



CROSS Chassis
from 160 A to 450 A



Important note!

The technical data enclosed is for general information. Please note that the operating instructions and references indicated on the products are for installation, operation and maintenance.

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Person to contact



System Transfer Switches

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CROSS Chassis Complete Reliability On-line Static Switch from 160 A to 450 A

Scope	2
System Description	2
Protection and Control Functions	4
Monitoring, Control and Communication	5
Technical Data	7
Options	9

1. Scope

This specification describes the CROSS Chassis series of static switches and presents their electrical and mechanical features.

1.1 The system

CROSS Chassis shall ensure redundant power to critical loads by providing the ability to switch between two independent alternative power sources. Switching will occur whenever the line supplying the load no longer falls within the acceptable (user definable) tolerance values.

The user will be able to set the operating mode of CROSS Chassis. When functioning in *Fixed Priority Mode* the user will select the preferred input line and CROSS Chassis will transfer to the priority line whenever its parameters fall within acceptable values. When functioning in *No Priority Mode* CROSS Chassis will treat both lines as equally acceptable (provided their parameters are both within the set tolerance values) and will therefore attempt no re-transfer back to a preferential source. CROSS Chassis will function so that the transfer between the two sources will be *break before make*, thus ensuring that the two sources will never be directly connected in parallel.

CROSS Chassis will ensure switching between independent AC power sources in both synchronous and asynchronous conditions. When the two lines are synchronous CROSS Chassis will transfer between the sources within 5 ms following a line failure. In asynchronous conditions transfer will occur within 5 ms and will follow a delay time (ranging from 0 to 1000 milliseconds) settable by the user. The acceptable phase angle difference between the two lines for synchronous transfers will be within a 30° range and selectable by the user (default value 10°). In order to maximise reliability CROSS Chassis control logic will be highly redundant and minimise the use of

common components. Also for top reliability, CROSS Chassis will rely on natural cooling and will therefore not require fans. CROSS Chassis shall be intended for complete integration with the customer's Power distribution Units (PDU) and will therefore not include switches. CROSS Chassis will be provided with inputs for the auxiliary contacts of the external switching devices. CROSS Chassis may only operate if inserted into a PDU.

1.2 Models available

CROSS Chassis shall include models with three-phase input and three-phase output as specified in the following table:

MODEL	Current (A)	Input	Output	poles
CROSS Chassis 160	160	Three-phase	Three-phase	4
CROSS Chassis 250	250	Three-phase	Three-phase	4
CROSS Chassis 450	450	Three-phase	Three-phase	4

Nominal currents are intended as continuous and may apply to any non linear load.

The 4-pole version of CROSS Chassis is configured so that the Neutral conductor can also be switched. This ability means that the sources can be separated completely during normal operation. Furthermore, the switching of the neutral can be programmed to be Make Before Break or Break Before Make type depending on specific installation conditions.

2. System Description

CROSS Chassis is the result of an innovative Research and Development programme designed to offer the most reliable power supply at minimum cost.

2.1 Microprocessor control and diagnostics

Operation and control of CROSS Chassis shall be provided through the use of microprocessor controlled logic. The coloured LED on the front panel of CROSS Chassis shall provide a simple and immediate indication of the operational state of the system. Indications, measurements and alarms together with event logging shall be shown on an LCD display. For a more detailed and complete description on local diagnostics, see section 4.4.

2.2 Modes of Operation

The operating mode of CROSS Chassis will be selected by the Priority pushbutton

P on the control panel of the unit (see section 4.3). To ensure safe operation both pushbutton P and T (manual Transfer button) will have to be enabled from the LCD display. CROSS Chassis will be able to operate in the following operating modes:

2.2.1 Fixed Priority Mode

When operating in *Fixed Priority Mode* CROSS Chassis will attribute a priority to one of the two sources. The priority source will be selected from the front panel by pressing pushbutton P for 2 seconds. The selected source will be indicated by the corresponding LED (S1 or S2). The selected priority source will continuously supply the load provided it stays within the tolerance windows. Failure of the priority source or an external command will cause transfer of the load to the reserve (low priority) source.

