



Siemens Energy & Automation White Paper

**Short Circuit Current Ratings (SCCR) for Industrial Control
Panels**

NEC®¹ Article 409 and Changes to UL 508A

Updated: March 8, 2007

¹ NEC is a registered trademark of the National Fire Protection Association

Introduction

Article 409 on Industrial Control Panels was added to the NEC in the 2005 edition. This Article requires all Industrial Control Panels to be marked with a Short Circuit Current Rating. The Short Circuit Current Rating (SCCR) requirements for UL 508A took effect in April 2006. These changes impact control panel builders, OEMs and end users in numerous ways:

- How customers select power circuit components for a control panel.
- How customers specify preferred manufacturers.
- How control panel manufacturers design and mark their panels.
- How customers install and modify control panels.

Siemens is committed to supplying our customers best in class products and services. Siemens has put together a comprehensive list of our device ratings and combination ratings to allow our customers to comply with NEC Article 409 and the changes in the UL 508A standard.

This document will provide the following:

- **Overview of Code Changes in NEC Article 409**
- **Overview of Supplement SB from UL 508A**
- **SCCR Control Panel Calculation Examples**
- **Process Flow Charts**
 - **Determination of the SCCR of a Component**
 - **Determination of the SCCR with Current Limiting Feeder Components**
 - **Determination of the SCCR of the Control Panel**

Overview of Code Changes in NEC Article 409

The **NFPA 70: National Electrical Code**² includes **Article 409** on the Construction of Industrial Control Panels operating at 600 volts or less.

Section 409.2 defines an Industrial Control Panel as:

An assembly of a systematic and standard arrangement of two or more components such as motor controllers, overload relays, fused disconnect switches, and circuit breakers and related control devices such as pushbutton stations, selector switches, timers, switches, control relays, and the like with associated wiring, terminal blocks, pilot lights, and similar components. The industrial control panel does not include the controlled equipment.

Section 409.110 requires a Short Circuit Current Rating (SCCR) to be marked on an Industrial Control Panel. It notes the rating is to be based on the rating of a listed and labeled assembly or using an approved method to establish the rating. It also includes a Fine Print Note (FPN) reference to UL 508A Supplement SB as an example of an approved method for determining the SCCR that can be marked on the panel.

² National Electrical Code is a registered trademark of the National Fire Protection Association

Overview of Supplement SB from UL 508A

UL508A is the safety standard for Industrial Control Panels.

NEC Article 409 references UL508A Supplement SB as an approved method for determining the SCCR of an Industrial Control Panel. The specific method is outlined in Section SB4.

The SCCR of the Control Panel is based on the SCCR of each component in the Power Circuit. Paragraph SB4.2.1 and Table SB4.1 list the following components as part of the Power Circuit:

- disconnect switches
- branch circuit protective devices
- branch circuit fuseholders
- load controllers
- motor overload relays
- meter socket base
- miniature or miscellaneous fuse
- supplementary protectors
- bus bars
- current meters
- current shunt
- switch unit
- receptacles
- terminal or power distribution blocks

Paragraph SB3.2.1 states that the primary short circuit protective device for the Control Circuit is also included in the calculation for the SCCR for the Power Circuit. Therefore, the SCCR of the overcurrent protective device (ex: Supplementary Protector or set of Fuses) used on the primary side of a Control Power Transformer **are** included in the determination of the SCCR of the Control Panel. Control Circuit Components downstream of these devices would **not** be included in the calculation of the SCCR.

The basic steps for developing a SCCR for the Control Panel are:

SB4.2 – Determine the short circuit current ratings (SCCR) of individual **power circuit components** using three possible methods.

- 1) from device markings or component instruction sheets

Most Siemens Power Control and Circuit Protection components include a standard short circuit rating on the front or side label. Example of a 3RT1045 contactor label:

IEC / EN 60947-4-1 Ic AC-1: 120 A Ue: 1000 V		LISTED 188C INC. CONT. EQ.	
Ue (V)	230 400/500	V AC	200 230 460 525
P AC-3 (kW)	22 37 55	1 PH, HP	15 15 -
AC-3 (A)	80 100 158	3 PH, HP	25 30 60 75
SQPD		BREAK ALL LINES	
Ue	400 V 50V10 60V5 65V6T	105 A 600 V AC	
Ig	50 kA 100 kA 100 kA	SHORT CIRCUIT 10 KA, 600 V	
Type 1	75 A 250 A 250 A	MAX. DIS. FUSE C10-300 A	
Type 2	75 A 160 A 125 A	75°C CU WIRE ONLY	
JEM AC3.1.0-0		TERMINAL KIT: 3RT1946-4G	
		TORQUE: 36..53 LB.IN 4..8 Nm	
		C/ 051125 * E05 *	

