

White paper

Arc flash energy reduction using ABB Emax 2 with second I Protection (2I) and Dual Settings



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Contents

1	Intro	oduction	2
2	ABE	3 Arc Flash Safety Solutions	4
	2.1	Dual Settings	4
	2.2	Second I (2I) Protection	4
	2.3	Activation of 2I and Dual settings	4
3	Imp	lementation of Arc Flash Safety Solutions	5
	3.1	Wiring	5
	3.2	Programming on Ekip connect	7
	3.3	Programing "2I" Protection with Ekip Connect	8
	3.4	"2I" Verification	11
	3.5	Programing "Dual Settings" Protection with	
		Ekip Connect	11
	3.6	Dual Setting verification	18
4	Prot	tection Benefits	19
	4.1	2I Benefits Summary	19
	4.2	Dual Setting Benefits Summary	20
5	Equ	ipment Selection	21
	5.1	Circuit Breaker	21
	5.2	Circuit Breaker Accessories	21
	5.3	Additional Accessories	21

1. Introduction

1.1 Purpose

Selective Coordination often requires upstream circuit breakers to wait in the event of a fault condition to allow downstream circuit breakers time to clear the fault. This increased time delay permits fault currents to flow and increases the amount of hazardous arc flash energy available the longer the fault current is allowed to flow. As you can see an opposing situation can result between Selective Coordination which needs upstream circuit breakers to remain closed during fault conditions, while Arc Flash Energy reduction methods requires these same circuit breakers to open quickly.

While the level of arc flash energy that results in a selectively coordinated system may be fully within acceptable levels to protect equipment from damage, this amount of arc energy is potentially very hazardous to personnel that may be working in the vicinity of the equipment.

¹ OSHA 29 Code of Federal Regulations (CFR) Part 1910 Subpart S requires that employers assess the arc flash hazard. If there is one present or likely in a certain area then the standard requires use of personal protective equipment. This equipment must be worn within specified boundaries given by the standard.



² NFPA 70E Standard for Electrical Safety in the Workplace recognizes that there are situations where working on energized electrical equipment is needed. As a result, strict guidelines are outlined in NFPA 70E for the various levels of Personnel Protective Equipment (PPE) that must be worn by personnel within arc flash boundaries.

³ IEEE 1584 Guide for Performing Arc-Flash Hazard Calculations provides guidelines for conducting a formal arc flash study of the devices in an electrical system. Facility engineers should perform an arc flash study to identify the recommended level of PPE and arc flash protection boundary.

In the 2011 edition, the NEC® added a new set of recommendations for addressing arc flash energy reduction in circuit breaker applications, per Article 240.87

⁴ 240.87 Noninstantaneous Trip.

Where the highest continuous current trip setting for which the actual overcurrent device installed in a circuit breaker is rated or can be adjusted is 1200A or higher, 240.87(a) and (b) shall apply.

(a) Documentation.

Documentation shall be available to those authorized to design, install, operate, or inspect the installation as to the location of the circuit breaker(s).

(b) Method to Reduce Clearing Time.

- One of the following or approved equivalent means shall be provided:
- (1) Zone-selective interlocking
- (2) Differential relaying
- (3) Energy-reducing maintenance switching with local status indicator
- (4) Energy-reducing active arc flash mitigation system
- (5) An approved equivalent meas

Note: An energy-reducing maintenance switch allows a worker to set a circuit breaker trip unit to 'no intentional delay' to reduce the clearing time while the worker is working within an arc-flash boundary as defined in NFPA 70E, 2009, Standard for Electrical Safety in the Workplace, and then to set the trip unit back to its normal setting after the potentially hazardous work is completed.

The idea behind this new NEC requirement is that in cases where the circuit breaker is used without an instantaneous trip function, an alternate means shall be provided to reduce the fault clearing time while a worker may be within the arc flash boundary of that circuit breaker. In this document we will concentrate on method three (3), energy-reducing maintenance switching with local status indicator.

³ IEEE guide for performing arc-flash hazard calculations. (2002). New York, New York: Institute of Electrical and Electronics Engineers.

¹ Part 1910 Subpart S. (2011). In OSHA 29 Code of Federal Regulations (CFR). Washington, D.C.: U.S. Dept of Labor, Occupational Safety and Health Administration.

² NFPA 70E standard for electrical safety in the workplace (2012 ed.). (2011). Quincy, MA: NFPA.

⁴ NFPA 70E standard for electrical safety in the workplace (2012 ed.). (2011). Quincy, MA: NFPA.

2. ABB Arc Flash Safety Solutions

With SACE Emax 2's Ekip trip units, a new level of safety during maintenance and operation is achieved. These powerful trip units are equipped with the most innovative technology on the market. Two of these integrated technologies are dual settings and second instantaneous protection which can be used to improve personnel and system safety by adhering to NEC Arc flash energy reduction requirements.

