Hardware Instruction Manual

CTF-Xtra Advanced SCR
Power Controller

CTF-Xtra 25A to 60A

CHROMALOX
Advanced Thermal Technologies

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Important Safeguards

⚠️ WARNING

HIGH VOLTAGE (up to 480 VAC) is used in the operation of this equipment; DEATH ON CONTACT may result if personnel fail to observe safety precautions.

Learn the areas containing high-voltage connections when installing or operating this equipment.

⚠️ WARNING

Be careful not to contact high-voltage connections when installing or operating this equipment.

Before working inside the equipment, turn power off and ground all points of high potential before touching them.

⚠️ CAUTION

The owner/installer must provide all necessary safety and protection devices and follow all current electrical wiring standards and regulations. Failure to do so may compromise the integrity of the controller and/or cause product failure resulting in a safety risk to operational and service personnel.

⚠️ CAUTION

This controller utilizes a heat sink which is designed to cool the unit during operation. Under no circumstance should air flow around the controller be compromised in any way. Failure to do so may result in the overheating of the controller, product failure, product temperatures and even fire.

⚠️ WARNING

During continuous operation, the heat sink can reach very high temperatures, and keeps a high temperature even after the unit is turned off due to its high thermal inertia.

Higher voltages may be present. DO NOT work on the power section without first cutting out electrical power to the panel. Failure to do so may cause serious injury or death.

⚠️ WARNING

ELECTRIC SHOCK HAZARD: Any installation involving control equipment must be performed by a qualified person and must be effectively grounded in accordance with the National Electrical Code to eliminate shock hazard.
1. Initial Instructions

1.1 General Description

CTF-Xtra is a compact advanced SCR power controller that provides a unique combination of performance, reliability, and flexibility. The CTF-Xtra controllers are based on an extremely versatile hardware and software platform, with options to select the best I/O configuration for your system.

The CTF-Xtra may be used as the power controller of single phase loads or as the Master Controller for 2- or 3-Leg, 3-phase loads. With the multiple command signal options, the CTF-Xtra is designed to manage several types of loads including resistive loads with high and low temperature coefficient, short wave IR lamps, or transformer primaries.

In particular, this new line of Chromalox controllers is the ideal solution for applications demanding high performance, continuous process monitoring and voltage, current, and temperature diagnostics such as:

- General industrial process heating
- Thermoforming
- Hot runners & injection molding
- Heat treatment furnaces
- Glass tempering furnaces

1.2 Features

- Rugged, industrial design & touch-safe exterior
- Ratings from 25 A to 60 A, at nominal voltage of 480 VAC
- Electronic over voltage fault protection
- Configurable analog and digital command inputs
- Several trigger modes, including; zero crossing (fixed cycle, burst-firing (D.O.T.), half single-cycle) and phase angle
- Current, voltage and temperature diagnostics
- Total and partial load interrupt
- Self-learn function of alarm limit for interrupted load
- SCR in short circuit
- Load in short circuit or overcurrent
- Master or slave Modbus RTU/RS485
- Integrated heat sink (and fan where applicable)
- cULus and cCSAus Listed, TÜV certified, CE

1.3 Product Inspection

Immediately after unpacking the unit and prior to installing, check the order code and the other data on the label attached to the outside of the container and write them down. If troubleshooting is necessary, you will need to provide this data to a Chromalox customer service representative.

Upon removing package, ensure that there is no physical damage to the controller during shipment, and that the package also contains the “Configuration and Programming” manual.

If there are signs of damage or if any parts are missing, notify your Chromalox representative immediately.

See “Mounting Dimensions” and “Mounting Template” figures in this document before installing the CTF-Xtra on the machine/host system control panel.
2. Dimensions and Weights

Dimensions in Inches (mm)

3. Installation – Mounting

To ensure proper performance, maximum safety and reliability, it is essential to install the unit correctly. This includes proper mounting, spacing, hardware and wiring. See below:

- Maximum surrounding air temperature is 40°C in “Open Type Equipment” which is suitable for use in pollution degree 2. For temperature >40°C refer to the Derating Curves.
- Install the unit vertically (max 10° inclination from vertical axis).