SHORT CIRCUIT 10KA, 600V

Exception: Siemens General Purpose Drives have short circuit current ratings published in the instruction manual. This fully meets the requirements of NEC article 409 and UL intentions in our construction file - E121068 (frame size A-C) and E192450 (frame size D-GX). In addition, when a drive is protected with fuses, circuit breaker, or self protected combination motor controller, the short circuit rating of the drive matches that of the protective device ahead of it.

- 2) or from the assumed short circuit current rating from table SB4.1 titled *Assumed maximum short circuit current rating for unmarked components* (excerpt below)

Component	Short circuit current rating, kA
Bus bars	10
Circuit breaker (including GFCI type)	5
Current meters	a
Current shunt	10
Fuseholder	10
Industrial control equipment:	
a. Auxiliary devices (overload relay)	5

- 3) or by testing a combination of components per UL508

Siemens has information on our Controls website and the UL 508A website that provides UL508 combination testing for NEMA, IEC and Solid State Soft Starter components used in conjunction with Circuit Breakers and Fuses. This testing provides a higher SCCR than the individual component ratings.

www.sea.siemens.com/Controls/SCCR

<http://www.ul.com/controlsequipment/shortcircuit.html>

Example of IEC Contactor/Overload/Circuit Breaker high short circuit ratings from the available summary tables:

ID Number	Combination Type	Individual Component							Combination SCGR							
		Type	Manufacturer	Catalog Designation	Ratings			kA	Volts	Ph	MAX HP	MAX NEC FLC	Min. Enclosure Vol. (cu ft)	Conditions of Acceptability	Combination UL File	Enclosure Vol. (cu in)
					Overload Current Rating	Relay Current Rating	Circuit Breaker Current Rating									
SE&A ITCR2006100	D	ICB	Siemens	ED63A	-	-	See Below	200	3	-	-	-	-	-	E43399 Vol. 1 Sec. 6	2395
		MC	Siemens	3RT1026	10	25	-	200	3	-	-	-	-	-		
		CLR	Siemens	3RB102, 3RU112	5	na	30	200	3	100	200	3	5	17.5		
SE&A ITCR2006101	D	ICB	Siemens	ED63A	-	-	See Below	200	3	-	-	-	-	E43399 Vol. 1 Sec. 6	2395	
		MC	Siemens	3RT1026	10	25	-	200	3	-	-	-	-			-
		CLR	Siemens	3RB102, 3RU112	5	na	30	200	3	100	200	3	5			16.7
SE&A ITCR2006102	D	ICB	Siemens	ED63A	-	-	See Below	240	3	-	-	-	-	E43399 Vol. 1 Sec. 6	2395	
		MC	Siemens	3RT1026	10	22	-	240	3	-	-	-	-			-
		CLR	Siemens	3RB102, 3RU112	5	na	30	240	3	100	240	3	5			15.2

Note: When a drive is protected with fuses, circuit breaker, or self protected combination motor controller, the short circuit rating of the drive matches that of the protective device ahead of it.

SB4.3 – modify the available short circuit current based on let-through values when using current limiting devices in the feeder circuit

- Example 1: **Standard Breaker**
 - ED63B100 100A **25 kA @480V**
 - All components downstream have a rating of at least **25 kA**
 - Panel SCCR = **25 kA**

- Example 2: **Current Limiting Breaker**
 - CED63B100 100A 200 kA @480V
 - At **100 kA** the CED63 has a peak let through current of **22 kA**
 - All components downstream have a rating of at least **25 kA**
 - All components have a SCCR higher than 22 kA
 - Panel SCCR = **100 kA**

The graph shows the relationship between available short-circuit current and peak let-through current for ED-Frame Type CED6 breakers. The x-axis represents Available Short Circuit Current (RMS Symmetrical Amperes x 10³) on a logarithmic scale from 1 to 300. The y-axis represents Peak Let-Thru Current (kA) on a logarithmic scale from 1 to 100. A solid line represents the peak let-through current, and a dashed line represents the maximum available symmetrical peak current. Key points are marked for 480 VAC, 240 VAC, and 120 VAC. A horizontal red line is drawn at 22 kA, and a vertical red line is drawn at 100 kA, intersecting the peak let-through curve.