2.1 Dual Settings

With the dual setting feature an extra level of protection against Arc Flash Hazard is provided within the trip unit. Two protective parameter sets are available called set A and set B. When this feature is used it can be set to activate an alternative set of parameters for long-time, short-time, 2nd short-time, instantaneous, ground fault, directional overcurrent, and/or over temperature settings. The alternative set of protective settings provide the ability to establish minimum delays on the protective functions during maintenance activities performed downstream of the breaker. With minimized delays, the potential to reduce the risk of injury to personnel during an arc flash incident is improved.

Set A and set B are completely interchangeable and both can be configured as the default or alternate set.

2.2 Second I (2I) Protection

Instantaneous protective settings are typically sacrificed to maintain selectivity with upstream and downstream protective devices in a power system. In these instances, the lack of consideration for the amount of available arc flash energy can increase the risk to personnel. The 2I feature permits opening of the circuit breaker faster than the standard instantaneous setting when a lower value is applied. It also is completely independent from ANSI 50 protective function, which means it has the capability to be set without affecting the other pre-set protections (ie. LSIG). The thresholds for this protection can be predetermined and stored to be ready for temporary activation. Once maintenance downstream is complete, the 2I setting can be deactivated.

2.3 Activation of 2I and Dual settings

2I and Dual Settings can be activated in four ways:

- Locally, directly on the input on the Ekip display unit
- Remotely, via any Ekip Com module connected to the circuit breaker
- Remotely, via a switch wired through an Ekip Signalling module.
- By a settable internal time, after circuit breaker closing (Dual settings only)

When 2I is active, the Ekip display unit will show a confirmation of the activation and a red LED alarm will flash on the diagnosis bar. For Dual settings, an A or a B will be displayed according to which set is active.

The following pages will explore setting "Second I" protection and dual settings remotely via a switch in order to provide instruction to engineers and designers regarding the requirements in 2011 NEC® article 240.87(3), for energy-reducing maintenance switching with local status indicator. This paper specifically addresses how to implement these requirements using **ABB SACE Emax 2** Low Voltage Power Circuit Breakers (LVPCBs).

3.1 Wiring

- 1. The digital input that will be used on the ABB Emax 2 Ekip Signalling 2k module is located on terminals H11 and HC1 shown on diagram 41 below of the circuit breaker and should be wired in series with a normally open contact on the main-tenance mode switch/selector switch.
 - Note: The Ekip Signalling 2k module requires the presence of an Ekip Supply module (see diagram 32 below) in the first available slot on the right of the circuit-breaker terminal box. The Ekip Supply module will power the digital input of the signaling module which will trigger the protective parameter "2l" to become active once programed.



Note: Diagram 41 is shown for the 1st installed Ekip Signalling 2k module, however up to a quantity of 3 Ekip Signalling 2k modules may be installed on circuit breaker frames E2.2 to E6.2 and up to a quantity of 2 Ekip Signalling 2k modules may be installed on circuit breaker frames E1.2.

Any one of the Ekip Signalling 2k modules may be program to accommodate the maintenance mode application but adjustments are required to the referenced connection points and programed settings.

2. Wire the Ekip Signalling 2K module, Ekip supply module, maintenance mode switch, timer, and blue pilot light as shown below



Note: The diagram shown is for a 110-240V AC/DC version of the Ekip supply module. If the 24-48V DC version of the Ekip supply module is used, it should not be included in the control circuit above.

3. Install the custom aluminum engraved nameplates on the deadfront enclosure around the pilot light and selector switch. Part# MP-NPE29-01 is for the blue pilot light. Part# MP-NPE29-02 is for the 2 position selector switch.



4. Apply the appropriate control voltage to power up the Ekip Supply module. If the Emax 2 breaker is a withdrawable type, rack the breaker into the test position.

3.2 Programming on Ekip Connect

The ABB Emax 2 Ekip Touch trip unit is very sophisticated and has many advanced features; in order to function properly it has to be programmed in a specific way to enable the desired functions. In this section we will outline the steps needed to complete the programming to enable "21 protection" and "dual settings".

- 1. Launch the free Ekip Connect software on the customer supplied laptop.
- 2. Connect one side of the micro USB cable ^C to the Ekip T&P module ^B and the other side to the Ekip Touch trip unit A. Connect the USB connection on the Ekip T&P module ^B to the customer supplied laptop.

You can confirm the proper connection is made when the green power led is on \bigcirc . Active communication will be indicated via the orange transmission indicator blinking on the Ekip T&P module **B**.



