some new features and enhances some previously offered features in DNP3 protocol.

This manual is published to help system integrator to expedite the process of replacing the DPU2000R with the REF615R. In this manual, the general features change is introduced in section 2.

The section 3 includes the lookup tables for the DI, counter, AI and control points. An IEC61850 path will be provided and mapped to the corresponding DPU2000R index as default mapping if the functionality and data class remain the same between DPU2000R and REF615R. Otherwise, a mitigation solution will be provided if available.

The section 4 shows the ACT logics that can help obtaining the mitigation result.

This document only covers the mitigation solutions for default DNP3 mapping list of DPU2000R. To obtain the complete DNP3 point list of REF615R, please refer to the Feeder Protection and Control REF615R DNP3 Point List Manual.

## 1.2 Intended audience

This manual addresses the communication system engineer or system integrator responsible for pre-engineering and engineering for communication setup in a substation from a protection relay perspective.

The system engineer or system integrator must have a basic knowledge of communication in protection and control systems and thorough knowledge of the specific communication protocol.

## 1.3 Product documentation

### 1.3.1 Document revision history

Document revision/date	Product version	History
A/2/24/2014	4.0	First release
B/9/24/2016	4.1	Content update



Download the latest documents from the ABB web site  
<http://www.abb.com/substationautomation>.

### 1.3.2 Related documentation

Name of the document	Document ID
DNP3 Communication Protocol Manual	1MRS240048-IB
DPU2000/1500R/2000R DNP3 Automation Technical Guide	TG 7.11.1.7-50
Instruction Book DPU2000R Distribution Protection Unit	1MRA587219-MIB
Feeder Protection and Control REF615R DNP3 Point List Manual	1MRS240051-IB

## 1.4 Symbols and conventions

### 1.4.1 Safety indication symbols



The caution icon indicates important information or warning related to the concept discussed in the text. It might indicate the presence of a hazard which could result in corruption of software or damage to equipment or property.



The information icon alerts the reader to important facts and conditions.






The tip icon indicates advice on, for example, how to design your project or how to use a certain function.

Although warning hazards are related to personal injury, it should be understood that operation of damaged equipment could, under certain operational conditions, result in degraded process performance leading to personal injury or death. Therefore, comply fully with all warning and caution notices.

## 1.4.2

### Manual conventions

Conventions used in protection relay manuals. A particular convention may not be used in this manual.

- Abbreviations and acronyms in this manual are spelled out in the glossary. The glossary also contains definitions of important terms.
- Push button navigation in the LHMI menu structure is presented by using the push button icons, for example:  
To navigate between the options, use  and .
- HMI menu paths are presented in bold, for example:  
Select **Main menu > Settings**.
- LHMI messages are shown in Courier font, for example:  
To save the changes in non-volatile memory, select `Yes` and press .
- Parameter names are shown in italics, for example:  
The function can be enabled and disabled with the *Operation* setting.
- Parameter values are indicated with quotation marks, for example:  
The corresponding parameter values are "Enabled" and "Disabled".
- Protection relay input/output messages and monitored data names are shown in Courier font, for example:  
When the function picks up, the `PICKUP` output is set to `TRUE`.
- Dimensions are provided both in inches and mm. If it is not specifically mentioned then the dimension is in mm.



## Section 2 DNP3 Features Mitigation

As the REF615R protection relay employs the state of art IEC61850 based platform, and the DNP3 standard has been upgraded to DNP3 level 2+ compatible, the DNP3 communication features have been changed accordingly with modified or enhanced features, which are summarized in the DNP3 Features Mitigation Table. For the complete DNP3 features please refer to the DNP3 user manual.

**Table 1: DNP3 Features Mitigation Table**

DPU2000R Features	Changes in REF615R
Seal-In Points	Seal-In points are not supported in REF615R. More detailed information about the value changes will be recorded with DNP3 events (Class 1, 2, 3 data). Also, provided is a mitigation solution employing the ACT tool to configure the SET/RESET AFLs to latch the values, please refer to Appendix A.1.
Scan Group	Scan group is DNP3 level 1 settings. REF615R is compatible with DNP3 level 2+, which support the more flexible polling scheme, therefore the scan group feature is not implemented in the default DNP3 point list. Instead, users can make the polling list by adding or removing the mapped points through CMT or specify the polling scheme with DNP3 objects.
ECP Source Registers	In REF615R, a comprehensive point list is offered as default mapping list. Instead of employing the DPU 2000R ECP Source Registers, user can use the CMT tool to rebuild a fully customized DNP3 polling list.
Counter points	Counters will be mapped as AI points
AI points bits variation	With DNP3 level 2+ compatibility, the AI points can be polled with either 16 bits or 32 bits by specifying different object variation numbers.
AI points scaling	No initial scaling will be provided except for measurement values. The measurement values are multiplied by 100 to maintain the first two decimals. Especially, for the Voltage measurements, unlike in DPU where the primary values are reported, in REF615R the voltage measurements are reported in secondary values with a default multiplication factor of 100. Customer can change the scaling method and factor of any individual point with CMT.
Force Logical Input and Force Physical Input	Please see point mitigation list
Event Record	Event record will be saved for each point if that point is included in a dataset.
Paired mode (network mode parameter 2)	The paired mode can be configured through the HMI or PCM600 in Configuration->Communication->Ethernet->DNP3.0 submenu.





## Section 3 DNP3 Communication Points Mitigation List

With the feature changes described in previous section, the point list has to be modified. With the best effort of keeping the original points to match their original points, some unavailable points are marked as reserved and possible substitute solutions are offered if possible. For the complete DNP3 point list, please refer to the DNP3 point list manual.

In the REF615R DNP3 list, some generic functions, e.g., MVGAPC8, SPCGGIO1, SRGAPC1, are employed to offer similar functions for the DPU2000R user. The default mapping of the generic functions' points could be modified if the default ACT logic is changed by the user.

### 3.1 Binary Input Point Mitigation Table

*Table 2: Binary Input Point Mitigation Table*

DPU2000R Point I.D.	DPU 2000R Description	REF615R Index	REF615R Points	Mitigation Explanations
0	Contact Input Status Changed (obj 1 only)			Refer to REF615R Analog input default Index 153 for relay health status.
1	Local Settings Change (obj 1 only)	1	LD0.LLN0.SetChg.stVal	
2	Remote Edit Disabled (obj 1 only)	2	CTRL.LLN0.Loc.stVal	
3	Alternate Settings Group 1 Enabled (obj 1 only)	3	LD0.LLN0.Act2SG.stVal	
4	Alternate Setting Group 2 Enabled (obj 1 only)	4	LD0.LLN0.Act3SG.stVal	
5	Fault Record Logged (obj 1 only)			N/A
6	Power was Cycled (obj 1 only)			Refer to REF615R Analog input default Index 155 for the number of power ups.
7	One/More Unreported Operations (obj 1 only)			N/A
8	Local Operator Interface Action (obj 1 only)			N/A
9	0 = Wye, 1 = Delta (obj 1 only)			N/A
10	0 = KWhr 1 = MWhr (obj 1 only)			N/A
11	52a Input Enabled - from Input Tab			N/A
12	52b Input Enabled - from Input Tab			N/A
13	43a - Reclose Function Enabled	13	LD0.DARREC1.InnhRec.stVal	
14	PH3 - Phase Torque Control Enabled			N/A
15	GRD - Ground Torque Control Enabled			N/A

# Section 3 DNP3 Communication Points Mitigation List

DPU2000R Point I.D.	DPU 2000R Description	REF615R Index	REF615R Points	Mitigation Explanations
16	SCC - Spring Charging Input Enabled	16	LD0.SSCBR1.InSprCha.stVal	
17	79S - Single Shot Reclose Input Enabled (See Point 127 for 79M Multi-Shot Reclosing)			N/A
18	TCM - Trip Coil Monitor Input Enabled			N/A
19	50-1 - 1st Inst. Unit Torque Control			N/A
20	50-2 - 2nd Inst. Unit Torque Control			N/A
21	50-3 - 3rd Inst. Unit Torque Control			N/A
22	ALT1 - Alternate 1 Settings Enabled	3	LD0.LLN0.Act2SG.stVal	Refer to REF615R Digital input default Index 3.
23	ALT2 - Alternate 2 Settings Enabled	4	LD0.LLN0.Act3SG.stVal	Refer to REF615R Digital input default Index 4.
24	ECI1 - Event Capture 1 Enabled			N/A
25	ECI2 - Event Capture 2 Enabled			N/A
26	WCI - Waveform Capture Enabled	26	DR.RDRE1.RcdTrg.stVal	
27	ZSC - Zone Sequence Coord. Enabled	27	LD0.DARREC1.ProCrd.stVal	
28	OPEN - Trip Contact Initiated	28	CTRL.CBCSWI1.OpOpn.general	
29	CLOSE - Close Contact Initiated	29	CTRL.CBCSWI1.OpCls.general	
30	46TC - Neg. Sequence Control Enabled	30	LD0.NSPTOC1.Mod.blockIn	
31	TRIP - Output Contact Energized	31	LD0.TRPPTRC1.Op.general	
32	CLOSE - Output Contact Energized	32	LD0.MVGAPC8.Q3.stVal	
33	ALARM - Self Check Alarm Energized			LD0.LPHD1.PhyHealth.stVal is an enum, mapped as AI (Grp 30, Idx 153). As LD0.LPHD1.PhyHealth.stVal = 3, the ALARM is true. The 6th bit of IIN1 is set when ALARM is true as well.
34	27 - Under Voltage Trip	34	LD0.PHPTUV1.Op.general	
35	46 - Negative Sequence Overcurrent Trip	35	LD0.NSPTOC1.Op.general	
36	50P1 - Phase Inst. Overcurrent Trip	36	LD0.PHHPTOC1.Op.general	
37	50N1 - Neutral Inst. Overcurrent Trip	37	LD0.EFHPTOC3.Op.general	
38	50P2 - Phase Inst. Overcurrent Trip	38	LD0.PHHPTOC2.Op.general	
39	50N2 - Neutral Inst. Overcurrent Trip	39	LD0.EFHPTOC4.Op.general	
40	50P3 - Phase Inst. Overcurrent Trip	40	LD0.PHIPTOC1.Op.general	
41	50N3 - Neutral Inst. Overcurrent Trip	41	LD0.EFIPTOC2.Op.general	