Spacing

To ensure maximum reliability, the device must be correctly installed in the panel in such a way as to obtain adequate heat exchange between the heat sink and the surrounding air under conditions of natural convection.

Under no circumstance shall any component, including cable channels, compromise minimum thermal spacing dimensions. Air must be able to flow vertically on the heat sink without any obstacles.

Considerations:

Solid state devices dissipate heat which may impact installation room temperature.
Exchange with external air or an air conditioner may be necessary to transfer heat outside the panel.

- Minimum vertical distance between unit and panel wall: 3.9" (100 mm)
- Minimum horizontal distance between unit and panel wall: 0.8" (20 mm)
- Minimum vertical distance between adjacent power control units: 11.8" (300 mm)
- Minimum horizontal distance between adjacent power control units: 0.4" (10 mm)
Installation – Mounting (cont’d.)

<table>
<thead>
<tr>
<th>Model</th>
<th>Length In. (mm)</th>
<th>Width In. (mm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>CTF 25-40-50A</td>
<td>4.4 (112)</td>
<td>1.7 (44)</td>
</tr>
<tr>
<td>CTF 60A</td>
<td>4.4 (112)</td>
<td>4.4 (113)</td>
</tr>
</tbody>
</table>

CTF Models 025A to 60A may be installed on a DIN Rail.

To install CTF-25A - 60A onto a DIN Rail:
- Depress the DIN mounting spring 📌
- Position controller on the DIN Rail at a slight angle
- Lower controller onto DIN Rail 📌
- Release the mounting spring

To remove from the DIN Rail:
- Depress the DIN mounting spring 📌
- Rotate bottom of controller off of the DIN Rail 📌
- Remove from DIN Rail

1. Press
2. Turn

Install Controller

Proper position for operation

Remove controller
This section covers the CTF-Xtra wiring installation instructions for the power supply, inputs, outputs and interfaces.

### Electrical power supply
- The controller DOES NOT have an On/Off switch. The user must install a switch or isolator that conforms to all codes and electrical safety requirements (CE mark) to cut off the power supply upstream of the controller. The switch must be installed in the immediate vicinity of the controller and within reach of the operator. A single switch can be used for multiple devices.
- The earth connection must be made with a specific lead.
- If the product is used in applications with risk of harm to persons or damage to machines or materials, it MUST be equipped with auxiliary alarm device(s). It is advisable to provide the ability to check for tripped alarms during regular operation. DO NOT install the product in rooms with hazardous (inflammable or explosive) atmosphere; it may be connected to elements that operated in such atmosphere only by means of appropriate interfaces that conform to current safety standards.

### Notes on Electrical Safety and Electromagnetic Compatibility

**CE MARKING:** EMC (electromagnetic compatibility) conformity in compliance with Directive 2004/108/CE and following modifications. Series CTF-Xtra controllers are mainly intended for industrial use, installed on panels or control panels of production process machines or systems. For purposes of electromagnetic compatibility, the most restrictive generic standards have been adopted, as shown on the tables.

**LV (low voltage) conformity Directive 2006/95/CE.** EMC compliance has been verified with respect to the information in Tables 1 and 2.

### Recommended Installation for purposes of EMC

**Instrument power supply**
- The power supply for the electronic instrumentation on the panels must always come directly from a cut/off device with fuse for the instrument part.
- Electronic instrumentation and electromechanical power devices such as relays, contactors, solenoids, etc., MUST ALWAYS be powered by separate lines.
- When the power supply line of electronic instruments is heavily disturbed by switching of SCR power groups or by motors, you should use an isolation transformer only for the controllers, grounding its sheathing.
- It is important for the system to be well grounded. Voltage between neutral and ground must not be > 1 V and resistance must be < 6Ω (Ohms).
- If the grid voltage is highly unstable, use a voltage stabilizer.
- In proximity of high frequency generators or arc welders, use adequate grid filters.
- The power supply lines must be separate from instrument input and output lines.
- Supply from Class II or from limited energy sources.