Note: It may be necessary to scan for the trip unit via the ABB Key before the device will appear in the Ekip Connect software

3. "Login" (login password is 0001)

= Ekip	Conne	ect 2.0.3	40.0 [Us	ser]								
File	Home	Tools	;									
	-	8	9	€	1	6		4	4			1
ABB Key	Serial	Bluetooth	Ethernet	Refresh Page	Generate Opa	Login	Logout	Change Password	Advanced User	Navigation Tree	Message List	About Ekip Connect
	9	ican		Refresh	Report		Use	r Account		Vie	w	About

4. Select "Advanced User" so all options are available. Now you are ready to begin programing.

= Ekip	Conne	ect 2.0.3	40.0 [U	ser]										
File	Home	Tools	;											
III	-	8	9	€}	Í	Þ		\mathbf{i}		4			1	
ABB Key	Serial	Bluetooth	Ethernet	Refresh Page	Generate	Open	Login	Logout	Change Password	Advanced User	lavigation Tree	Message List	About Ekip Connect	
	9	ican		Refresh	Repo	ort		Use	r Account		Vie	w	About	

3.3 Programming "2I" Protection with Ekip Connect

1. Enable Local Bus to see Ekip Signalling module 2K1

UNIT CONFIGURATION			
LED Alive	Enabled	Enabled	~
TFT Orientation	Landscape	Landscape	~
Ext Toroid Type	None	None	~
Ext Ground Toroid	100 A	100 A	~
Monitor Time	15 min	15	~
Start Up threshold	0.10 A	0.10	~
Language	English	English	~
Harmonic Distortion Warning	Off	Off	~
Phase Rotation Warning	Off	Off	~
Phase Rotation Cycle	123	123	~
Power factor Warning	Off	Off	~
Power factor Threshold	0.95	0.95	~
Local Bus Enable	Enabled	Enabled	~
Operating Mode Par	Locai	Local	\sim
Open/Close Remote Direct Command	Enabled	Enabled	~
GTE filter			\checkmark
V0 filter			~

 Turn on the 2I protection feature by selecting "Protection Parameters" > "Settings A" in the left hand column, then under "Second I" select "Enabled" in the drop down menu

🗵 🔋 Ekip	T&P	0.00					
3 🔳	Ekip Touch CB TagName @ 3	Settings A					
	Information						
	Status						
	Warning/Alarms	OVERLOAD PROTECTION	(L - ANSI 49)		SECOND I		
	Trips	 Status	Enabled		Status	Enabled Enabled	
9	Measures Menu	 Function	t=k/i^2 t=k/i^2	\sim	Threshold 131	1.50 ln	1.50 🗸
	Measures	 Prealarm I1	90 % 11	90 🗸		1.00 11	
	Other Measures	 Throchold I1	1 000 lp	1,000 2		ON (G - ANSI 50N TD/68/	54NI)
	CB Statistics	 Theshold II	1.000 m	1.000 +		0. 11 10.00	
	Unit configuration	 Time t1	144.00 s	144.00	Status	Disabled Disabled	×
۲	Protection Parameters	 Thermal memory	Disabled Disabled	~	Trip enable	Enabled Enabled	~
	Settings A				BlockOnStartUp		\checkmark
	Other Settings A	TIME-DELAYED OVERCURI	RENT PROTECTION (S	- ANSI 50	BlockOnOutOfFrequency		~
9	Modules	 TD/68/51)			BlockOnProgStatusA		~
	Ekip Signalling 2K-1	 Status	Disabled Disabled	~	BlockOnProgStatusB		~
	Ekip COM Ethernet/IP	Trip enable	Enabled Enabled	~	BlockOnProgStatusC		~
	Ekip Synchrocheck	 BlockOnStartLIn		~	BlockOn ProgStatusD		
9	Programmable Status and Outputs	BlockOnOutOfFraguanau			BIOCKOTIFTOgStatusD		
	Programmable Status	 BlockOnOutOrrequency			Function	t=K t=K	`
	Outputs	BlockOnProgStatusA		`	Prealarm I4	90 % 14	90 🗸
	Functions	BlockOnProgStatusB		~	Threshold 14 (t=k)	0.250.ln	0 250 🗸
	Measures History	COMMANDS Current/Time	curve			Submit	Reset

3. Next set the 2I protection threshold by selecting from the "Threshold I31" dropdown options. I31 can be set from 1.50 In to 15.0 In at increments of 0.10 In.

SECOND I			
Status	Enabled Enabled		~
Threshold I31	1.50 In	1.50	~

Note: The Threshold I31 setting should be determined by the customer. The circuit breaker will ship with factory default settings. ABB recommends that a short circuit, coordination, and arc flash hazard analysis be performed by the customer to determine all appropriate protective device settings. 4. The next step is to program the signaling input of the 2K to activate the 2I protection mode. In the left column select "Functions" and scroll to "Second I" in the main section of the window. Choose from the Second I Mode dropdown "Function Dependent". Choose "Ekip Signalling 2K input 1" as the function, and select the desired time delay to be used once the "maintenance switch" is turned on.