DPU2000R Point I.D.	DPU 2000R Description	REF615R Index	REF615R Points	Mitigation Explanations
42	51P - Phase Time Overcurrent Trip	42	LD0.PHLPTOC1.Op.general	
43	51N - Neutral Time Overcurrent Trip	43	LD0.EFLPTOC2.Op.general	
44	59 - Over Voltage Trip	44	LD0.PHPTOV1.Op.general	
45	67P - Direct. Overcurrent Trip (pos seq)	45	LD0.DPHLPTOC1.Op.general	
46	67N - Direct. Overcurrent Trip (neg seq)	46	LD0.DEFLPTOC1.Op.general	
47	81S - Frequency Shed (1st stage)	47	LD0.LSHDPTRC1.Op.general	
48	81R - Frequency Restore (1st stage)	48	LD0.LSHDPTRC1.RestLodOp.general	
49	PATA - Phase A Target Alarm Energized			Refer to REF615R Analog input default index 299, LD0.LEDGGIO1.ISCSO1.stVal
50	PBTA - Phase B Target Alarm Energized			Refer to REF615R Analog input default index 300, LD0.LEDGGIO1.ISCSO2.stVal
51	PCTA - Phase C Target Alarm Energized			Refer to REF615R Analog input default index 301, LD0.LEDGGIO1.ISCSO3.stVal
52	TCFA - Trip Coil Failure Alarm Energized	52	LD0.MVGAPC8.Q1.stVal	
53	TCC - Tap Changer Cutout Energized	53	LD0.DARREC1.ActRec.stVal	
54	79DA - Reclosing Disabled Alm Energized			Refer to REF615R Digital input default Index 13. It is not an exact match, but offers similar information.
55	PUA - Pick Up Alarm Energized	55	LD0.LEDPTRC1.Str.general	
56	79LOA - Recloser Lock Out Alm Energized	56	LD0.DARREC1.LO.stVal	
57	BFA - Breaker Failure Alarm Energized	57	LD0.SSCBR1.OpnAlm.stVal	
58	PDA - Phs Demand Current Alm Energized			N/A
59	NDA - Neut Demand Current Alm Energized			N/A
60	BFUA - Blown Fuse Alarm Energized	60	LD0.SEQRFUF1.Str.general	
61	KSI - KSI Summation Alarm Energized	61	LD0.SSCBR1.APwrAlm.stVal	
62	79CA-1 - Recloser Counter Alm 1 Energized	62	LD0.SSCBR1.OpNumAlm.stVal	
63	HPFA - High Power Factor Alm Energized			N/A
64	LPFA - Low Power Factor Alm Energized			N/A
65	OCTC - O/C Trip Counter Alm Energized			N/A
66	50-1D - 1st Inst O/C Disabled. Alm Energized			N/A

# Section 3 DNP3 Communication Points Mitigation List

DPU2000R Point I.D.	DPU 2000R Description	REF615R Index	REF615R Points	Mitigation Explanations
67	50-2D - 2nd Inst O/C Dis. Alm Energized			N/A
68	STC - Settings Table Chg Alm Energized	1	LD0.LLN0.SetChg.stVal	Refer to REF615R Digital input default Index 1.
69	ZSC - Zone Sequence Coord. Energized	27	LD0.DARREC1.ProCrd.stVal	Refer to REF615R Digital input default Index 27.
70	PH3-D - PHS O/C Disabled Alm Energized			N/A
71	GRD-D - GRD O/C Disabled Alm Energized			N/A
72	32PA - 67P Pickup Alarm Energized	72	LD0.DPSRDIR1.Dir.general	
73	32NA - 67N Pickup Alarm Energized	73	LD0.DNZSRDIR1.Dir.general	
74	27-3P - Phase Under Voltage Trip	389	LD0.PHPTUV2.Op.general	Set the Number of pickup phases to 3 out of 3 and refer to the point mapped to LD0.PHPTUV2.Op.general (mention the number)
75	VarDA - 3PHS Kvar Demand Alm Energized			N/A
76	79CA-2 - Recloser Counter Alm 2 Energized			N/A
77	TRIPA - Single Pole Trip (phase A)	49	LD0.LEDPTRC1.Op.phsA	
78	TRIPB - Single Pole Trip (phase B)	50	LD0.LEDPTRC1.Op.phsB	
79	TRIPC - Single Pole Trip (phase C)	51	LD0.LEDPTRC1.Op.phsC	
80	52a Input Closed	81	CTRL.CBCSWI1.PosCls.stVal	
81	52b Input Closed	80	CTRL.CBCSWI1.PosOpn.stVal	
82	43a Input Closed	82	LD0.DARREC1.RdyRec.stVal	
83	Input 1 Input Closed	83	LD0.XUGGIO110.Ind1.stVal	
84	Input 2 Input Closed	84	LD0.XUGGIO110.Ind2.stVal	
85	Input 3 Input Closed	85	LD0.XUGGIO110.Ind3.stVal	
86	Input 4 Input Closed	86	LD0.XUGGIO110.Ind4.stVal	
87	Input 5 Input Closed	87	LD0.XUGGIO110.Ind5.stVal	
88	Input 6 Input Closed	88	LD0.XUGGIO110.Ind6.stVal	
89	Input 7 Input Closed	89	LD0.XUGGIO110.Ind7.stVal	
90	Input 8 Input Closed (NOTE : INPUT 6 ON DPU 1500)	90	LD0.XUGGIO110.Ind8.stVal	
91	Input 9 Input Closed			N/A
92	Input 10 Input Closed			N/A
93	Input 11 Input Closed			N/A
94	Input 12 Input Closed			N/A
95	Input 13 Input Closed			N/A
96	Fault Rec Stat (bit 0) 0=Wye, 1=Delta (obj 2 only)			N/A

DPU2000R Point I.D.	DPU 2000R Description	REF615R Index	REF615R Points	Mitigation Explanations
97	Fault Rec Stat (bit 1) 0=Fault, 1=Event (obj 2 only)			N/A
98	67P - Direct. Overcurrent Trip (pos seq)	45	LD0.DPHLPTOC1.Op.general	Refer to REF615R Digital input default Index 45.
99	67N - Direct. Overcurrent Trip (neg seq)	46	LD0.DEFLPTOC1.Op.general	Refer to REF615R Digital input default Index 46.
100	ULI 1 - User Logical 1 Enabled			Use MVGAPC points to get the the same functionality as ULI point.
101	ULI 2 - User Logical 2 Enabled			Use MVGAPC points to get the the same functionality as ULI point.
102	ULI 3 - User Logical 3 Enabled			Use MVGAPC points to get the the same functionality as ULI point.
103	ULI 4 - User Logical 4 Enabled			Use MVGAPC points to get the the same functionality as ULI point.
104	ULI 5 - User Logical 5 Enabled			Use MVGAPC points to get the the same functionality as ULI point.
105	ULI 6 - User Logical 6 Enabled			Use MVGAPC points to get the the same functionality as ULI point.
106	ULI 7 - User Logical 7 Enabled			Use MVGAPC points to get the the same functionality as ULI point.
107	ULI 8 - User Logical 8 Enabled			Use MVGAPC points to get the the same functionality as ULI point.
108	ULI 9 - User Logical 9 Enabled			Use MVGAPC points to get the the same functionality as ULI point.
109	CRI - Clear Recloser Counter Energized			N/A
110	ULO 1 - User Logical 1 Enabled			Use MVGAPC points to get the the same functionality as ULI point.
111	ULO 2 - User Logical 2 Enabled			Use MVGAPC points to get the the same functionality as ULI point.
112	ULO 3 - User Logical 3 Enabled			Use MVGAPC points to get the the same functionality as ULI point.
113	ULO 4 - User Logical 4 Enabled			Use MVGAPC points to get the the same functionality as ULI point.
114	ULO 5 - User Logical 5 Enabled			Use MVGAPC points to get the the same functionality as ULI point.
115	ULO 6 - User Logical 6 Enabled			Use MVGAPC points to get the the same functionality as ULI point.
116	ULO 7 - User Logical 7 Enabled			Use MVGAPC points to get the the same functionality as ULI point.
117	ULO 8 - User Logical 8 Enabled			Use MVGAPC points to get the the same functionality as ULI point.
118	ULO 9 - User Logical 9 Enabled			Use MVGAPC points to get the the same functionality as ULI point.
119	PVArA - Positive 3 PHS Kvar Alarm Energized			N/A
120	NVArA - Negative 3 PHS Kvar Alarm Energized			N/A
121	LOADA - Load Current Alarm Energized	121	LD0.CMMXU1.HiAlm.stVal	