Siemens offers a full line of Current Limiting Circuit Breakers. Refer to the Circuit Protection web page for links to Information and Instruction Guides that provide specific let-through current values for Siemens Type CED6, CFD6, CJD6, CLD6, CMD6, CND6, and CPD6 Current Limiting Circuit Breakers.

http://automation.usa.siemens.com/power/product/circuit_breakers.html

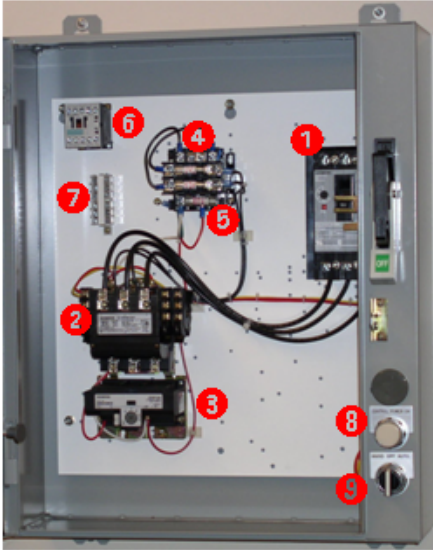
For **fuse** information, reference Table SB4.2 titled *Peak let through currents, I_p, and clearing, I_{2t}, for fuses.*

SB4.4 – Determine the SCCR for the control panel which is limited to the lowest value of a component or circuit from SB4.2 or SB4.3.

This will be reviewed through the series of examples that follow.

The manufacturer of the Control Panel also has the option of submitting their completed panel to UL for testing at a higher short circuit rating than provided by the component manufacturers.

SCCR Control Panel Calculation Examples



This panel includes the following components

<u>Power Circuit</u>		<u>Catalog #</u>
①	Circuit Breaker	ED63B050
②	Contactor	40FP32AA
③	Overload Relay	48BSH3M10
④	Fuses on primary of the CPT	CC Fuses
<u>Control Circuit</u>		<u>Catalog #</u>
⑤	Control Power Transformer (CPT)	MT0050A
⑥	Control Relay	3RH1122-1AK61
⑦	Terminal Blocks	8WA1011-0DF21
⑧	Pilot Light	52PC4E2
⑨	Hand-Off-Auto	52SA2CABA1

The components listed under Control Circuit do not need to be included in the calculation of the SCCR of the Control Panel.

Example 1A: The first calculation will be based on SB4.2 and reviewing the individual SCCR values marked on the components or found in the list for unmarked components.

The individual SCCRs for each of the Power Circuit Components are as follows:

	<u>Power Circuit</u>	<u>Catalog #</u>	<u>SCCR @ 480V</u>
①	Circuit Breaker	ED63B050	25 kA
②	Contactor	40FP32AA	5 kA
③	Overload Relay	48BSH3M10	5 kA
④	Fuses on primary of the CPT	CC Fuses	200 kA

Both the contactor and the overload relay have a 5 kA rating @ 480V. If no additional information is available, this Control Panel would be marked with a SCCR of 5 kA @ 480VAC.

Example 1B: The second calculation will be based on SB4.2 and reviewing manufacturer information for tested combinations with higher short circuit current ratings.

A review of the Siemens UL508 Combination Testing Tables shows that Siemens has tested this Circuit Breaker/Contactor/Overload Relay combination to 100 kA @ 480V. This UL testing can be referenced when determining the SCCR of the panel.

NOTE A: For Combinations using current transformers, the current transformer must be provided as specified on the installation instructions for the overload relay.