Status						
Warning/Alarms	Functions					
Trips		0.00 S			0.00 S	
Measures Menu						
Measures	SECOND I		RESTART DLOG 2			
Other Measures	Second I Mode	Function Dependent Function Dependent				
CB Statistics	E contar mode		Function	Disabled	-	
Unit configuration	Function	Disabled Ekip Signalling 2k1 in	<u>s</u>		Disabled	
Protection Parameters	Delay	0.00 s 0.00 s				
Settings A			Delay	0.00 s	0.00 s	
Other Settings A	SIGNALLING RES	ET			0.00 5	
Programmable Status and Outputs						
Programmable Status	Function	Disabled				
Functions		Disabled				
Measures History		0.00				E
Trip History	Delay	0.00 s				
Events log						
Datalogger					and the second se	
Naturrie Analyzer	- SECONDIMODE 2	nd I Mode ON 2nd I Mode OFF			Submit	Réset

5. Click on "Submit" to save the changes. The first time you submit any programming changes you will be asked for a password if it was not entered during login, the password is "0001".



 Next program the input of the Ekip Signalling 2K to activate the 2I feature and switch it on and off. In the left column select "Modules" > "Ekip Signalling 2k-1". Ensure that the "Input I 11" polarity is set to "Active Closed".

Ekip	T&P Ekip Touch CB TagName @ 3	Ekip Signalling	2K-1				
	Information			01.00	Latineu		<u> </u>
	Status	HW version		00.01	Signal Source	Custom 0xA408 Custom 0xA408	
	Warning/Alarms	Boot version		04.01	Delav	0.00 s 0.00 s	
	Trips				min Activation Time	0 ms 0	× I
	Measures Menu	STATUS			minAcuvation mine	UTITS U	
	Measures	Input I 11		Off	OUTPUT O 42		
	Other Measures	Input I 12		Off	0010012		
	CB Statistics	Output O 11		Open	Contact Type	Normally Open Normally Open	×
	Unit configuration	Output O 12		Open	Latched	OFF OFF	\sim
	Protection Parameters				Signal Source	None None	
	Settings A	INPLIT L11			Delay	0.00 \$ 0.00 \$	
	Other Settings A	D.L.A			min Activation Time	0.003 0.003	
	Modules	Polanty	Active Closed Active Closed		min Activation Time	Ums 0	•
	Ekip Signalling 2K-1	Delay	0.10 s 0.10 s				
	Ekip COM Ethernet/IP				STATUS		
	Ekip Synchrocheck				Flash CRC algorithm sta	tus	active
	Programmable Status and Outputs	Polarity	Active Closed Active Closed		Flash CRC algorithm res	ult	Ok
	Programmable Status	Delaw					
	Outputs	Delay	0.10 S 0.10 S				
	Functions						
	Measures History	- COMMANDS	Sign Reset Sign Test	Start Autotest		Submit	Reset

- 7. Next program the output of the Ekip Signalling 2K. In the left column select "Modules" > "Ekip Signalling 2k-1".
- 8. Ensure that the under "Output O 11" the "Contact Type" is set to "Normally Open". Ensure that the "Latched" setting is set of "OFF". The "Delay" setting can be left at "0.00s" or adjusted as desired. Ensure that the "min Activation Time" is set at "0 ms".

🗵 🚦 Ekip	T&P	- Ekin Si	apolling 21/ 1						
3 🗖	Ekip Touch CB TagName @ 3	Ekip Si	gnalling ZK-1						
	Information								^
	Status							_	
	Warning/Alarms	INFORM	ATION			OUTPUT O 11			
	Trips	Serial Nu	mber	35203	2618990w010	Contact Type	Normally Open Normally Open		
	Measures Menu	SW vers	ion		01.68	Latched	OFF OFF	\sim	
	Measures	HW vers	ion		00.01	Signal Source	Custom 0xA408 Custom 0xA408		
	Other Measures	Boot ver	sion		04 01	Signal Source	Custom 004408 Custom 004408	_	
	CB Statistics					Delay	0.00 s		
	Unit configuration	STATUS				min Activation Time	0 ms 0	\sim	
	Protection Parameters				01			_	
	Settings A	input I 11							
	Other Settings A	Input I 12			Off	Contact Type	Normally Open Normally Open	\sim	41
	Modules	Output C	011		Open	Latched	OFF OFF	\sim	
	Ekip Signalling 2K-1	Output C	12		Open	Cianal Course	Nono Nano		
	Ekip COM Ethernet/IP					Signal Source	None None		
	Ekip Synchrocheck	INPUTI	11			Delay	0.00 s		
	Programmable Status and Outputs	Polarity		Active Closed Active Clo	sed 🗸	min Activation Time	0 ms 0	\sim	
	Programmable Status	Delay		0.10 s 0.10 s					
	Outputs					STATUS			
	Functions	0011111	0	Olan Taat	Otard Autotard		Qubmit	Deset	
	Measures History	- COMMAN	IDS Sign Re	set Sign Test	Start Autotest		Submit	Reset	

- 9. Select the "Signal Source".
- 10. When the window opens, select "Custom" for Trigger type.
- 11. Select "Alarm/Warning 5H" for Events group.
- 12. Select "Second I Activated" until the black "X" changes to a "1".