### Input and output connections

Before connecting or disconnecting any connection, always check that the power and control cables are isolated from voltage. Appropriate devices must be provided: fuses or automatic switches to protect power lines. The fuses present in the module function solely as a protection for the CTF-Xtra semiconductors.
- Connected outside circuits must be doubly isolated.
- To connect analog or linear inputs, strain gauges, TC, RTD, etc., you have to:
  - physically separate the input cables from those of the power supply, outputs, and power connections.
  - use braided and shielded cables, with sheathing grounded at a single point.

### Installation Notes

Ensure that the over voltage protection device is properly installed to terminals 1/L1 and 2/T1. Additionally, the applications with solid state units require a safety automatic switch to disengage the load power line during certain alarm events.
5. Emission, Immunity and Safety Standards

Table 1: EMC Emission

<table>
<thead>
<tr>
<th>Description</th>
<th>Standard</th>
<th>Group</th>
</tr>
</thead>
<tbody>
<tr>
<td>AC semiconductor motor controllers and conductors for non-motor loads</td>
<td>EN 60947-4-3</td>
<td></td>
</tr>
<tr>
<td>Emission enclosure compliant in firing mode single cycle and phase angle if external filter fitted</td>
<td>EN 60947-4-3 CISPR-11 EN 55011</td>
<td>Class A Group 2</td>
</tr>
</tbody>
</table>

Table 2: EMC Immunity

<table>
<thead>
<tr>
<th>Description</th>
<th>Standard</th>
<th>Parameters</th>
</tr>
</thead>
<tbody>
<tr>
<td>Generic standards, immunity standard for industrial environments</td>
<td>EN 60947-4-3</td>
<td>4 kV contact discharge 8 kV air discharge</td>
</tr>
<tr>
<td>ESD immunity</td>
<td>EN 61000-4-2</td>
<td>10 V/m amplitude modulated 80 MHz-1 GHz 10 V/m amplitude modulated 1.4 GHz-2 GHz</td>
</tr>
<tr>
<td>RF interference immunity</td>
<td>EN 60947-4-3</td>
<td>10 V/m amplitude modulated 0.15 MHz-80 MHz</td>
</tr>
<tr>
<td>Conducted disturbance immunity</td>
<td>EN 60947-4-3</td>
<td>2 k V power line 2 k V I/O signal line</td>
</tr>
<tr>
<td>Burst immunity</td>
<td>EN 60947-4-3</td>
<td>Power line-line 1 kV Power line-earth 2 kV Signal line-earth 2 kV Signal line-line 1 kV</td>
</tr>
<tr>
<td>Surge immunity</td>
<td>EN 60947-4-4</td>
<td>Tests are not required. Immunity is demonstrated by the successful completion of the operating capability test</td>
</tr>
<tr>
<td>Magnetic fields immunity</td>
<td>EN 60947-4-5</td>
<td>100%U, 70%U, 40%U,</td>
</tr>
<tr>
<td>Voltage dips, short interruptions and voltage immunity tests</td>
<td>EN 61000-4-11</td>
<td></td>
</tr>
</tbody>
</table>

Table 3: LVD Safety

<table>
<thead>
<tr>
<th>Description</th>
<th>Standard</th>
</tr>
</thead>
<tbody>
<tr>
<td>Safety requirements for electrical equipment for measurement, control and laboratory use</td>
<td>EN 61010-1 UL 508</td>
</tr>
</tbody>
</table>

**ATTENTION**

This product has been designed for class A equipment. Use of the product in domestic environments may cause radio interference, in which case the user may be required to employ additional noise mitigation methods.