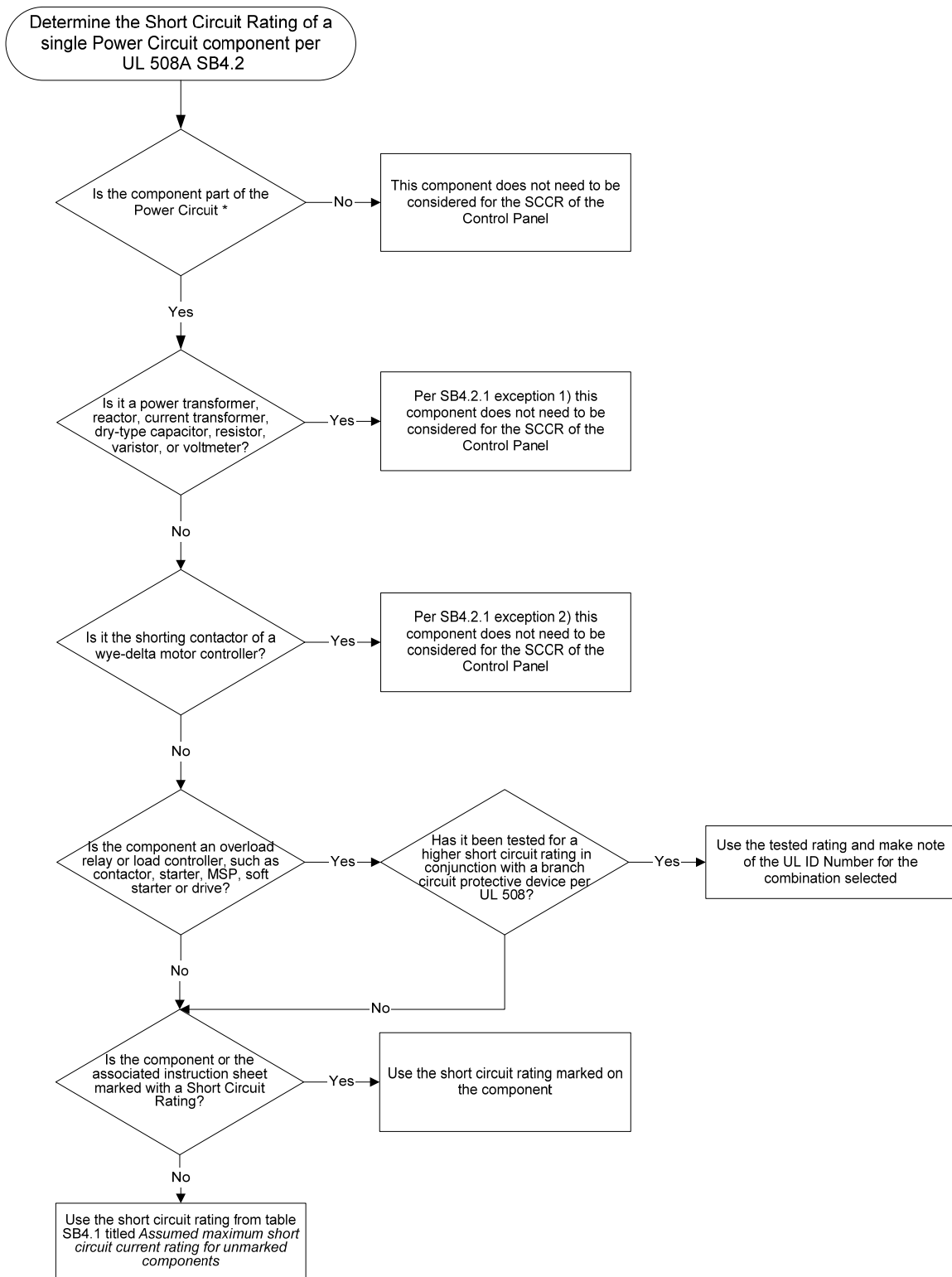
ID Number	Combination Type	Individual Component				Ratings		Combination SCCR										
		Type	Manufacturer	Catalog Designation	kA	Volts	Poles	kA	Volts	Ph	MAX HP	MAX NEC FLC	Min. Enclosure Vol (cu ft)	Conditions of Acceptability	Combination UL File	Enclosure Vol (cu in)		
SE&A CTR2006055	C	CB	Siemens	ED63B	25	-	See Below	480	3	100	480	3	25	34	1.38	1, 3 (For 480C3)	E43399 Vol. 1 Sec. 6	2385
		MC	Siemens	40FP32A	5	50	-	480	3									
		OLR	Siemens	4BARE, 4BASE	5	9 - 18	20	480	3									
		OLR	Siemens	4BARF, 4BASF	5	13 - 27	30	480	3									
		OLR	Siemens	4BARG, 4BASG	5	20 - 40	40	480	3									
		OLR	Siemens	4BRH, 4BESH	5	22 - 45	50	480	3									
OLR	Siemens	4BGC3	5	60	90	480	3											