13. Click Apply and OK. Then click on "Submit" to save your changes. The signaling module is now programed to activate the 2l protective setting when the maintenance mode switch is in the on position and close the output contact to start the timer.

3.4 "2I" Verification

1. You can verify this by selecting "Warning/Alarms" in the left hand column and under "SECOND I" will indicate an active setting for "Prot Second I" when the maintenance mode selector switch is on.



- 2. You can verify that the output is working by selecting "Outputs" in the left column and identifying that "(2K-1) Output 1" will indicate a closed state and the external blue pilot light should be flashing/blinking when the maintenance mode selector switch is on.
- 3. The default protective parameter set is "Set A", when the "maintenance switch" is put into maintenance mode, the Ekip power supply will power the digital input of the signaling module and this will cause the protective parameter to activate "2I". The display of the trip unit will indicate 2I is activated through an alarm indicator



3.5 Programing "Dual Settings" Protection with Ekip Connect

- 1. Turn on the Dual settings feature by selecting "Unit configuration" in the left hand column, then under "DUAL SET" select "On" in the Enable Dual Set drop down menu.
- 2. Turn on Dual SET Change ALWAYS, to "Enabled".

۹ ا	 Ekip Programming Ekip Touch -QF8 @ 3 Information Status Warning/Alarms Trips Measures Menu CB Statistics Unit configuration Protection Parameters Modules Programmable Status and Outputs Functions Measures History Trip History Events log Datalogger 						
9) 🔺	🔺 Ekij	p Touch -QF8 @ 3	Unit configuration			
			Information		On	On -	
			Status	Warning	011		d
			Warning/Alarms	Phase Rotation Warning	Off	Off 🗸	7
			Trips	Phase Rotation Cycle	102	123	
			Measures Menu	Pausa fastas Marsia	123	0#	-
			CB Statistics	Power factor warning	Off	UT T	_
			Unit configuration	Power factor Threshold	0.95	0.95 -	r.,
		€	Protection Parameters	Operating Mode Par	Remote	Remote -	r
			Modules	Open/Close Remote	Enabled	Enabled .	7
			Programmable Status and Outputs	Direct Command	Enabled	Lindbiod	٥
			Functions	Modules network	Override	Override -	7
			Measures History	Dual Set Change			
			Trip History	Always	Enabled	Enabled •	r.,
			Events log	S/G HW Zone	Enabled	Enchlad	1
			Datalogger	Selectivity repeat	Enableu	Ellabled	
				DUAL SET			
				Set in Use	Set A		
				Selection	Set B	Set B 🗸	r
				Enable Dual Set	Off	On -	-

3. Ensure "Selection" is on "Set A".

DUAL SET		
Set in Use	Set A	
Selection	Set A Set A	+
Enable Dual Set	On On	•

4. Now click on "Submit" to save your changes



5. Now click on "Settings B" in the left hand column and enter the set B programming parameters

💿 🚦 Ekip Pr	rogramming
💿 🔺 Eki	p Touch -QF8 @ 3
	Information
	Status
	Warning/Alarms
	Trips
	Measures Menu
	CB Statistics
	Unit configuration
Ð	Protection Parameters
	Settings A
	Other Settings A
	Settings B
	Other Settings B

Settings B

OVERLOAD PROTECTION	I (L - AN SI 49)		SECOND I		
Status	Enabled		Status	Enabled	Enabled -
Function	t=k/i^2	t=k/i^2	 Threshold I31 	2.00 In	2.00 -
Prealarm I1	90 %	90 -	•		
Threshold I1	1.000 In	1.000	EARTH FAULT PROTECTION	TION (G - ANSI 50N TI	D/68/51N)
Time t1	144.00 s	144.00	 Status 	Enabled	Enabled 🗸
Thermal memory	Disabled	Disabled	 Trip enable 	Enabled	Enabled 🔹
			Function	t=k	t=k -
TIME-DELAYED OVERCU	RRENT PROTECTIO	N (S - ANSI 50	Prealarm I4	90 % 14	90 🔻
<u>TD/68/51)</u>			Threshold I4 (t=k)	0.200 ln	0.200 -
Status	Enabled	Enabled •	 Time t4 (t=k) 	0.40 s	0.40 🔻
Trip enable	Enabled	Enabled	Zone selectivity status	Disabled	Disabled 🔹
Function	t=k	t=k ·	Zone Selectivity Type	Logic and Hardware	Logic and Hardware 🔹 🔻
Threshold I2 (t=k)	2.00 In	2.00	•		
Time t2 (t=k)	0.05 s	0.05	DIRECTIONAL OVERCU	IRRENT PROTECTION	I (D - AN SI 67/68)
Thermal memory	Disabled	Disabled	Threshold I7 BWD	2.00 In	2.00 -
Zone Selectivity Type	Logic and Hardware	Logic and Hardware	Zone Selectivity Type	Logic and Hardware	Logic and Hardware 🔹 👻
SECOND TIME-DELAYED	OVERCURRENT PR	OTECTION (S2 - ANS	SI OVER TEMPERATURE	(T)	
50 ID)			Trip enable	Disabled	Disabled 🔹
Status	Disabled	Disabled	•		
Trip enable	Enabled	Enabled	<u>•</u>		
Threshold I5 (t=k)	2.00 In	2.00	-		
Time t5 (t=k)	0.05 s	0.05	•		
Zone Selectivity Type	Logic and Hardware	Logic and Hardware	▼		

Note: The settings should be determined by the customer. The circuit breaker will ship with factory default settings. ABB recommends that a short circuit, coordination, and arc flash hazard analysis be performed by the customer to determine all appropriate protective device settings.