# Section 3 DNP3 Communication Points Mitigation List

DPU2000R Point I.D.	DPU 2000R Description	REF615R Index	REF615R Points	Mitigation Explanations
122	81O-1 - Over Frequency (1st Stage)	122	LD0.FRPTOF1.Op.general	
123	81O-2 - Over Frequency (2nd Stage)	123	LD0.FRPTOF2.Op.general	
124	81S-2 - Over Frequency Shed (2nd Stage)	124	LD0.LSHDPTRC2.Op.general	
125	81R-2 - Over Frequency Restore (2nd Stage)	125	LD0.LSHDPTRC2.RestLodOp.general	
126	CLTA - Cold Load Timer Alarm Energized	126	LD0.MVGAPC8.Q2.stVal	
127	79M – Multi-Shot Reclose Input Enabled	127	LD0.DARREC1.InReClsOn.stVal	
128	LOCAL - Local Supervisory Control	2	CTRL.LLN0.Loc.stVal	Refer to REF615R Digital input default Index 2.
129	SBA - Slow Breaker Alarm			N/A
130	ARCI - Automatic Reclose Inhibited**	130	LD0.DARREC1.AROn.stVal	
131	TARC - Initiate Trip and Auto Reclose**	131	LD0.DARREC1.OpOpn.general	
132	SEF TC - Sensitive Earth Fault Torque Control**			N/A
133	Ext BFI - External Breaker Fail Indicate**			N/A
134	BFI - Breaker Fail Indicate**	134	LD0.CCBRBRF1.InStr.stVal	
135	UDI - User Display Input**			N/A
136	25 - Synch Check Function**	136	LD0.SECRSYN1.Mod.blockIn	
137	25 BYPASS - Synch Check Function Bypass**	137	LD0.SECRSYN1.ByPss.stVal	
138	TGT - Target LED's Reset**			N/A
139	SIA - Seal In Alarms Reset**			N/A
140	Pwatt1 - Positive Watt Alarm 1 Energized**			N/A
141	Pwatt2 - Positive Watt Alarm 2 Energized**			N/A
142	SEF - Sensitive Earth Fault Alarm Trip**	142	LD0.EFLPTOC4.Op.general	
143	BZA - Bus Zone Alarm **			N/A
144	BF TRIP - Breaker Fail Trip**	144	LD0.CCBRBRF1.InCBFit.stVal	
145	BF RETRIP - Breaker Fail Retrip**	145	LD0.CCBRBRF1.OpIn.general	
146	32P-2 - Phase Directionality Alarm**	72	LD0.DPSRDIR1.Dir.general	Refer to REF615R Digital input default Index 72.
147	32N-2 - Neutral Directionality Alarm**	73	LD0.DNZSRDIR1.Dir.general	Refer to REF615R Digital input default Index 73.
148	25 - In Synchronism**	148	LD0.SECRSYN1.Rel.stVal	
149	79V - Recloser Voltage Enabled**			N/A

DPU2000R Point I.D.	DPU 2000R Description	REF615R Index	REF615R Points	Mitigation Explanations
150	RClin - Recloser In **	150	LD0.DARREC1.Op.general	
151	59G - Voltage Zero Sequence Overvoltage Alarm**	151	LD0.ROVPTOV1.Str.general	
152	LO1 - Latching Output 1**	152	LD0.SRGAPC1.Q1.stVal	
153	LO2 - Latching Output 2**	153	LD0.SRGAPC1.Q2.stVal	
154	LO3 - Latching Output 3**	154	LD0.SRGAPC1.Q3.stVal	
155	LO4 - Latching Output 4**	155	LD0.SRGAPC1.Q4.stVal	
156	LO5 - Latching Output 5**	156	LD0.SRGAPC1.Q5.stVal	
157	LO6 - Latching Output 6**	157	LD0.SRGAPC1.Q6.stVal	
158	LO7 - Latching Output 7**	158	LD0.SRGAPC1.Q7.stVal	
159	LO8 - Latching Output 8**	159	LD0.SRGAPC1.Q8.stVal	
160	79ON - Hot Hold Tagging On**			N/A
161	79OFF - Hot Hold Tagging Off**			N/A
162	79TAG - Hot Hold Tagging Tagged**			N/A
163	59-3 - 3 phase OV	44	LD0.PHPTOV1.Op.general	Refer to REF615R Digital input default Index 44.
164	47- Neg Seq OV	164	LD0.NSPTOV1.Op.general	
165	21P-1 - ZONE1 OC			N/A
166	21P-2 - ZONE2 OC			N/A
167	21P-3 - ZONE3 OC			N/A
168	21P-4 - ZONE4 OC			N/A
169	50-3D - Instantaneous Disabled Alarm			N/A
170	OCI Control Button C1	170	LD0.SPCGGIO1.SPCSO1.stVal	
171	OCI Control Button C2	171	LD0.SPCGGIO1.SPCSO2.stVal	
172	OCI Control Button C3	172	LD0.SPCGGIO1.SPCSO3.stVal	
173	OCI Control Button C4	173	LD0.SPCGGIO1.SPCSO4.stVal	
174	OCI Control Button C5	174	LD0.SPCGGIO1.SPCSO5.stVal	
175	OCI Control Button C6	175	LD0.SPCGGIO1.SPCSO6.stVal	
176	TripT - Trip Target	176	LD0.LEDPTRC1.Op.general	
177	NTA - Neutral Trip Target		LD0.LEDGGIO1.ISCSO4.stVal	LD0.LEDGGIO1.ISCSO4.stVal (Grp 30, Idx 302)
178	TimeT - Time OC Trip Target		LD0.LEDGGIO1.ISCSO5.stVal	LD0.LEDGGIO1.ISCSO5.stVal (Grp 30, Idx 303)
179	InstT - Instantaneous OC Trip Target		LD0.LEDGGIO1.ISCSO6.stVal	LD0.LEDGGIO1.ISCSO6.stVal (Grp 30, Idx 304)
180	NegSeqT - Negative Sequence Trip Target		LD0.LEDGGIO1.ISCSO7.stVal	LD0.LEDGGIO1.ISCSO7.stVal (Grp 30, Idx 305)
181	FreqT - Frequency Trip Target		LD0.LEDGGIO1.ISCSO8.stVal	LD0.LEDGGIO1.ISCSO8.stVal (Grp 30, Idx 306)
182	DirT - Directional Trip Target		LD0.LEDGGIO1.ISCSO9.stVal	LD0.LEDGGIO1.ISCSO9.stVal (Grp 30, Idx 307)

# Section 3 DNP3 Communication Points Mitigation List

DPU2000R Point I.D.	DPU 2000R Description	REF615R Index	REF615R Points	Mitigation Explanations
183	VoltT - Voltage Trip Target		LD0.LEDGGIO1.ISCSO10.stVal	LD0.LEDGGIO1.ISCSO10.stVal (Grp 30, Idx 308)
184	DistT - Distance Trip Target		LD0.LEDGGIO1.ISCSO11.stVal	LD0.LEDGGIO1.ISCSO11.stVal (Grp 30, Idx 309)
185	SEFT - Sensitive Earth Trip Target		LD0.LEDGGIO1.ISCSO11.stVal	LD0.LEDGGIO1.ISCSO11.stVal (Grp 30, Idx 309)
186	ULO10 - User Logical Out 10			Use MVGAPC points to get the the same functionality as ULJ point.
187	ULO11 - User Logical Out 11			Use MVGAPC points to get the the same functionality as ULJ point.
188	ULO12 - User Logical Out 12			Use MVGAPC points to get the the same functionality as ULJ point.
189	ULO13 - User Logical Out 13			Use MVGAPC points to get the the same functionality as ULJ point.
190	ULO14 - User Logical Out 14			Use MVGAPC points to get the the same functionality as ULJ point.
191	ULO15 - User Logical Out 15			Use MVGAPC points to get the the same functionality as ULJ point.
192	ULO16 - User Logical Out 16			Use MVGAPC points to get the the same functionality as ULJ point.
193	HBHL - Hot Bus Hot Line	193	LD0.SECRSYN1.LLLBInd.stVal	
194	HBDL - Hot Bus Dead Line	194	LD0.SECRSYN1.DLLBInd.stVal	
195	DBHL - Dead Bus Hot Line	195	LD0.SECRSYN1.LLDBInd.stVal	
196	DBDL - Dead Bus Dead Line	196	LD0.SECRSYN1.DLDBInd.stVal	
197	46A - Trip 46A	197	LD0.NSPTOC2.Op.general	
198	46A (L) - Trip 46A Latched			N/A
199	LIS1 - Latch In Set 1	199	LD0.SRGAPC1.Set1.stVal	
200	LIS2 - Latch In Set 2	200	LD0.SRGAPC1.Set2.stVal	
201	LIS3 - Latch In Set 3	201	LD0.SRGAPC1.Set3.stVal	
202	LIS4 - Latch In Set 4	202	LD0.SRGAPC1.Set4.stVal	
203	LIS5 - Latch In Set 5	203	LD0.SRGAPC1.Set5.stVal	
204	LIS6 - Latch In Set 6	204	LD0.SRGAPC1.Set6.stVal	
205	LIS7 - Latch In Set 7	205	LD0.SRGAPC1.Set7.stVal	
206	LIS8 - Latch In Set 8	206	LD0.SRGAPC1.Set8.stVal	
207	LIR1 - Latch In Reset 1	207	LD0.SRGAPC1.Rs1.stVal	
208	LIR2 - Latch In Reset 2	208	LD0.SRGAPC1.Rs2.stVal	
209	LIR3 - Latch In Reset 3	209	LD0.SRGAPC1.Rs3.stVal	
210	LIR4 - Latch In Reset 4	210	LD0.SRGAPC1.Rs4.stVal	
211	LIR5 - Latch In Reset 5	211	LD0.SRGAPC1.Rs5.stVal	
212	LIR6 - Latch In Reset 6	212	LD0.SRGAPC1.Rs6.stVal	
213	LIR7 - Latch In Reset 7	213	LD0.SRGAPC1.Rs7.stVal	
214	LIR8 - Latch In Reset 8	214	LD0.SRGAPC1.Rs8.stVal	
215	TR_SET - Set Hot Line Tag function			N/A