When the priority line returns within the acceptable tolerance window the load will automatically be transferred back to the priority line following a delay time – re-transfer time – set by the user. In the event of both sources falling outside the acceptable tolerance windows defined by the normal limit parameters, CROSS Chassis will transfer to the source which remains within the acceptable window defined by the critical limit parameters. In the event of both sources falling outside the critical limit parameters CROSS Chassis will stop supplying the load.

2.2.2 No Priority Mode

When operating in *No Priority Mode* CROSS Chassis will treat both sources as equally acceptable and will therefore supply the load from whichever source last complied with the tolerance parameters.

2. System Description

This operating mode will be selected from pushbutton P and will be indicated by the simultaneous lighting of LED S1 and S2. If the load is supplied from source S1 and if this source fails to comply with the acceptable tolerance values CROSS Chassis will transfer the load to source S2. The load will stay on this line and will not attempt to return to S1 even when it returns to the appropriate values. The load will switch back to S1 only if source S2 fails. In the event of both sources falling outside the acceptable tolerance windows defined by the normal limit parameters, CROSS Chassis will transfer to the source which remains within the acceptable window defined by the critical limit parameters. In the event of both sources falling outside the critical limit parameters CROSS Chassis will stop supplying the load.

2.3 Transfer Modes

CROSS Chassis will switch the supply to the load in the following conditions:

2.3.1 Line Failure Transfer

CROSS Chassis will continuously monitor voltage (RMS and instant value) and frequency values of both source lines and check they stay within the defined tolerance window. If the line supplying the load moves out of the tolerance window CROSS Chassis will automatically transfer the load to the other line. Transfer time will be ≤ 5 msec both for synchronous and asynchronous sources. If the sources are asynchronous the *asynchronous transfer delay time* will define the additional delay after which transfer will occur. During this interval the load will not be supplied. *Asynchronous transfer delay time* will be user defined and range from 0 to 1000 msec. When the source returns to normal CROSS Chassis will re-transfer back to the original source if this corresponds to the priority line and CROSS Chassis is operating in *Fixed Priority Mode*. If CROSS Chassis is operating in *No Priority Mode* there will be no transfer back to the original source.

2.3.2 User Transfer

Transfer pushbutton T on the front panel of CROSS Chassis allows the permanent transfer of the load (assuming the

manual re-transfer timeout parameter is not enabled). The transfer shall occur without an interruption at the output. CROSS Chassis will allow a transfer upon pressing pushbutton T only if the alternative source is within the acceptable tolerance levels and in phase with the line supplying the load. If the alternative source does not have the acceptable voltage and frequency values the transfer command will be aborted. If the two sources are asynchronous, transfer will be delayed until the phase difference falls within the *phase error limit* parameter set by the user. While the two sources are asynchronous and the transfer command is pending the LED indicating priority will both be flashing. If the transfer has not occurred after a time interval defined by the user (*pending command timeout* parameter) the command will be aborted. Following transfer, provided CROSS Chassis is operating in *No Priority Mode*, the load will be kept on the new source while its parameters stay within the acceptable tolerance values. If CROSS Chassis is operating in *Fixed Priority Mode* and the load switches to reserve line this will be highlighted by an alarm (load on reserve line). However there will be no transfer back to the priority line unless the user enables a timeout function (*manual re-transfer timeout* parameter enable) which is present only when operating in *Fixed Priority Mode*. If the function is activated the load will be transferred back to the priority line upon the end of the time setting.

If the operating mode is changed from *Fixed Priority Mode* to *No Priority Mode* while the load is supplied by the reserve line the active alarm signal will stop. If the operating mode is changed from *No Priority Mode* to *Fixed Priority Mode* while the load is supplied by the reserve line the alarm signal will be activated.

It will be possible to transfer the load to a line outside the normal limits but within the critical limits, provided the *override* function is activated. This function is found in the menu provided on the display.

2.3.3 External Command Transfer

It will be possible through the optional customer interface board to activate 4 input failure signals referred to either of the two sources. Depending on the

priority mode selected the signals will be interpreted differently by the control logic of CROSS Chassis. If CROSS Chassis is operating in *Fixed Priority Mode* the possible signals will be: Preferred Source Failure, Reserve Source Failure, Transfer inhibited and Source supply selection. If CROSS Chassis is operating in *No Priority Mode* the possible signals will be: S1 Source Failure, S2 Source Failure, Transfer inhibited and Source supply selection.