6. Now click on "Submit" to save your changes



7. The next step is to program the signaling input of the Ekip Signalling 2K1 module to activate the dual setting feature and switch between the Set A and Set B programming parameters. Select "Ekip Signalling 2K1" in the menu in the left hand column and set the "INPUT 1 01" to "Active Closed".

7. The next step is to program the signaling input of the Ekip Signalling 2K1 module to activate the dual setting feature and switch between the Set A and Set B programming parameters. Select "Ekip Signalling 2K1" in the menu in the left hand column and set the "INPUT 1 01" to "Active Closed".

9 🚦	Ekip T					
9	E	kip Touch CB TagName @ 3	EKIP Signa	Ekip Signalling ZK-1		
		Information				
		Status				
		Warning/Alarms	INFORMATI	ON		
		Trips	Serial Numb	er 352035218990w010		
		Measures Menu	SW version	01.68		
		Measures		01.00		
		Other Measures	Dest version	00.01		
		CB Statistics	Boot version	04.01		
		Unit configuration	074710			
		Protection Parameters	STATUS			
		Settings A	Input I 11	Off		
		Other Settings A	Input I 12	Off		
		Settings B	Output O 11	Open		
		Other Settings B	Output O 12	Open		
		Modules				
		Ekip Signalling 2K-1	INPUT I 11			
	9	Programmable Status and Outputs	Polarity	Active Closed Active Closed		
		Programmable Status	Delew			
		Outputs	Delay	0.10 S 0.10 S		
		Functions				
		Measures History	INPUT I 12			
		Trip History	Polarity	Active Closed Active Closed		
		Events log	Delay	0.10 s 0.10 s		
		B.L.L				

8. The next step is to program the O 01 output relay contact, select "Ekip Signalling 2K1" in the left hand column and set the "Contact Type" to "Normally Open", and the "Signal Source" to "Custom" by clicking the three dots next to the white square.

Ekip Signalling 2K-1				
INFORMATION		OUTPUT O 11		_
Serial Number	352035218990w010	Contact Type	Normally Oper Normally Open	\checkmark
SW version	01.68	Latched	OFF OFF	\sim
HW version	00.01	Signal Source	None None	
Boot version	04.01	Delay	0.00 s 0.00 s	
STATUS		min Activation Time	0 ms 0	~

9. Once the three dots are clicked the "Simple trigger" window opens and from the "Trigger type" dropdown choose "custom". Next from the "Events group:" dropdown choose "Ekip Signalling 2K + Local I/O H" and in the "Events:" list below click "Ekip Signalling 2K Input 1" until the corresponding "X" becomes a "1". Click "Apply" and "OK" to close the window.

🕴 Simple trigg	jer		×
Trigger type:	Custom		
Custom trigger			
Events group:	Ekip Signalling 2K outp	ut H	•
Events:	Ekip Signalling 2K 3.1 Ekip Signalling 2K 3.2 Not used Not used Not used Not used Not used Not used Not used		1 X X X X X X X X X X X
Ekip Signalling 28	(output H		
Ekip Signalling 2K m	odule output status.		
Register value:	0xB401		Apply
		ОК	Cancel

Ekip Signalling 2K-1

INFORMATION		OUTPUT O 11		
Serial Number	352035218990w010	Contact Type	Normally Open Normally Open	~
SW version	01.68	Latched	OFF OFF	~
HW version	00.01	Signal Source	Custom: 0xB401 Custom: 0xB401	
Boot version	04.01	Delay	0.00 s 0.00 s	
STATUS		min Activation Time	0 ms 0	~

10. Now click on "Submit" to make the changes effective.



11. Next choose "Functions" in the left hand column and under "Switch to Set B" change the "Function" to "trigger type" "Ekip Signalling 2K1 input 1". Do this by clicking on the three dots next to the white box corresponding to the "Function" option and the "Simple trigger" window will pop up.