DPU2000R Point I.D.	DPU 2000R Description	REF615R Index	REF615R Points	Mitigation Explanations
216	TR_RST - Reset Hot Line Tag function			N/A
217	ULI10 - User Logical Input 10			Use MVGAPC points to get the the same functionality as ULI point.
218	ULI11 - User Logical Input 11			Use MVGAPC points to get the the same functionality as ULI point.
219	ULI12 - User Logical Input 12			Use MVGAPC points to get the the same functionality as ULI point.
220	ULI13 - User Logical Input 13			Use MVGAPC points to get the the same functionality as ULI point.
221	ULI14 - User Logical Input 14			Use MVGAPC points to get the the same functionality as ULI point.
222	ULI15 - User Logical Input 15			Use MVGAPC points to get the the same functionality as ULI point.
223	ULI16 - User Logical Input 16			Use MVGAPC points to get the the same functionality as ULI point.
224	46A_TC - 46A Torque Control	224	LD0.NSPTOC2.Mod.blockIn	
225	LOCAL_D - Local Remote Switch Status	2	CTRL.LLN0.Loc.stVal	Refer to REF615R Digital input default Index 2.
226	SW_SET - Retentive Switch Set Control Active			N/A
227	SHIFT_A - Status Of TEST A Ring Shift Register			N/A
228	SHIFT_B - Status Of TEST B Ring Shift Register			N/A
229	PRIMSETTACTIVE - Primary Settings Status Indicator	229	LD0.LLN0.Act1SG.stVal	
230	ALT1SETTACTIVE - Alternate 1 Setting Status Indicator	3	LD0.LLN0.Act2SG.stVal	Refer to REF615R Digital input default Index 3.
231	ALT2SETTACTIVE - Alternate 2 Setting Status Indicator	4	LD0.LLN0.Act3SG.stVal	Refer to REF615R Digital input default Index 4.
232	SHIFT_A1 - TEST A is in Stage 1 of Test Procedure.			N/A
233	SHIFT_A2 - TEST A is in Stage 2 of Test Procedure			N/A
234	SHIFT_A3 - TEST A is in Stage 3 of Test Procedure			N/A
235	SHIFT_A4 - TEST A is in Stage 4 of Test Procedure			N/A
236	SHIFT_B1 - TEST B is in Stage 1 of Test Procedure.			N/A
237	SHIFT_B2 - TEST B is in Stage 2 of Test Procedure			N/A
238	SHIFT_B3 - TEST B is in Stage 3 of Test Procedure			N/A
239	SHIFT_B4 - TEST B is in Stage 4 of Test Procedure			N/A

## 3.2 Analog Input Point Mitigation Table

Table 3: Analog Input Point Mitigation Table

DPU2000R Point I.D.	DPU 2000R Description	REF615R Index	REF615R Points	Mitigation Explanations
0	Ia (Load Currents)	0	LD0.CMMXU1.A.phsA.instCVal.mag.f	
1	Ia Angle	1	LD0.CMMXU1.A.phsA.instCVal.ang.f	
2	Ib	2	LD0.CMMXU1.A.phsB.instCVal.mag.f	
3	Ib Angle	3	LD0.CMMXU1.A.phsB.instCVal.ang.f	
4	Ic	4	LD0.CMMXU1.A.phsC.instCVal.mag.f	
5	Ic Angle	5	LD0.CMMXU1.A.phsC.instCVal.ang.f	
6	In	6	LD0.RESCMMXU1.A.res.instCVal.mag.f	
7	In Angle	7	LD0.RESCMMXU1.A.res.instCVal.ang.f	
8	Iavg			N/A
9	KVAn (Mag) (*1000)	9	LD0.VMMXU1.PhV.phsA.cVal.mag.f	
10	KVAn (Ang) (See point 91 for KVab)	10	LD0.VMMXU1.PhV.phsA.cVal.ang.f	
11	KVbn (Mag) (*1000)	11	LD0.VMMXU1.PhV.phsB.cVal.mag.f	
12	KVbn (Ang)	12	LD0.VMMXU1.PhV.phsB.cVal.ang.f	
13	KVcn (Mag) (*1000)	13	LD0.VMMXU1.PhV.phsC.cVal.mag.f	
14	KVcn (Ang)	14	LD0.VMMXU1.PhV.phsC.cVal.ang.f	
15	KWan	15	LD0.SPEMMXU1.W.phsA.instCVal.mag.f	
16	KWbn	16	LD0.SPEMMXU1.W.phsB.instCVal.mag.f	
17	KWcn	17	LD0.SPEMMXU1.W.phsC.instCVal.mag.f	
18	KW3	18	LD0.PEMMXU1.TotW.instMag.f	
19	KVARan	19	LD0.SPEMMXU1.VAr.phsA.instCVal.mag.f	
20	KVARbn	20	LD0.SPEMMXU1.VAr.phsB.instCVal.mag.f	
21	KVARcn	21	LD0.SPEMMXU1.VAr.phsC.instCVal.mag.f	
22	KVAR3	22	LD0.PEMMXU1.TotVAr.instMag.f	
23	KWHra	23	LD0.SPEMMTR1.DmdWhA.actVal	
24	KWHrb	24	LD0.SPEMMTR1.DmdWhB.actVal	
25	KWHrc	25	LD0.SPEMMTR1.DmdWhC.actVal	
26	KWHr3	26	LD0.PEMMTR1.DmdWh.actVal	
27	KVARHra	27	LD0.SPEMMTR1.DmdVArhA.actVal	
28	KVARHrb	28	LD0.SPEMMTR1.DmdVArhB.actVal	
29	KVARHrc	29	LD0.SPEMMTR1.DmdVArhC.actVal	
30	KVARHr3	30	LD0.PEMMTR1.DmdVArh.actVal	
31	I0	31	LD0.CSMSQI1.SeqA.c3.instCVal.mag.f	
32	I0 Angle	32	LD0.CSMSQI1.SeqA.c3.instCVal.ang.f	
33	I1	33	LD0.CSMSQI1.SeqA.c1.instCVal.mag.f	
34	I1 Angle	34	LD0.CSMSQI1.SeqA.c1.instCVal.ang.f	
35	I2	35	LD0.CSMSQI1.SeqA.c2.instCVal.mag.f	