---

EMC filters are required in Phase Angle firing mode. The filter model and current level depend on the configuration and load used. The power filter MUST be connected as close as possible to the CTF. You can use a filter connected between the power line and CTF or an LC group connected between the CTF output and the load.

The CE declaration of conformity is available on request.
6. Controller Overview

6.1 Layout

CTF-Xtra

CTF-Xtra with RS485 Communications

1. Supply/control connector
2. HB key calibration
3. TTL port for configuration
4. LED indicators
5. Power terminal “Line” (1/L1)
6. Power terminal “Load” (2/T1)
7. Heatsink
8. DIN rail lever
9. Switch serial line terminal
10. RS485 serial port connector
11. Address Rotary switch
12. Over voltage protector

25 to 60 Amp Models
(fan not shown)

PERIODIC CLEANING

Due to their design, these controllers inherently dis- sipate heat during normal operation. It is critical that the heat sink and fans remain clean and fully operable. Therefore, every 6–12 months, the heat sink fins and fan (on applicable models) shall be inspected for debris.

Clean, dry compressed air should be used to keep the heat sink and fan free of debris.

IN CASE OF OVERHEAT ALARM

If periodic cleaning does not eliminate the problem, do as follows:

a. Disconnect the fan connector from the controller
b. Check the condition of the fan
c. Clean or replace the fan

**NOTE:** Ensure that the air flow arrow on the fan is pointing towards the heat sink.

d. Power up the device and check fan rotation when under load.
7. Connections and Indication

7.1 Input & Output Connections (CTF-Xtra 25 - 60 Amp)

- Synchronous output for Master/Slave connection
- Alarm output (solid state relay - HB option)
- Green Led (RUN)
- Yellow Led (STATUS)
- Red Led (Alarm output HB)
- Yellow Led (Status digital input)
- Led: Green = SCR ON
- Yellow = Temperature OVER

1/L1 LINE connection
2/T1 LOAD connection
3/L2 Reference connection of line voltage

Earth Ground

Top view WITHOUT Modbus Option

Top view WITH Modbus Option

Key HB

J2 TTL port for Port Configuration

J3, J4 RJ10 connectors RS485 serial line Modbus

Address x 1
Address x 10

Switch for serial line

Input control signal (+)
Potentiometer output power supply (+5Vdc)
Digital input (PWM input)
Power supply terminal 24Vac/Vdc

Fixed screw at heatsink

Identification label

Over Voltage Protector

Without Modbus Option

With Modbus Option

Key HB

J1 Power supply /control connector
7.2 LED Logic

### Description of LED’s

<table>
<thead>
<tr>
<th>LED</th>
<th>Description</th>
<th>Color</th>
</tr>
</thead>
<tbody>
<tr>
<td>RUN</td>
<td>Flashing during normal operation</td>
<td>Green</td>
</tr>
<tr>
<td></td>
<td>On steadily: according to Firmware setting (see Software manual)</td>
<td></td>
</tr>
<tr>
<td>STATUS</td>
<td>Off : during normal operation</td>
<td>Yellow</td>
</tr>
<tr>
<td></td>
<td>On : according to Firmware setting (see Software manual)</td>
<td></td>
</tr>
<tr>
<td>ALARM</td>
<td>State HB alarm output / Power Fault Alarm / Fuse Open</td>
<td>Red</td>
</tr>
<tr>
<td>DI</td>
<td>Digital Input Status</td>
<td>Yellow</td>
</tr>
</tbody>
</table>
| ON / OVER TEMP | Green: SCR on  
Yellow: ON, SCR overtemperature alarm                                    | Green  |

The state of the LEDs matches the corresponding parameter, except in the following special cases:
- LED 1 (green) + LED 2 (yellow) both flashing rapidly: autobaud is in progress
- LED 2 (yellow) flashing rapidly: SSR temperature sensor broken or SSR Over Heat or Reversed Phase Error or Load Short Protection