	Ekip T8	₩P	Europhiana.			
۵	🔳 Eki	p Touch CB TagName @ 3	Functions			
		Information				
		Status				
		Warning/Alarms	EXTERNAL TRIP			
		Trips	Function	Disabled	Disabled	
	Ð	Measures Menu	Delay	0.00 c	0.00 c	
		Measures	Delay	0.00 5	0.00 5	
		Other Measures				
		CB Statistics	TRIP RESET			_
		Unit configuration	Function	Disabled	Disabled	
		Protection Parameters	Delay	0.00 s	0.00 s	
		Settings A				
		Other Settings A	SWITCH ON SET B			
		Other Settings B		Ekip Signalling 2k1		
		Modules	Function	Input 1	Ekip Signalling 2k1 Inp	•
		Fkin Signalling 2K-1	Delay	0.00 s	0.00 s ···	-
	(1)	Programmable Status and Outputs				
		Programmable Status	SWITCH ON LOCAL			
		Outputs	Function	Disabled	Dischied	-
		Functions	Function	Disableu	Disabled	
		Measures History	Delay	0.00 s	0.00 s	
		Trip History				

12. Next choose the "trigger type" "Ekip Signalling 2K1 input 1" from the drop down then click "Apply" and "OK" to close the window.

🗲 Simple trig	iger		×
Trigger type:	Ekip Signalling 2k1 Ir	nput 1	•
			X X X X X X X X X X X X X X X X X X X X
Global status info	rmation (summary).		
Register value:	0x0005		Apply
		ОК	Cancel

13. Next choose the time delay wanted once the maintenance switch is turned on.

SWITCH ON SET B		
Function	Ekip Signalling 2k1 Input 1	Ekip Signalling 2k1 Inr
Delay	0.00 s	0.05 s

14. Now click on "Submit" to save your changes



3.6 Dual Setting verification

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 The default protective parameter set is "Set A", when the maintenance switch is put into the maintenance position it will supply 24 Vdc to the digital input of the signaling module and this will cause the protective parameter set to change to "Set B". The display of the trip unit will indicate if Set A is active or Set B by the presence of this symbol.

if the **Dual Set** function is enabled (see the **Setting** menu), the letter identifies the active configuration.

You can also verify this by looking for the "Set B ON" message, in the "Event Log"

🕘 📒 Ekip	Programming						
۵ 🔺	Ekip Touch -QF8 @ 3						
	Information	Events log					
	Status						
	Warning/Alarms						
	Trips						
۲	Measures Menu	Event type	Date	Time			
	Measures	Set B On	31.12.1999	00:47:05 408			
	Other Measures	Par changed by Test Bus	31.12.1999	00:47:05 404			
	CB Statistics	Par changed by Test Bus	31.12.1999	00:24:28 578			
	Unit configuration	Par changed by Test Bus	31. 12. 1999	00:15:56 013			
۵	Protection Parameters	L3 Sensor Disconnected	31.12.1999	00:00:01 102			
	Settings A	L2 Sensor Disconnected	31.12.1999	00:00:01 102			
	Other Settings A	L1 Sensor Disconnected	31.12.1999	00:00:01 102			
	Settings B	Battery Low On	31.12.1999	00:00:00 617			
	Other Settings B	Supply from Test Conn On	31, 12, 1999	00:00:00 137			
9	Modules	Trip Coil Disconnected	31, 12, 1999	00:00:00 118			
	Ekip Signalling 4K	configuration Error	31, 12, 1999	00.00.00 028			
9	Programmable Status and Outputs	Invalid Date Warning On	31 12 1999	00.00.00 028			
	Programmable Status	Voltare Medule Present	21 12 1000	00:00:00 020			
	Functions	Voltage Module Present	31.12.1999	00:00:00 028			
	Measures History	Ekip Signalling 4k Present	31.12.1999	00:00:00 028			
	Trin History	CB Status Undefined	31.12.1999	00:00:00 028			
	Events log						

 The signaling module digital input can be checked to see if it is active by checking the "Ekip Signalling 2K1" in the left hand column. Under "INPUT STATUS" it will show input I 01 as "ON" when the "maintenance switch" is in the maintenance position.

Ekip Signalling 2K-1	
STATUS	
Input I 11	On
Input I 12	Off
Output O 11	Open
Output O 12	Open

3. The signaling module will have a green "Power" LED illuminated and a green LED to indicate the status of the input relay contacts. To verify if everything is working correctly check to see if the green "Power" LED and the green "I 01" LED are illuminated when in maintenance mode.

4 Protection Benefits

The "maintenance switch" is a simple and effective way to reduce the potential arc flash energy present when workers are in the vicinity of the electrical equipment; this creates a safer work environment and can also reduce the PPE requirements. This method can be implemented with a small amount of wiring and additional parts making it a cost effective option.