DPU2000R Point I.D.	DPU 2000R Description	REF615R Index	REF615R Points	Mitigation Explanations
36	I2 Angle	36	LD0.CSMSQI1.SeqA.c2.instCVal.ang.f	
37	KV1 (*1000)	37	LD0.VSMSQI1.SeqV.c1.instCVal.mag.f	
38	KV1 Angle	38	LD0.VSMSQI1.SeqV.c1.instCVal.ang.f	
39	KV2 (*1000)	39	LD0.VSMSQI1.SeqV.c2.instCVal.mag.f	
40	KV2 Angle	40	LD0.VSMSQI1.SeqV.c2.instCVal.ang.f	
41	Frequency (*100)	41	LD0.FMMXU1.Hz.instMag.f	
42	Power Factor (*100) Signed, two's comp + = Leading - = Lagging	42	LD0.PEMMXU1.TotPF.instMag.f	
43	Demand Ia (Load Currents)	43	LD0.CMSTA1.AvAmpsA.mag.f	
44	Demand Ib	44	LD0.CMSTA1.AvAmpsB.mag.f	
45	Demand Ic	45	LD0.CMSTA1.AvAmpsC.mag.f	
46	Demand In	46	LD0.RESCMSTA1.AvAmps.mag.f	
47	Demand kWan	47	LD0.SPEMMXU1.W.phsA.cVal.mag.f	
48	Demand kWbn	48	LD0.SPEMMXU1.W.phsB.cVal.mag.f	
49	Demand kWcn	49	LD0.SPEMMXU1.W.phsC.cVal.mag.f	
50	Demand kW3	50	LD0.PEMMXU1.TotW.mag.f	
51	Demand kVARan	51	LD0.SPEMMXU1.VAr.phsA.cVal.mag.f	
52	Demand kVARbn	52	LD0.SPEMMXU1.VAr.phsB.cVal.mag.f	
53	Demand kVARcn	53	LD0.SPEMMXU1.VAr.phsC.cVal.mag.f	
54	Demand kVAR3	54	LD0.PEMMXU1.TotVAr.mag.f	
55	Fault Type (element)	55	LD0.FLTMSTA1.ProFcn.stVal	
56	Fault Record Reclose Seq (bits 0-3)(FLT)			N/A
57	Fault Record Active Set (bits 4-7)(FLT)	57	LD0.FLTMSTA1.ActSG.stVal	
58	Fault Number(FLT)	58	LD0.FLTMSTA1.OpCnt.stVal	
59	Ia (Fault Currents)(FLT)	59	LD0.FLTMSTA1.AmpsA.mag.f	
60	Ib(FLT)	60	LD0.FLTMSTA1.AmpsB.mag.f	
61	Ic(FLT)	61	LD0.FLTMSTA1.AmpsC.mag.f	
62	In(FLT)	62	LD0.FLTMSTA1.AmpsN.mag.f	
63	Ia Angle(FLT)			N/A
64	Ib Angle(FLT)			N/A
65	Ic Angle(FLT)			N/A
66	In Angle(FLT)			N/A
67	Zero Seq I (Mag)(FLT)			N/A
68	Pos Seq I (Mag)(FLT)	68	LD0.FLTMSTA1.AmpsPsSeq.mag.f	
69	Neg Seq I (Mag)(FLT)	69	LD0.FLTMSTA1.AmpsNgSeq.mag.f	
70	Zero Seq I (Ang)(FLT)			N/A
71	Pos Seq I (Ang)(FLT)			N/A
72	Neg Seq I (Ang)(FLT)			N/A

# Section 3 DNP3 Communication Points Mitigation List

DPU2000R Point I.D.	DPU 2000R Description	REF615R Index	REF615R Points	Mitigation Explanations
73	KVab/KVan (Mag) (*1000)(FLT)	KVan 73 KVab 76	KVan LD0.FLTMSTA1.VoltsA.mag.f KVab LD0.FLTMSTA1.VoltsAB.mag.f	REF615R supports the two measurements in different points.
74	KVbc/KVbn (Mag) (*1000)(FLT)	KVbn 74 KVbc 77	KVbn LD0.FLTMSTA1.VoltsB.mag.f KVbc LD0.FLTMSTA1.VoltsBC.mag.f	REF615R supports the two measurements in different points.
75	KVca/KVcn (Mag) (*1000)(FLT)	KVcn 75 KVca 78	KVcn LD0.FLTMSTA1.VoltsC.mag.f KVca LD0.FLTMSTA1.VoltsCA.mag.f	REF615R supports the two measurements in different points.
76	Vab/Van (Ang)(FLT)			N/A
77	Vbc/Vbn (Ang)(FLT)			N/A
78	Vca/Vcn (Ang)(FLT)			N/A
79	Pos Seq V (Mag)(FLT)	79	LD0.FLTMSTA1.VPsSeq.mag.f	
80	Neg Seq V (Mag)(FLT)	80	LD0.FLTMSTA1.VNgSeq.mag.f	
81	Pos Seq V (Ang)(FLT)			N/A
82	Neg Seq V (Ang)(FLT)			N/A
83	Fault location (*10)(FLT)	83	LD0.FLTMSTA1.FltDisKm.mag.f	
84	Fault impedance, real part (*1000)(FLT)	84	LD0.FLTMSTA1.FltZ.cVal.mag.f	
85	Breaker Operate Time (*1000)(FLT)			N/A
86	Relay Operate Time (*1000)(FLT)	86	LD0.FLTMSTA1.OpTm.mag.f	
87	Operation message #			N/A
88	Operation Value (if any)			N/A
89	Operation Number			N/A
90	KVab (Mag) (*1000)	90	LD0.VMMXU1.PPV.phsAB.instCVal.mag.f	
91	KVab (Ang)	91	LD0.VMMXU1.PPV.phsAB.instCVal.ang.f	
92	KVbc (Mag) (*1000)	92	LD0.VMMXU1.PPV.phsBC.instCVal.mag.f	
93	KVbc (Ang)	93	LD0.VMMXU1.PPV.phsBC.instCVal.ang.f	
94	KVca (Mag) (*1000)	94	LD0.VMMXU1.PPV.phsCA.instCVal.mag.f	
95	KVca (Ang)	95	LD0.VMMXU1.PPV.phsCA.instCVal.ang.f	
96	I Scale Factor			N/A
97	User Register 1			N/A
98	User Register 2			N/A
99	User Register 3			N/A
100	User Register 4			N/A
101	User Register 5			N/A
102	User Register 6			N/A
103	User Register 7			N/A
104	User Register 8			N/A
105	User Register 9			N/A
106	User Register 10			N/A
107	User Register 11			N/A
108	User Register 12			N/A

DPU2000R Point I.D.	DPU 2000R Description	REF615R Index	REF615R Points	Mitigation Explanations
109	User Register 13			N/A
110	User Register 14			N/A
111	User Register 15			N/A
112	User Register 16			N/A
113	User Register 17			N/A
114	User Register 18			N/A
115	User Register 19			N/A
116	User Register 20			N/A
117	User Register 21			N/A
118	User Register 22			N/A
119	User Register 23			N/A
120	User Register 24			N/A
121	User Register 25			N/A
122	User Register 26			N/A
123	User Register 27			N/A
124	User Register 28			N/A
125	User Register 29			N/A
126	User Register 30			N/A
127	User Register 31			N/A
128	User Register 32			N/A
129	3-Phase Volt - Amps	129	LD0.PEMMXU1.TotVA.instMag.f	
130	W Power Factor			Refer to REF615R Analog input default Index 42.
131	Uw Power Factor Status			Refer to REF615R Analog input default Index 42.
132	I0 Zero Sequence Measured			Refer to REF615R Analog input default Index 6 for similar information.
133	I0 Zero Sequence Angle Measured			N/A
134	V0 Zero Sequence Measured	134	LD0.RESVMMXU1.PhV.res.instCVal.mag.f	
135	V0 Zero Sequence Angle Measured	135	LD0.RESVMMXU1.PhV.res.instCVal.ang.f	
136	V0 Zero Sequence Calculated	136	LD0.VSMSQI1.SeqV.c3.instCVal.mag.f	
137	V0 Zero Sequence Angle Calculated	137	LD0.VSMSQI1.SeqV.c3.instCVal.ang.f	
138	Fault Distance (Km or Mi)	138	LD0.DRFLO1.FltDisKm.mag.f	
139	Voltage Differential Magnitude			N/A
140	Voltage Differential Angle			N/A
141	Synch Check Slip Frequency			N/A

### 3.3 Counter Point Mitigation Table

*Table 4: Counter Point Mitigation Table*

DPU2000R Point I.D.	DPU 2000R Description	REF615R Index	REF615R Points	Mitigation Explanations
0	KSI Sum A Counter			N/A
1	KSI Sum B Counter			N/A
2	KSI Sum C Counter			N/A
3	Overcurrent Trip Counter			N/A
4	Breaker Operations Counter	146	LD0.SSCBR1.OpCnt.stVal	Counters are mapped as AI points (group 30) in REF 615R
5	Reclose Counter 1	147	LD0.DARREC1.FrqOpCnt.stVal	Counters are mapped as AI points (group 30) in REF 615R
6	1st Reclose Counter	148	LD0.DARREC1.OpCnt1.stVal	Counters are mapped as AI points (group 30) in REF 615R
7	2nd Reclose Counter	149	LD0.DARREC1.OpCnt2.stVal	Counters are mapped as AI points (group 30) in REF 615R
8	3rd Reclose Counter	150	LD0.DARREC1.OpCnt3.stVal	Counters are mapped as AI points (group 30) in REF 615R
9	4th Reclose Counter	151	LD0.DARREC1.OpCnt4.stVal	Counters are mapped as AI points (group 30) in REF 615R
10	Reclose Counter 2			N/A