Preferred or S1 source failure, Reserve or S2 source failure

If the signal refers to the line supplying the load CROSS Chassis will activate a line failure transfer to the other source. If the signal refers to the line not supplying the load CROSS Chassis will not allow the transfer to this source. When the signal ends the load will transfer back to the priority source if CROSS Chassis is operating in *Fixed Priority Mode*; if CROSS Chassis is operating in *No Priority Mode* there will be no re-transfer.

Source supply selection

Depending on which one of the two modes is selected the command will react as follows: If *Fixed Priority Mode* is selected the command will change the existing priority mode. As soon as the command is disabled the previous priority mode shall be restored. If *No Priority Mode* is selected CROSS Chassis will act as for the manual transfer command (see par. 2.3.2.).

Transfer inhibited

CROSS Chassis will inhibit the transfer between source 1 and 2 and vice versa and will supply the load from the existing source.

2.3.4 Operation Under Output Short Circuit

CROSS Chassis will inhibit transfer whenever an output short circuit is detected, thus avoiding the transfer of the short circuit to the alternative source. The instant short circuit threshold level is user definable. The default setting is 3In. When the current falls below the threshold value and the voltage value is acceptable CROSS Chassis automatically resets and enables transfer. CROSS Chassis internal logic will recognise a short circuit condition at the output and inhibit transfers even if an upstream protection device trips and the current goes to zero.

2. System Description

2.3.5 Operation Under Overload

An overload condition will be recognised whenever the load is above 105% of nominal and an overload alarm will appear on the display. Depending on the overload level a timeout will be activated showing the remaining thermal autonomy. The timeout will be related to the overload levels shown to the right.

$105\% < I_{out} < 125\%$	timeout	10 min.	(overload level 1 timeout)
$125\% < I_{out} < 150\%$	timeout	1 min.	(overload level 2 timeout)
$150\% < I_{out} < 200\%$	timeout	10 sec.	(overload level 3 timeout)
$200\% < I_{out}$	timeout	1 sec.	(overload level 4 timeout)

Once the timeout has expired, an "overload timeout expired" alarm message will be displayed. Power continues nevertheless to be supplied to the load. If the *Overload transfer inhibition enable* parameter is set as YES, CROSS Chassis will inhibit the transfer between the sources.

CROSS Chassis will reset the overload condition as well as the timeout expired condition whenever the output current drops below 100%.

2.3.6 Maintenance by-pass

CROSS Chassis shall have to be fitted with external bypass switches which enable a load transfer to the supply

sources without causing a power interruption to the critical load. The external switching devices (not included with CROSS Chassis) shall have to include mechanical interlocks to ensure that the two bypass switches (one for each line) cannot be simultaneously closed, thus avoiding the direct connection of the two sources. The control logic will ensure that in the event of an accidental closure of the by-pass on the passive line CROSS Chassis will transfer the load so as to avoid a permanent paralleling of the two sources. In the 4-pole version, the external breakers must also guarantee the complete isolation of the neutral of the two sources when in BYPASS mode.

2.3.7 Neutral Switching

The switching of the neutral can be programmed to be either "Make Before Break" (MBB, short neutral overlapping during transfer) or "Break Before Make" (BBM, no neutral overlapping). Also, it is possible to activate a continuous monitoring of the voltage difference between the two neutral conductors. For correct operation and setup of the installation it is important to be aware of how the neutral lines of the two input sources are configured.

3. Protection and Control Functions

3.1 Static Switch Fault detector

CROSS Chassis will be able to diagnose the following SCR fault conditions:

1. Short Circuit SCRs active line
2. Short Circuit SCRs passive line
3. Open Circuit SCRs active line
4. Open Circuit SCRs passive line

Depending on the presence of the external optional tripping coil the system will react differently.

Behaviour in case of SCR in short circuit

Condition 1 will inhibit the transfer on the passive line. If the external tripping

coils are present, this condition will activate the auxiliary contacts on the passive line. Condition 2 will transfer the load on the faulty SCR, and then inhibit further transfers if the external tripping coils are not present. If the tripping coils are present, condition 2 will trip the coils on the passive line and inhibit further transfers.

Behaviour in case of SCR in open circuit on active line

Condition 3 will cause a transfer to the passive line and inhibit further transfers. If the external tripping coils are present, condition 3 will also activate the auxiliary contacts to open the active line.