<ol style="list-style-type: none"> 1 2 3 4 	<p>Power Circuit Circuit Breaker Contactor Overload Relay Fuses on primary of the CPT</p>)	<p>Catalog # ED63B050 40FP32AA 48BSH3M10 CC Fuses</p>	<p>SCCR @ 480V 100 kA 200 kA</p>	<p>Per UL ID SE&A CTR2006055</p>
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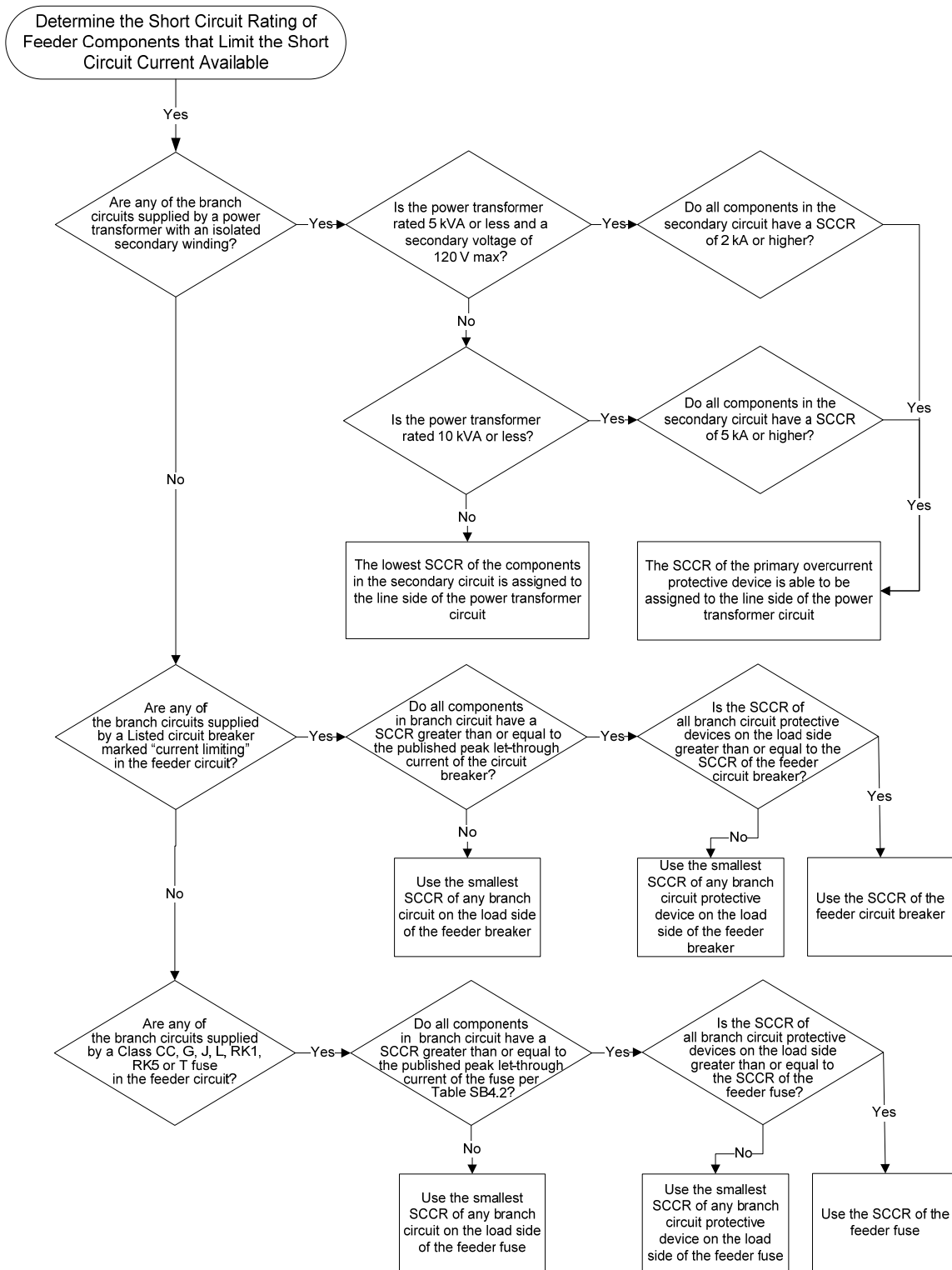
The tested circuit breaker & starter combination has been UL tested for a SCCR of 100 kA @ 480V. The fuses have a SCCR of 200 kA. Since 100 kA is the lowest SCCR rating of any component or combination, this Control Panel would be marked with a SCCR of 100 kA @ 480VAC.