### 3.4 Binary Output Mitigation Table

*Table 5: Binary Output Point Mitigation Table*

DPU2000R Point I.D.	DPU 2000R Description	REF615R Index	REF615R Points	Mitigation Explanations
0	Trip Contact operate test	0	LD0.XUGGIO100.SPCSO1.Oper.ctlVal	
1	Close Contact operate test			N/A
2	Output 1 Contact operate test	2	LD0.XUGGIO110.SPCSO1.Oper.ctlVal	
3	Output 2 Contact operate test	3	LD0.XUGGIO110.SPCSO2.Oper.ctlVal	
4	Output 3 Contact operate test	4	LD0.XUGGIO100.SPCSO3.Oper.ctlVal	
5	Output 4 Contact operate test	5	LD0.XUGGIO100.SPCSO4.Oper.ctlVal	
6	Output 5 Contact operate test	6	LD0.XUGGIO100.SPCSO5.Oper.ctlVal	
7	Output 6 Contact operate test	7	LD0.XUGGIO100.SPCSO6.Oper.ctlVal	
8	Output 7 Contact operate test			N/A
9	Output 8 Contact operate test			N/A
10	Trip operate command	10	LD0.SPCRGGIO1.SPCSO12.Oper.ctlVal	Refer to the appendix 2
11	Close operate command	11	LD0.SPCRGGIO1.SPCSO13.Oper.ctlVal	Refer to the appendix 2.
12	Reset Alarms/Target LEDs	12	LD0.LLN0.LEDRs1.Oper.ctlVal	

DPU2000R Point I.D.	DPU 2000R Description	REF615R Index	REF615R Points	Mitigation Explanations
13	Reset Peak and Minimum Demand Currents	13	LD0.CMSTA1.RecRs.Oper.ctlVal	
14	ULO1 Output Energize	14	LD0.SPCRGGIO1.SPCSO1.Oper.ctlVal	Work as 43A input. Refer to the appendix 2
15	ULO2 Output Energize	15	LD0.SPCRGGIO1.SPCSO2.Oper.ctlVal	Refer to the appendix 2
16	ULO3 Output Energize	16	LD0.SPCRGGIO1.SPCSO3.Oper.ctlVal	Refer to the appendix 2
17	ULO4 Output Energize	17	LD0.SPCRGGIO1.SPCSO4.Oper.ctlVal	Refer to the appendix 2
18	ULO5 Output Energize	18	LD0.SPCRGGIO1.SPCSO5.Oper.ctlVal	Refer to the appendix 2
19	ULO6 Output Energize	19	LD0.SPCRGGIO1.SPCSO6.Oper.ctlVal	Refer to the appendix 2
20	ULO7 Output Energize	20	LD0.SPCRGGIO1.SPCSO7.Oper.ctlVal	Refer to the appendix 2
21	ULO8 Output Energize	21	LD0.SPCRGGIO1.SPCSO8.Oper.ctlVal	Refer to the appendix 2
22	ULO9 Output Energize	22	LD0.SPCRGGIO1.SPCSO9.Oper.ctlVal	Refer to the appendix 2
23	Reserved			N/A
24	Trip Operate Command	24	LD0.SPCRGGIO1.SPCSO12.Oper.ctlVal	Refer to the appendix 2.
25	Close Operate Command	25	LD0.SPCRGGIO1.SPCSO13.Oper.ctlVal	Refer to the appendix 2.
26	Reset Seal In Points			N/A
27	Reserved			
28	Reserved			
29	Reserved			
30	Reserved			
31	Reserved			
32	Forced Logical Input 1 - status (52a)			N/A
33	Forced Logical Input 1 - unforce (52a)			N/A
34	FLI 2 - status (52b)			N/A
35	FLI 2 - unforce (52b)			N/A
36	FLI 3 - status (43A)			N/A
37	FLI 3 - unforce (43A)			N/A
38	FLI 4 - status (PH3)			N/A
39	FLI 4 - unforce (PH3)			N/A
40	FLI 5 - status (GRD)			N/A
41	FLI 5 - unforce (GRD)			N/A
42	FLI 6 - status (SCC)			N/A
43	FLI 6 - unforce (SCC)			N/A
44	FLI 7 - status (79S)			N/A
45	FLI 7 - unforce (79S)			N/A
46	FLI 8 - status (79M)			N/A
47	FLI 8 - unforce (79M)			N/A
48	FLI 9 - status (7CM)			N/A
49	FLI 9 - unforce (TCM)			N/A
50	FLI 10 - status (50-1)			N/A
51	FLI 10 - unforce (50-1)			N/A

# Section 3

## DNP3 Communication Points Mitigation List

DPU2000R Point I.D.	DPU 2000R Description	REF615R Index	REF615R Points	Mitigation Explanations
52	FLI 11 - status (50-2)			N/A
53	FLI 11 - unforce (50-2)			N/A
54	FLI 12 - status (50-3)			N/A
55	FLI 12 - unforce (50-3)			N/A
56	FLI 13 - status (ALT1)			N/A
57	FLI 13 - unforce (ALT1)			N/A
58	FLI 14 - status (ALT2)			N/A
59	FLI 14 - unforce (ALT2)			N/A
60	FLI 15 - status (ECI1)			N/A
61	FLI 15 - unforce (ECI1)			N/A
62	FLI 16 - status (ECI2)			N/A
63	FLI 16 - unforce (ECI2)			N/A
64	FLI 17 - status (WCI)			N/A
65	FLI 17 - unforce (WCI)			N/A
66	FLI 18 - status (ZSC)			N/A
67	FLI 18 - unforce (ZSC)			N/A
68	FLI 19 - status (OPEN)			N/A
69	FLI 19 - unforce (OPEN)			N/A
70	FLI 20 - status (CLOSE)			N/A
71	FLI 20 - unforce (CLOSE)			N/A
72	FLI 21 - status (46)			N/A
73	FLI 21 - unforce (46)			N/A
74	FLI 22 - status (67P)			N/A
75	FLI 22 - unforce (67P)			N/A
76	FLI 23 - status (67N)			N/A
77	FLI 23 - unforce (67N)			N/A
78	FLI 24 - status (ULI 1)			N/A
79	FLI 24 - unforce (ULI 1)			N/A
80	FLI 25 - status (ULI 2)			N/A
81	FLI 25 - unforce (ULI 2)			N/A
82	FLI 26 - status (ULI 3)			N/A
83	FLI 26 - unforce (ULI 3)			N/A
84	FLI 27 - status (ULI 4)			N/A
85	FLI 27 - unforce (ULI 4)			N/A
86	FLI 28 - status (ULI 5)			N/A
87	FLI 28 - unforce (ULI 5)			N/A
88	FLI 29 - status (ULI 6)			N/A
89	FLI 29 - unforce (ULI 6)			N/A
90	FLI 30 - status (ULI 7)			N/A
91	FLI 30 - unforce (ULI 7)			N/A



DPU2000R Point I.D.	DPU 2000R Description	REF615R Index	REF615R Points	Mitigation Explanations
92	FLI 31 - status (ULI 8)			N/A
93	FLI 31 - unforce (ULI 8)			N/A
94	FLI 32 - status (ULI 9)			N/A
95	FLI 32 - unforce (ULI 9)			N/A
96	Forced Phy. Input 1 - status (IN1)			N/A
97	Forced Phy. Input 1 - unforce (IN1)			N/A
98	FPI 2 - status (IN2)			N/A
99	FPI 2 - unforce (IN2)			N/A
100	FPI 3 - status (IN3)			N/A
101	FPI 3 - unforce (IN3)			N/A
102	FPI 4 - status (IN4)			N/A
103	FPI 4 - unforce (IN4)			N/A
104	FPI 5 - status (IN5)			N/A
105	FPI 5 - unforce (IN5)			N/A
106	FPI 6 - status (IN6)			N/A
107	FPI 6 - unforce (IN6)			N/A
108	FPI 7 - status (IN7)			N/A
109	FPI 7 - unforce (IN7)			N/A
110	FPI 8 - status (IN8)			N/A
111	FPI 8 - unforce (IN8)			N/A
112	reserved			
113	reserved			
114	reserved			
115	reserved			
116	reserved			
117	reserved			
118	reserved			
119	reserved			
120	reserved			
121	reserved			
122	Forced Phy. Output 1 - status (OUT1)			N/A
123	Forced Phy. Output 1 - unforce (OUT1)			N/A
124	FPO 2 - status (OUT2)			N/A
125	FPO 2 - unforce (OUT2)			N/A
126	FPO 3 - status (OUT3)			N/A
127	FPO 3 - unforce (OUT3)			N/A
128	FPO 4 - status (OUT4)			N/A
129	FPO 4 - unforce (OUT4)			N/A
130	FPO 5 - status (OUT5)			N/A
131	FPO 5 - unforce (OUT5)			N/A

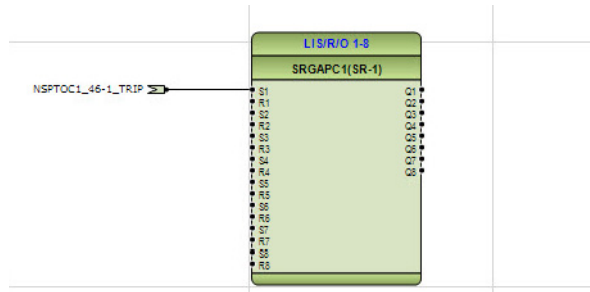
# Section 3 DNP3 Communication Points Mitigation List