Behaviour in case of SCR in open circuit on passive line

Condition 4 will inhibit the transfer to the passive line. If the external tripping coils are present, condition 4 also activates the auxiliary contact to open the passive line.

MASTERGUARD CROSS Chassis STS 160 A and 450 A

4. Monitoring, Control and Communication

4.1 General

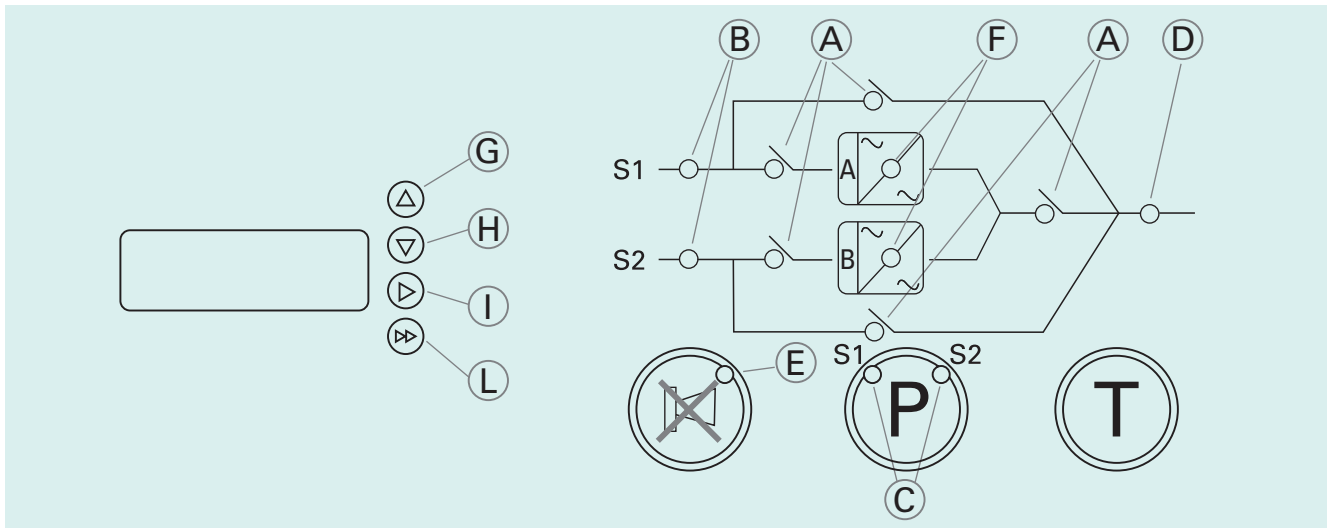
CROSS Chassis shall incorporate the necessary controls, instruments and indicators to allow the operator to monitor the system status and performance, as well as take appropriate actions.

4.2 Mimic panel

The UPS shall have a mimic panel with Light Emitting Diodes (LEDs) to indicate the condition of the subassemblies, see table shown to the right:

Source 1	normal operation	green
Source 2	normal operation	green
Input switch 1	normal operation (closed)	green
Input switch 2	normal operation (closed)	green
By pass switch 1	normal operation (closed)	green
By pass switch 2	normal operation (closed)	green
Output	normal operation (closed)	green
Source 1	alarm	green-off
Source 2	alarm	green-off
Output	alarm/warning	green-flashing

4.3 Control and command pushbuttons



Audible alarm cancel:
This button stops the acoustic alarm. When this button is pressed the red LED starts to flash.



Priority Selection:
Selects operating mode- *Fixed Priority Mode* or *No Priority Mode*.
The push button must be pressed for at least 2 sec.



Transfer:
This button enables the load to be switched from one source to the other. The push button must be pressed for at least 2sec.

In normal conditions the Priority and Transfer pushbuttons are inhibited and may be activated only from the 'manual commands' page using the LCD display. Following the 'manual mode timeout' period the pushbuttons will again be inhibited.

4.4 Display

An LCD display shall be provided to visualise over 50 operating parameters of CROSS Chassis. The messages shall be accessed by pushbuttons. The text shall be available in 6 languages: English, Italian, French, German, Spanish and Portuguese.