This example shows that it is critical to review Siemens UL tested combinations when determining the SCCR of the control panel. By knowing the tested combination rating, this panel would be marked with a Short Circuit Current Rating of 100 kA @ 480V, instead of 5 kA as shown in Example 1.

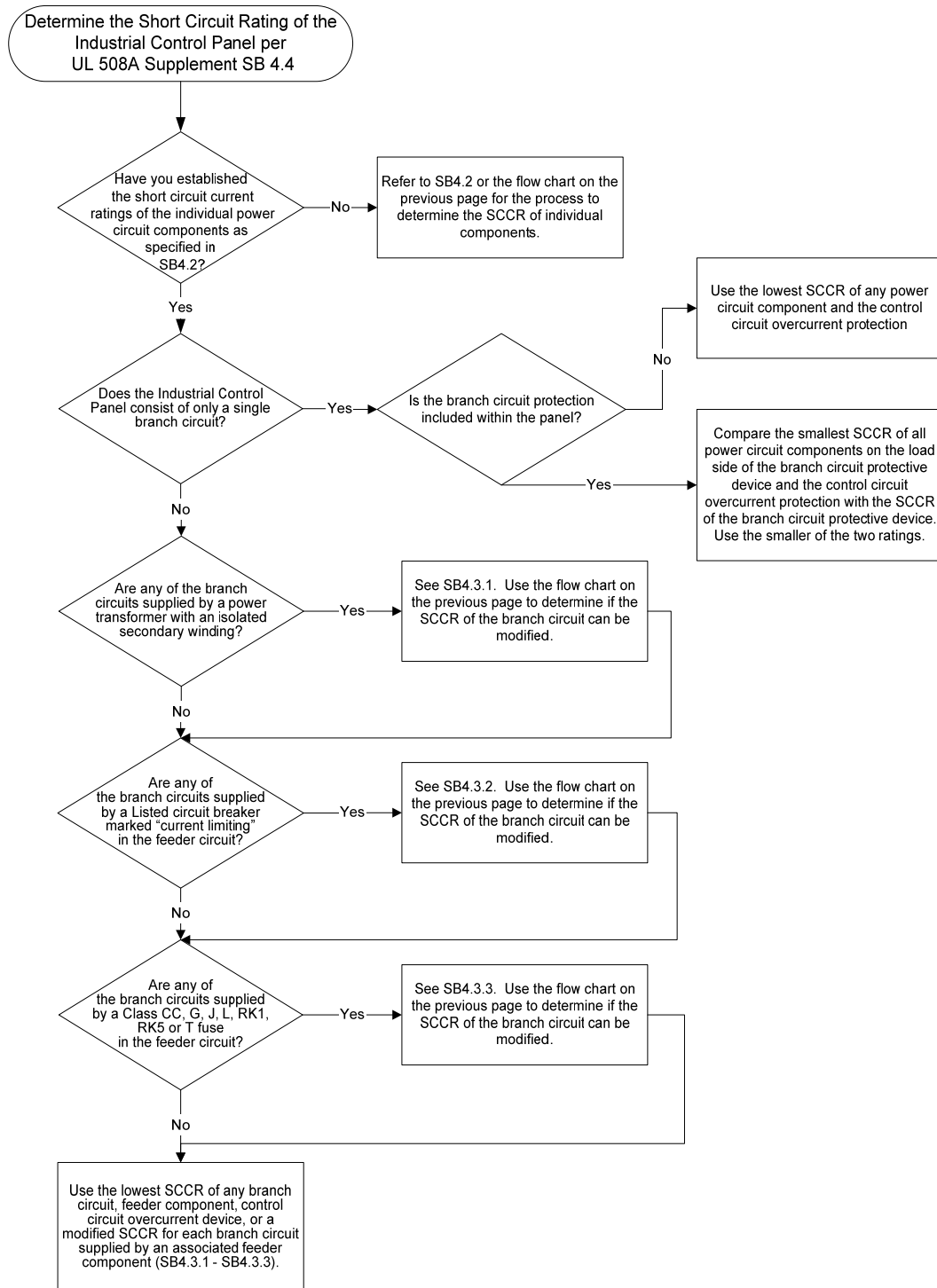
Flow Chart for Determination of the SCCR of a Component (SB4.2)