DPU2000R Point I.D.	DPU 2000R Description	REF615R Index	REF615R Points	Mitigation Explanations
132	FPO 6 - status (OUT6)			N/A
133	FPO 6 - unforce (OUT6)			N/A
134	reserved			
135	reserved			
136	reserved			
137	reserved			
138	C1 – Pushbutton Control	138	LD0.SPCGGIO1.SPCSO1.Oper.ctlVal	
139	C2 – Pushbutton Control	139	LD0.SPCGGIO1.SPCSO2.Oper.ctlVal	
140	C3 – Pushbutton Control	140	LD0.SPCGGIO1.SPCSO3.Oper.ctlVal	
141	C4 – Pushbutton Control	141	LD0.SPCGGIO1.SPCSO4.Oper.ctlVal	
142	C5 – Pushbutton Control	142	LD0.SPCGGIO1.SPCSO5.Oper.ctlVal	
143	C6 – Pushbutton Control	143	LD0.SPCGGIO1.SPCSO6.Oper.ctlVal	
144	ULO10 – User Logical Output Control			N/A
145	ULO11 – User Logical Output Control			N/A
146	ULO12 – User Logical Output Control			N/A
147	ULO13 – User Logical Output Control			N/A
148	ULO14 – User Logical Output Control			N/A
149	ULO15 – User Logical Output Control			N/A
150	ULO16 – User Logical Output Control			N/A
151	HLT_SET – Hot Line Tagging Set/HLT_RST – Hot Line Tagging Reset	151	LD0.SPCGGIO1.SPCSO8.Oper.ctlVal	
152	HLT_RST – Hot Line Tagging Reset			N/A

# Section 4 Appendix

## 4.1 Appendix: A Mitigation Figures

1. Seal-in Points. Connect the point that needs to be latched to any set-input, e.g. S1, of SRGAPCx, and use the output Q1 to read the latched status of the point, i.e., LD0.SRGAPCx.Q1.stVal. Use control command of LD0.SRGAPC1.Rs1.Oper.ctlVal to reset the 46-1 trip latch.

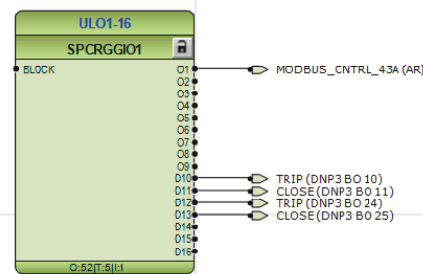


**Figure 1:** Example of creating seal in point for 46-1 trip

2. SPCRGGIO1 function block is used for adapting several DPU2000R control functions to the REF615R.

Note: Both DNP3 and Modbus share the same ACT configuration. Therefore, customize the ACT will affect DNP3 and Modbus communication protocols.

The SPCRGGIO1 in default ACT configuration is shown in Figure 2,



**Figure 2:** SPCRGGIO1 Default ACT Configuration

The default DNP index assignment is shown in Table 6

Table 6: Default DNP index assignment

IEC61850 Data Attribute Name	Default Control Index	DPU2000R Point Description	DNP3 Description
LD0.SPCRGGIO1.SPCSO1.Oper.ctlVal	14	ULO1 Output Energize	ULO1 Output Energize (43A-RCNTRL-1 Output 1)
LD0.SPCRGGIO1.SPCSO2.Oper.ctlVal	15	ULO2 Output Energize	ULO2 Output Energize (RCNTRL-1 Output 2)
LD0.SPCRGGIO1.SPCSO3.Oper.ctlVal	16	ULO3 Output Energize	ULO3 Output Energize (RCNTRL-1 Output 3)
LD0.SPCRGGIO1.SPCSO4.Oper.ctlVal	17	ULO4 Output Energize	ULO4 Output Energize (RCNTRL-1 Output 4)
LD0.SPCRGGIO1.SPCSO5.Oper.ctlVal	18	ULO5 Output Energize	ULO5 Output Energize (RCNTRL-1 Output 5)
LD0.SPCRGGIO1.SPCSO6.Oper.ctlVal	19	ULO6 Output Energize	ULO6 Output Energize (RCNTRL-1 Output 6)
LD0.SPCRGGIO1.SPCSO7.Oper.ctlVal	20	ULO7 Output Energize	ULO7 Output Energize (RCNTRL-1 Output 7)
LD0.SPCRGGIO1.SPCSO8.Oper.ctlVal	21	ULO8 Output Energize	ULO8 Output Energize (RCNTRL-1 Output 8)
LD0.SPCRGGIO1.SPCSO9.Oper.ctlVal	22	ULO9 Output Energize	ULO9 Output Energize (RCNTRL-1 Output 9)
LD0.SPCRGGIO1.SPCSO10.Oper.ctlVal	10	Trip operate command	Trip operate command
LD0.SPCRGGIO1.SPCSO11.Oper.ctlVal	11	Close operate command	Close operate command
LD0.SPCRGGIO1.SPCSO12.Oper.ctlVal	24	Trip operate command	Trip operate command
LD0.SPCRGGIO1.SPCSO13.Oper.ctlVal	25	Close operate command	Close operate command
LD0.SPCRGGIO1.SPCSO14.Oper.ctlVal	257		RCNTRL-1 Output 14
LD0.SPCRGGIO1.SPCSO15.Oper.ctlVal	258		RCNTRL-1 Output 15
LD0.SPCRGGIO1.SPCSO16.Oper.ctlVal	259		RCNTRL-1 Output 16

- a For the ULO1 Output Energize (43A-RCNTRL-1 Output 1), it is "OR"ed to control the DARREC1 (79) function inhibit reclose input.

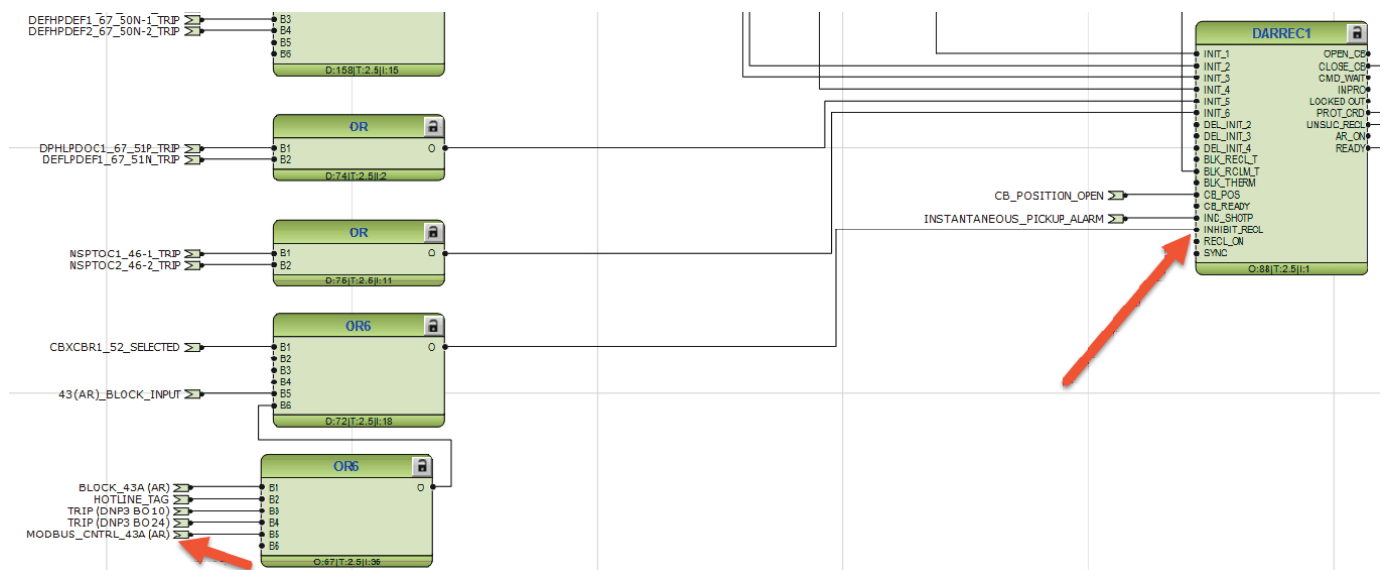
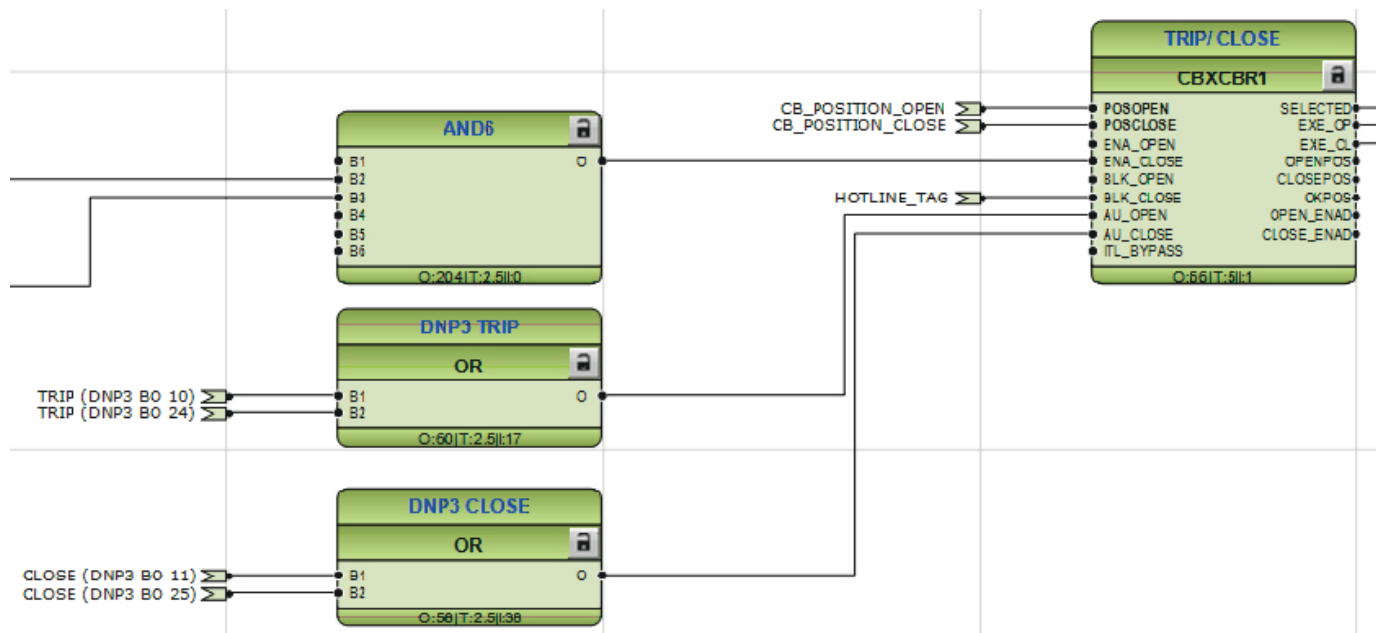