By using the appropriate pushbuttons it shall be possible to display the following:



Scroll up



Scroll down



Scroll to the right



Next page

4.4.1 Analogue measurements

- Load Power	- Frequency source 1
- Phase Difference	- Frequency source 2
- Input Voltage Source 1 (U, V, W)	- Output Voltage (U, V, W)
- Input Voltage Source 2 (U, V, W)	- Output Current (U, V, W)
- Voltage difference across the Neutrals	- Output Frequency
- Output Neutral Current	

4. Monitoring, Control and Communication

4.4.2 Messages and alarms

Main menu

System normal	Preferred source S1	CROSS Chassis serial number
System alarm	Preferred source S2	Eprom code
Preferred source failure	Reserve source failure	Sources out of sync
Over/under freq both source	Pref. SCR ovrl.transf. inh.	Pref. SCR ovrl.transf. inh
Transfer inhibited		

S1, S2 Status

Normal running	Out of limit inhibit	Source failure
Shorted static switch	Open static switch	Isolation breaker open
Bypass of source	Overheating	

Output Status

Load on preferred source	Load on reserve line	Load not supplied
Isolation breaker open	Load on reserve	

4.4.3 Events Logging

The events logging function will provide access to the history of CROSS Chassis from the LCD display. This function will memorise and record the timing of status events and alarms. Samples will be taken every 100ms and the last 64 events will be recorded. It will be possible to download the event log file through the local serial port (see 4.5) using a dedicated software interface running on a PC. Please contact MASTERGUARD Technical Support to obtain the software interface.

The connector # 1 shall be wired as follows:

Pin 1 (DCD)	Pin 4 (DTR)	Pin 7 (RTS)
Pin 2 (RXD)	Pin 5 (GND)	Pin 8 (CTS)
Pin 3 (TXD)	Pin 6 (DSR)	Pin 9 (RI)

The connector # 2 shall be wired as follows:

Pin 1 (DCD)	Pin 3 (TXD)	Pin 5 (GND)
Pin 2 (RXD)	Pin 4 (DTR)	

4.6 Volt Free Contacts

CROSS Chassis shall be equipped with a D type 9 pin female connector with the following volt free contacts:

- 1 Preferred Source Failure (S1 source failure in No Priority Mode)
- 2 Reserve Source Failure (S2 source failure in No Priority Mode)
- 3 Sources out of Synchronism
- 4 Overload

4.7 Summary Alarm

A summary alarm contact will be available from a terminal connection.

4.5 RS232C

CROSS Chassis shall be equipped with two D type 9 pin male connectors for connection to computers with RS232C serial communications port.

MASTERGUARD CROSS Chassis STS 160 A and 450 A

5. Technical Data

5.1 CROSS Chassis Data		160	250	450
Nominal input voltage (V)		380-415		
Default (V)		400		
Input voltage tolerance (%)		+30, -40		
Input phases		3 +N		
Nominal frequency (Hz) [selectable]		50/60		
Number of poles		4		
Frequency tolerance (%) (user definable)		± 5		
Nominal Current (A)		160	250	450
Efficiency at In (%)		≥99		
Overload capacity (without fuses)				
For 10 minutes (%)		125		
For 1 minute (%)		150		
For 10 seconds (%)		200		
For 1 second (A)		5300		
SCR Characteristics				
$I^2T @ T_{vj} = 130^{\circ}C$ (A ² .s)		1125x10 ³		
$I_{TSM} @ T_{vj} = 130^{\circ}C; 8,3...10msec$ (A)		15000		
Transfer Mode (for Phases)		Break-Before- Making Switching (No source overlap)		
Transfer Time				
Source failure (msec)		≤5		
Static Switch Fault detector (Open and Closed SCR)		Yes		
Ventilation		Natural		
Neutral sized		1.7 In		
Cable entry		Bottom		
Dimensions (mm): W		700		
D		600		
H		1200		
Weight (kg)		135	150	160
EMC Compatibility (IEC EN 62040-2)		Class C2		
Protection degree		IP00		
Security*		IEC EN 62040-2		

* guaranteed if used inside a cubicle compliant to safety standards for IEC EN 62040-2