⁵ Table 1 – 2I protections effect on Personal Protective Equipment (Switchgear, 24 inch boundary, Grounded, 480V system)

Second I	Arcing Current (kA)	Clearing Time (ms)	Incident Energy (cal/cm ²)	Hazard Risk Category	PPE Required
Without 2I	30	190	13.1	3	Cotton underclothing plus FR shirt, pants, overalls or equivalent
With 2I	30	30	2.2	1	Flame Retardant (FR) shirt and pants

⁵ ABB, Inc,. (2009). Arc flash hazards. Wichita Falls, TX USA: ABB. Retrieved from https://library.e.abb.com/public/2b5f3d9051ccdd76852576ac006dc16b/1SXU21020 4G0201.pdf

4.1 2I Benefits Summary

Table 1 indicates that with 2I protection activated, prior to maintenance, the amount of arc flash energy released during arc fault is significantly reduced. This reduces the risk of injury to the person performing maintenance on the energized equipment because the risk level is reduced by 2. Consequently, less PPE is required which further reduces the risk of injury do to mistakes caused by the oversized equipment necessary at the higher Hazard Risk Category (HRC). Less PPE also means less money needs to be spent on PPE. Furthermore, money can be saved because 2I protection is integrated into the trip unit. This eliminates the need for an additional component to provide this protection. If implemented correctly, 2I protection is a simple solution that can provide safety, convenience and cost savings.

The different HRC and PPE levels can be viewed in the NFPA 70E: Standard for Electrical Safety in the Workplace.

Time current curve - Set A

Fault current lk= 48.11kA

Load current Ib= 23.30kA

I: off



Time current curve - Set B



L: I1: 0.85 t1: 3s S: t=const I2: 1.5 t2: 0.05s Fault current Ik= 48.11kA Load current Ib= 23.30kA I: off

4 Protection Benefits

⁶ Table 2 – Summary of Time-Current Selectivity Calculations v Dual Setting Protection Calculations

Summary table

	Time-current selectivity	Dual setting
Flash Protection Boundary	1.29 m	0.77 m
Arc Incident Energy	8.83 cal/cm ²	3.15 cal/cm ²
PPE Category	3	1
Additional wiring	NO	NO
Notes	long trip times for multi-tiered selectivity chains	switching from set A to set B can be automatic and/or remotely operated

⁶ ABB, Inc,. (2009). Arc flash hazards. Wichita Falls, TX USA: ABB. Retrieved from https://library.e.abb.com/public/2b5f3d9051ccdd76852576ac006dc16b/1SXU21020 4G0201.pdf

4.2 Dual Setting Benefits Summary

The above example shows how the two parameter sets A and B can be adjusted so that set A can be used under normal conditions to achieve selective coordination and set B when maintenance operations are carried out on the switchgear to insure a fast trip time under fault conditions.

Set A allows time-current selectivity, whereas Set B adopts the minimum setting values of the protection functions L and S and allows the above calculation.

In this example the flash protection

boundary, arc incident energy, and PPE category are all reduced when switching from set A to set B. While not applicable to every system, this shows that dual setting can be used to reduce the risk of injury to personnel while working on an active system.

Dual settings is a flexible solution which can help its users mitigate Arc flash hazard risks but also can be used to maintain selective coordination within a system.

The different HRC and PPE levels can be viewed in the NFPA 70E: Standard for Electrical Safety in the Workplace.

5 Equipment Selection

5.1 Circuit Breaker

ABB SACE Emax 2 equipped with one of the following trip units:

For "Second I":

- All Ekip Touch, or
- All Ekip HI-Touch,

For Dual settings:

- All Ekip HI-Touch

5. 2 Circuit Breaker Accessories

For "Second I" and "Dual Settings":

Ekip modules	US ordering code	Global ordering code
Ekip Signalling 2k module	ZEA2K1	1SDA074167R1
Ekip Supply module	ZEAPWRS	1SDA074172R1
Ekip Test & Programming module	ZEAEKPTP	1SDA066989R1

5. 3 Additional Accessories

To complete the installation of the energy-reducing "maintenance switch" function we will need the following:

For "Second I" and "Dual Settings":

Accessory parts	US ordering code	Global ordering code
Timer with adjustable time delays from 0.05 sec. to 300 hrs. in 10 ranges, and 24-48 VDC, 24-240 VAC rated control supply voltage, and control input, and 2 SPDT (c/o) output contacts	1SVR730040R3300	1SVR730040R3300
Blue pilot light 110-130 VAC/DC	ML1-20L10L13	1SFA616920R8005 1SFA616921R2144 1SFA611605R1200 1SFA611400R1004
2 position selector switch with long BEZEL NO+NC (22mm)	M2SS4-40B11	1SFA611203R1006 1SFA611605R1111
Alternative: 2 position key operated selector switch NO+NC (22mm)	M2SSK1-40111	1SFA611280R1001 1SFA611610R1010 1SFA611605R1101
Custom aluminum engraved nameplate for pilot light; use product selector page 7.129 for ordering o Line 1: MAINTENANCE o Line 2: MODE ON o Line 3: WHEN LIT	MP-NPE29-01	SK615541-1 (Custom engraving)
Custom aluminum engraved nameplate for selector switch; use product selector page 7.129 for ordering o Line 1: MAINT. MODE o Line 2: OFF o Line 3: ON (Custom Engraving)	MP-NPE29-02	SK615541-1

- Free Ekip Connect Software - can be downloaded here

- Customer supplied laptop with Microsoft Windows Operating System

Contact us

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