Figure 3: Default Logic for 43A Control

To use this functionality, the output 1 should be set to "Toggle" mode and use the "Latch On" and "Latch Off" CROB in DNP3 to enable and disable the 43A control.

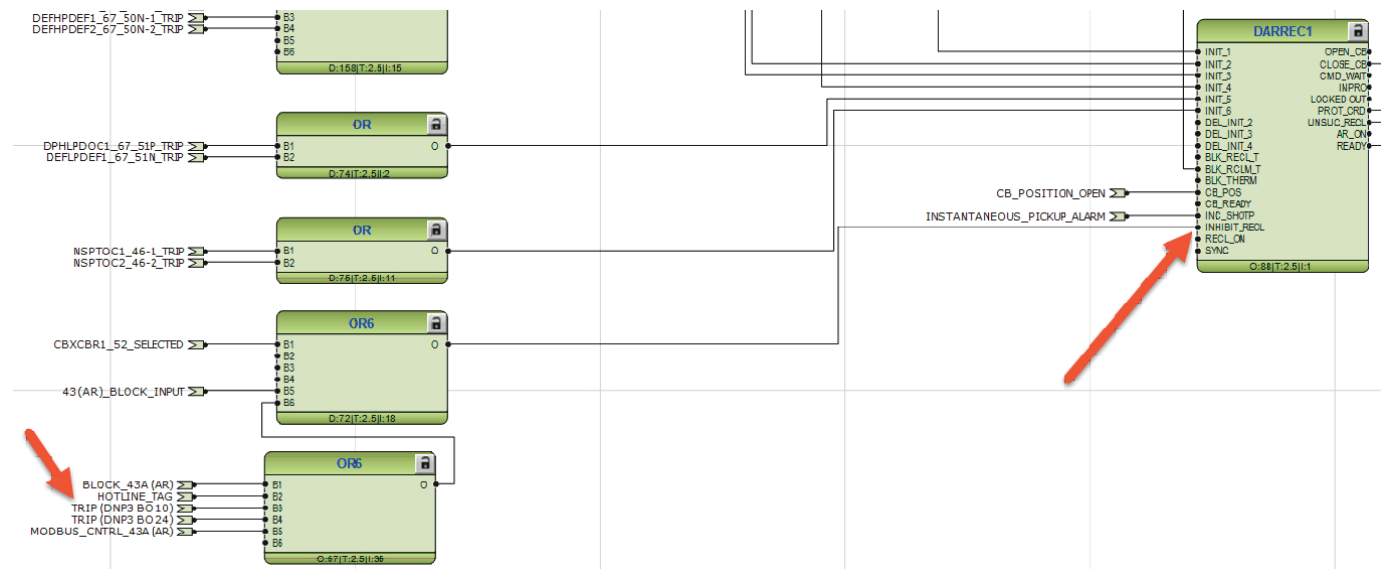
- b The Output pairs 10/11 (index 10/11) and output 12/13 (index 24/25) are used for the trip and close command. The two pairs have identical functionality. They are connected to the auxiliary open and auxiliary close input in the CBXCBR (52-1) function.



**Figure 4:** Default Logic for Trip and Close Control

To use these control points. The output 10 – 13 should be set to “Pulsed” mode and the pulse length should be 500 ms. (Mainly for the trip block 79 reclose time period to match the DPU trip block behavior).

The Trip commands are “OR”ed to control the DARREC1 (79) function inhibit reclose input. Therefore, this Trip command is independent of the 43A input.



**Figure 5:** Default Trip Logic Connected to 79 Inhibit Input

- c To use the other ULO 2-8 outputs, the outputs have to be turned on in either “Toggled” mode or “Pulsed” mode. For the ULO 10 – 16, there is no default mapping in ACT. User can use the SPCRGGIO 14- 16 and other spare SPCGGIO outputs by assigning the IEC61850 DA name to the corresponding index with CMT.

## Section 5      Glossary

DPU2000R Features	Changes in REF615R
Seal-In Points	Seal-In points are not supported in REF615R. More detailed information about the value changes will be recorded with DNP3 events (Class 1, 2, 3 data). Also, provided is a mitigation solution employing the ACT tool to configure the SET/RESET AFLs to latch the values, please refer to Appendix A.1.
Scan Group	Scan group is DNP3 level 1 settings. REF615R is compatible with DNP3 level 2+, which support the more flexible polling scheme, therefore the scan group feature is not implemented in the default DNP3 point list. Instead, users can make the polling list by adding or removing the mapped points through CMT or specify the polling scheme with DNP3 objects.
ECP Source Registers	In REF615R, a comprehensive point list is offered as default mapping list. Instead of employing the DPU 2000R ECP Source Registers, user can use the CMT tool to rebuild a fully customized DNP3 polling list.
Counter points	Counters will be mapped as AI points
AI points bits variation	With DNP3 level 2+ compatibility, the AI points can be polled with either 16 bits or 32 bits by specifying different object variation numbers.
AI points scaling	No initial scaling will be provided except for measurement values. The measurement values are multiplied by 100 to maintain the first two decimals. Especially, for the Voltage measurements, unlike in DPU where the primary values are reported, in REF615R the voltage measurements are reported in secondary values with a default multiplication factor of 100. Customer can change the scaling method and factor of any individual point with CMT.
Force Logical Input and Force Physical Input	Please see point mitigation list
Event Record	Event record will be saved for each point if that point is included in a dataset.
Paired mode (network mode parameter 2)	The paired mode can be configured through the HMI or PCM600 in Configuration->Communication->Ethernet->DNP3.0 submenu.

<b>ACT</b>	Application Configuration Tool from PCM600
<b>AFL</b>	Application function block library
<b>AI</b>	Analog Input
<b>ANSI</b>	American National Standards Institute
<b>AR</b>	Autoreclosing
<b>BI</b>	Binary Input
<b>BIO</b>	Binary Input Output
<b>BO</b>	Binary Output
<b>CB</b>	Circuit breaker
<b>CMT</b>	Communication Management tool in PCM600
<b>CT</b>	Current transformer
<b>CTRL</b>	Control logical device

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<b>DFR</b>	Digital fault recorder
<b>DNP3</b>	A distributed network protocol originally developed by Westronic. The DNP3 Users Group has the ownership of the protocol and assumes responsibility for its evolution.
<b>DPC</b>	Double-point control
<b>DPS</b>	Double-point status
<b>DR</b>	Disturbance recorder
<b>EMC</b>	Electromagnetic compatibility
<b>HMI</b>	Human-machine interface
<b>I/O</b>	Input/output
<b>ID</b>	Identifier or identification
<b>IEC 61850</b>	International standard for substation communication and modelling
<b>Protection relay</b>	Intelligent electronic device
<b>LD0</b>	Logical device zero (0)
<b>LED</b>	Light-emitting diode
<b>LHMI</b>	Local human-machine interface
<b>LLN0</b>	Logical node zero (0)
<b>MCD</b>	Momentary change detect
<b>Modbus</b>	A serial communication protocol developed by the Modicon company in 1979. Originally used for communication in PLCs and RTU devices.
<b>MOM</b>	Momentary position
<b>PCM600</b>	Protection and Control Protection Relay Manager
<b>PLC</b>	Programmable logic controller
<b>PST</b>	Parameter Setting tool in PCM600
<b>REF615R</b>	Wire-alike replacement option for DPU2000R with the same form factor
<b>SBO</b>	Select-before-operate
<b>stVal</b>	Status value
<b>SW</b>	Software
<b>UDR</b>	User-definable register
<b>UTC</b>	Coordinated universal time
<b>Val</b>	Value
<b>WHMI</b>	Web human-machine interface





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