7.3 Connections

#### 7.3.1 Connector J1

<table>
<thead>
<tr>
<th>PIN</th>
<th>Name</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>OUT AL HB</td>
<td>OUT Alarm Switch (HB)</td>
</tr>
<tr>
<td>2</td>
<td>OUT_Master</td>
<td>Control output Slave (+7V)</td>
</tr>
<tr>
<td>3</td>
<td>GND</td>
<td>GND Control analog input</td>
</tr>
<tr>
<td>4</td>
<td>+ IN</td>
<td>+ Control analog input</td>
</tr>
<tr>
<td>5</td>
<td>+5V_POT</td>
<td>Output potentiometer</td>
</tr>
<tr>
<td>6</td>
<td>IN_DIG</td>
<td>Digital input &amp; PWM Input</td>
</tr>
<tr>
<td>7</td>
<td>24 V Supply</td>
<td>Supply 18 to 32 Vac/Vdc</td>
</tr>
<tr>
<td>8</td>
<td>24 V Supply</td>
<td></td>
</tr>
<tr>
<td>9</td>
<td>24 V Supply</td>
<td></td>
</tr>
</tbody>
</table>
### 7.4 RECOMMENDED GAUGES

<table>
<thead>
<tr>
<th>CTF Current Level</th>
<th>Terminal</th>
<th>Cable Wire</th>
<th>Wire Terminal</th>
<th>Tightening Torque / Tool</th>
</tr>
</thead>
<tbody>
<tr>
<td>25A</td>
<td>1/L1, 2/T1, PE</td>
<td>4 mm² 10 AWG</td>
<td>Wire terminal / Eye D. 6mm</td>
<td>2.5 Nm / Phillips screwdriver PH2 - PH3</td>
</tr>
<tr>
<td>40A</td>
<td>1/L1, 2/T1, PE</td>
<td>10 mm² 7 AWG</td>
<td>Wire terminal / Eye D. 6mm</td>
<td>2.5 Nm / Phillips screwdriver PH2 - PH3</td>
</tr>
<tr>
<td>50A</td>
<td>1/L1, 2/T1, PE</td>
<td>10 mm² 7 AWG</td>
<td>Wire terminal / Eye D. 6mm</td>
<td>2.5 Nm / Phillips screwdriver PH2 - PH3</td>
</tr>
<tr>
<td>60A</td>
<td>1/L1, 2/T1, PE</td>
<td>16 mm² 5 AWG</td>
<td>Wire terminal / Eye D. 6mm</td>
<td>2.5 Nm / Phillips screwdriver PH2 - PH3</td>
</tr>
<tr>
<td>-</td>
<td>3/L2 (Ref. Vline)</td>
<td>0.25 ...2.5 mm² 23...14 AWG</td>
<td>Wire stripped for 8 mm or with tag terminal</td>
<td>0.5 ...0.6 Nm / Flat-head screwdriver tip 0.6 x 3.5 mm</td>
</tr>
</tbody>
</table>

**NOTE:** Cables must be Copper “Stranded Wire” or “Compact-Stranded Wire” type with max. operating temp. 60/75°C

### 7.5 TTL CONFIGURATION PORT (CTF STANDARD)

**Connector J2**

<table>
<thead>
<tr>
<th>Connector S1/S2 RJ10 4-4 pin</th>
<th>Nr. Pin</th>
<th>Name</th>
<th>Description</th>
<th>Note</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>GND</td>
<td>Ground</td>
<td>Use of this port requires custom USB to TTL Configuration Cable. Chromalox PCN: 309171</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>RX_TTL</td>
<td>Data reception TTL from CTF</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>TX_TTL</td>
<td>Data transmission TTL to CTF</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>(Reserved)</td>
<td>DO NOT connect</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*Cable type:* flat telephone cable for pin 4-4 conductor 28 AWG