5. Technical Data

5.2 User Setting		160	250	450
Nominal Voltage	(V)	380-415		
Default	(V)	400		
Phase Difference		±30°		
Default		±10°		
Over Voltage Critical Limit (RMS)	(%)	+5,+20		
Default	(%)	+10		
Over Voltage Fatal Limit (RMS)	(%)	+20,+30		
Default	(%)	+20		
Under Voltage Critical Limit (RMS)	(%)	-5,-35		
Default	(%)	-13		
Under Voltage Fatal Limit (RMS)	(%)	-35,-40		
Default	(%)	-35		
Instant Short Circuit Overload Threshold		1 - 5In		
Default		3In		
Asynchronous transfer delay time	(msec)	0 – 1000		
Default	(msec)	10		
Re-Transfer Time	(sec)	5 - 36000		
Default	(sec)	30		
Manual Transfer Timeout Enable		On/Off		
Default		Off		
Manual Transfer Timeout	(min)	1 - 600		
Default	(min)	30		
Neutral Transfer Mode		BBM or MBB		
Default		MBB		
5.3 Ambient Conditions				
Operating temperature	(°C)	0 - 40		
Acoustic noise	(dBA):	<45		

MASTERGUARD CROSS Chassis STS 160 A and 450 A

6. Options

6.1 Remote display

To access information on the operating state of CROSS Chassis, a remote LCD shall be available. See section 4.4 for the messages shown on the LCD. A 30 metre cable fitted with appropriate connectors shall be supplied for connection to the remote display.

6.2 Galvanic isolation (Special option)

This option shall include an isolation transformer housed in a separate cabinet and connected to the output or input of CROSS Chassis. The transformer shall include an electrostatic screen as standard. When this option is included the efficiencies reported in section 5 are no longer valid. The transformer cabinets will have top cable entry and will not include switches. Galvanic isolation downstream from the CROSS can also be provided by third parties in the installation. In this case the inrush currents caused by the transformers must be carefully evaluated and must be compatible with the SCRs. In particular the following items must be thoroughly cared:

- the coordination of the transformer inrush currents with the SCRs or with the optional fuses if installed within CROSS Chassis (see also 6.6) must be ensured
- the magnitude of the inrush currents must be evaluated in the worst operating conditions of the transformer (i.e. asynchronous CROSS commutation with maximum residual magnetization flux in the transformer etc.)
- normal CROSS commutations can cause transformer inrush currents even higher than the first insertion ones (i.e. with residual magnetization flux equal to zero)

Please contact MASTERGUARD Technical Support whenever transformers are used downstream from CROSS Chassis.

6.3 Customer Interface Board

It shall be possible to add to the CROSS Chassis 4 digital input and 4 digital outputs by adding an extra board.

6.4 LIFE.net

This option shall allow the remote monitoring of MASTERGUARD UPS and CROSS Chassis switches through dedicated telephone lines in order to ensure the maximum reliability of the units throughout their operational life. The monitoring shall be a true 24 hour, 365 day service thanks to a unique feature that allows trained Service Engineers to be constantly in contact electronically with the service centre and therefore the UPS and CROSS Chassis switches. The units shall automatically telephone the service centre at defined intervals to provide detailed information that shall be analysed in order to predict near term failures. In addition, it shall be possible to control the unit remotely.

The transmission of data to the MASTERGUARD Service Centre shall take place via modem at the following intervals:

- ROUTINE: typically once a day
- EMERGENCY: when a problem occurs or the parameters are outside the tolerance limits
- MANUAL: following the request of the service centre

During the call the service centre shall:

- Identify the unit connected
- Recognise the type of call
- Request the data stored in the memory of CROSS Chassis during the time interval since the last connection
- Request real time information from the unit (selectable)

The service centre shall analyse historical data and issue a regular detailed report to the customer informing him of the unit's operational condition and any critical states.

6.4.1 Telephone switch for LIFE.net

The installation of this telephone switch for LIFE.net shall allow the user to use a telephone line normally used for other purposes (fax or telephone).

6.5 J-Bus Protocol

A special J-Bus kit will ensure compatibility of CROSS Chassis with J-Bus protocol on RS485.

6.6 Special additional fuses on phases

Even if CROSS Chassis is designed to provide the maximum current carrying capability under any condition, additional fuses can be provided on request for phase SCR protection. In this case the characteristics of the fuses will also have to be taken into consideration for the proper design of protection selectivity in the installation, along with the SCR data shown in table 5.

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