Flow Chart for Determination of the SCCR with Current Limiting Feeder Components (SB4.3)



Flow Chart for Determination of the SCCR of the Control Panel (SB4.4)



Go to the Siemens Resource Center for up-to-date information

<http://www.sea.siemens.com/controls/sccr>

In April 2006, the Short Circuit Current Rating (SCCR) requirements of NEC 409 went into effect. These changes have impacted you, our customer. You now need to consider how you select power circuit components for your control panels, how you determine your preferred manufacturers for power components and how you design and install your industrial control panels. Siemens is committed to supplying our customers with best in class products and services. With the implementation of NEC Article 409 and the changes to UL 508A, Siemens has put together a comprehensive list of our device ratings and combination ratings.

Click [here](#) to download our updated White Paper which provides a step by step explanation of NEC409 SCCR requirements and gives numerous examples for determining your SCCR rating for your industrial control panel.

Click [here](#) to download a FAQ document on SCCR and Siemens standard variable frequency drives.

View the links below for the latest information on Siemens SCCRs. If additional information is required, please contact your [local sales office](#).

High Short Circuit Current Ratings for Siemens Control Components and Assemblies

These files are dedicated to high short circuit ratings for Control Panels that incorporate combination motor control components.

[Complete Siemens Controls SCCRs_all data in one file.xls](#)
[IEC Contactors & Overload Relays with Fuses.xls](#)
[IEC Contactors & Overload Relays with Instantaneous Trip Circuit Breakers.xls](#)
[IEC Contactors & Overload Relays with Thermal Magnetic Circuit Breakers.xls](#)
[NEMA Contactors & Overload Relays with Fuses.xls](#)
[NEMA Contactors & Overload Relays with Instantaneous Trip Circuit Breakers.xls](#)
[NEMA Contactors & Overload Relays with Thermal Magnetic Circuit Breakers.xls](#)
[NEMA Starters with Fuses.xls](#)
[NEMA Starters with Instantaneous Trip Circuit Breakers.xls](#)
[NEMA Starters with Thermal Magnetic Circuit Breakers.xls](#)
[Solid State Soft Starters with Fuses.xls](#)
[Solid State Soft Starters with Instantaneous Trip Circuit Breakers.xls](#)
[Solid State Soft Starters with Thermal Magnetic Circuit Breakers.xls](#)

Siemens has provided additional documentation of our product SCCR ratings for your reference.

IEC Contactors, Overload Relays and Motor Starter Protections (MSPs)

[UL File of High SCCRs for IEC Contactors and Starters.pdf](#)
[SIEMENS SCCRs for SIRIUS IEC 020407.xls](#)
[UL Report for Contactors 3RT101.pdf](#)
[UL Report for Contactors 3RT102.pdf](#)
[UL Report for Contactors 3RT103.pdf](#)
[UL Report for Contactors 3RT104.pdf](#)
[UL Report for MSP 3RV102 Manual and Group.pdf](#)
[UL Report for MSP 3RV1021 Type E Combo.pdf](#)
[UL Report for MSP 3RV103 Manual and Group.pdf](#)
[UL Report for MSP 3RV1031 Type E Combo.pdf](#)
[UL Report for MSP 3RV104 Manual and Group.pdf](#)
[UL Report for MSP 3RV1041 Type E Combo.pdf](#)
[UL Report for MSP Contactor Combinations 3RA.pdf](#)

Definite Purpose Controls

[UL Report Definite Purpose Contactors Class 42 & Class 45.pdf](#)

NEMA Controls

[SCCR Summary for NEMA Controls.pdf](#)

[UL File of High SCCRs for NEMA Contactors and Starters.pdf](#)

Lighting Controls

[LEN Ratings.pdf](#)

[SIEMENS SCCRs for LEN Lighting Contactors.pdf](#)

UL Website for Short Circuit Current Ratings

UL has developed a website dedicated to Short Circuit Current Ratings of Industrial Control Panels Incorporating Combination Motor Controller Components. This site includes the appropriate Siemens SCCR information.

<http://www.ul.com/control/equipment/shortcircuit.html>

Codes and Standards Information Websites

[IEEE \(Institute of Electrical and Electronic Engineers\)](#)

[UL 508A \(Underwriters Laboratories panel builder information\)](#)

[ANSI \(American National Standards Institute\)](#)

[NFPA \(National Fire Protection Association\)](#)

[OSHA \(Occupational Safety and Health Administration\)](#)