### 7.6 MODBUS RS485 PORTS (OPTION)

**Connectors J3, J4**

<table>
<thead>
<tr>
<th>Connector S1/S2 RJ10 4-4 pin</th>
<th>Nr. Pin</th>
<th>Name</th>
<th>Description</th>
<th>Note</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>GND1 (**)</td>
<td>Use of these ports requires custom USB to RS485 configuration cable. (Chromalox PCN: 309180) (*) Insert the RS485 line termination in the last device on the Modbus line, see dip-switches. (**) Connect the GND signal between Modbus devices with a line distance &gt; 100 m.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Tx/Rx+</td>
<td>Data reception/transmission (A+)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Tx/Rx+</td>
<td>Data reception/transmission (B-)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>+V (reserved)</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*Cable type:* flat telephone cable for pin 4-4 conductor 28 AWG
8. Load Connection Example

For 1 single-phase load, single-phase line (L1-N) or open delta (L1-L2)

Fuse Note:
I2T Fuse: Rapid Blow Fuse.
Inst. Fuse: Low amperage, fast-acting "instrumentation" fuse.
See Fuse & Fuse Holder’s section.

---

CAUTION

The I2T fuses are designed to protect the SCR from Faults on the Load Connection side. They are NOT intended to provide branch circuit or wire protection.

---

For 1 single-phase load with transformer single-phase line (L1-N) or open delta (L1-L2).

Fuse Note:
FT Fuse: Rapid Blow Fuse.
Inst. Fuse: Low amperage, fast-acting “instrumentation” fuse.
See Fuse & Fuse Holder’s section.
**(Master-Slave) For controlling 2 Legs of a 3 Phase Load**

**CAUTION**

The *I₂T* fuses are designed to protect the SCR from Faults on the Load Connection side. They are **NOT** intended to provide branch circuit or wire protection.

**Fuse Note:**
- *I₂T* Fuse: Rapid Blow Fuse.
- Inst. Fuse: Low amperage, fast-acting “instrumentation” fuse.
  See Fuse & Fuse Holder’s section.

---

**(Master-Slave) For controlling 3 legs of a 3 Phase Load**

**CAUTION**

The *I₂T* fuses are designed to protect the SCR from Faults on the Load Connection side. They are **NOT** intended to provide branch circuit or wire protection.

**Fuse Note:**
- *I₂T* Fuse: Rapid Blow Fuse.
- Inst. Fuse: Low amperage, fast-acting “instrumentation” fuse.
  See Fuse & Fuse Holder’s section.
(3 Master units) For single-phase loads, with division of maximum load with isolators S1, S2, S3, maintaining balance of three-phase line.

**CAUTION**

The I2T fuses are designed to protect the SCR from Faults on the Load Connection side. They are NOT intended to provide branch circuit or wire protection.

Fuse Note:
I2T Fuse: Rapid Blow Fuse.
Inst. Fuse: Low amperage, fast-acting "instrumentation" fuse.
See Fuse & Fuse Holder's section.

(Master/Slave Example) For controlling 3 Legs of a 3 Phase Star (Wye) load with neutral. (4-Wire)

**CAUTION**

The I2T fuses are designed to protect the SCR from Faults on the Load Connection side. They are NOT intended to provide branch circuit or wire protection.

Fuse Note:
I2T Fuse: Rapid Blow Fuse.
Inst. Fuse: Low amperage, fast-acting "instrumentation" fuse.
See Fuse & Fuse Holder's section.
9. Inductive and Transformer Coupled Load Guidelines

a) Connect a varistor (MOV) between each wire of the primary transformer and ground. Varistor data: rated voltage 660 Vrms… 1000 Vrms; minimum energy 100J
b) The maximum current controllable by the device is less than the product’s rated value (see technical data).
c) In ZC and BF trigger mode, use the Delay-triggering function to limit peak magnetization current.
d) In PA trigger mode, use the Softstart function.
e) DO NOT use HSC trigger mode.
f) DO NOT connect RC snubbers in parallel to the transformer primary.
g) Select the inductive load using the Hd.1 parameter (ref. Software manual)

10. Firing (Trigger) Mode Overview

The CTF-Xtra offers multiple software trigger modes for both zero-crossing and phase angle firing.

Zero Crossing Modes
This function eliminates EMC noise.

**ZC**
Constant cycle time \((T_c \geq 1 \text{ sec, settable from 1 to 200 sec})\)
Cycle time is divided into a series of conduction and non-conduction cycles in proportion to the power value to be transferred to the load.

For example, if \(T_c = 10\text{ sec}\), if the power value is 20% there is conduction for 2 sec (120 conduction cycles @ 60Hz) and non conduction for 8 sec (480 non conduction cycles @ 60Hz).

**BF**
Burst Firing or DOT (Demand Oriented Transfer) (Zero Crossing Variant) with variable cycle time.
This mode controls power on the load via a series of conduction ON and non conduction OFF cycles. The ratio of the number of ON cycles to OFF cycles is proportional to the power value to be supplied to the load.

The cycle time repeat period is kept to a minimum for each power value (whereas in ZC mode the period is always fixed and not optimized).
The parameter $bF.Cy$ defines the minimum number of conduction cycles settable from 1 to 10. In the following example, the parameter $= 2$.

HSC - Half single cycle

This mode corresponds to Burst Firing that manages ON and OFF half-cycles. It is useful for reducing the flickering of filaments with short/medium-wave IR lamp loads. With these load types, to limit current with low power, it is useful to set a minimum power limit (for example, $Lo.p = 10\%$).

NOTE: This mode is NOT allowed with inductive loads (transformers). It is designed for resistive loads in single phase, star (wye) with neutral, or open delta configuration.

Phase Angle (PA)

This mode controls power on the load by varying the trigger angle $\theta$.

Example:
- if power to be transferred to the load is $100\%$, $\theta = 180^\circ$
- or if power to be transferred to the load is $50\%$, $\theta = 90^\circ$
10.1 ADDITIONAL CONTROL FUNCTIONS

Softstart

This type of control method can be enabled either in phase control or pulse train mode and in zero-crossing mode (ZC, BF, HSC).

In phase control, the increment of conduction angle $\theta$ stops at the corresponding value of the power to be transferred to the load.

Control of maximum peak current (useful in case of short circuit on the load or of loads with high temperature coefficients to automatically adjust start time to the load) can be enabled during softstart. When the load shut-off time (user programmable) is exceeded, the ramp is reactivated at the next power-on.

---

**Example of firing ramp with phase Soft-Start**

---

**RMS current limit**

The option for controlling the load current limit is available in all work modes.

If the current value exceeds the limit (settable in the nominal full-scale range) in PA mode, the conduction angle is limited; however, while in zero-crossing mode (ZC, BF, HSC) the cycle time conduction percentage is limited.

This limitation ensures that the RMS value (i.e., not the instantaneous value) of the load current does NOT exceed the set RMS current limit.

---

**Example of conduction angle limitation in PA mode to ensure the RMS current limit remains below the nominal current of the load.**
**DT**

“Delay triggering” (for ZC, BF control modes only)
Settable from 0° to 90°.
Useful for inductive loads (transformer primaries)

To conduct inductive loads controlled in PA mode, do not use delay triggering; instead, use the phase angle Soft-Start ramp.

Comparison of method to fire a transformer: Soft-Start Ramp (for PA mode) / Delay triggering (for ZC and BF mode)
10.2 DIGITAL INPUT (PWM)

This digital input can be used to receive information on the % of power to be supplied to the load.

The signal can be generated by a controller or external PLC via digital outputs (logic output for Chromalox Process Controllers).

This is obtained by alternating the output “ON” time, T_{on} with the output “OFF” time, T_{off}.

The sum of T_{on}+T_{off} is constant, and is called Cycle-Time.

\[ \text{CycleTime} = \frac{T_{on}+T_{off}}{2} \]

The power level is given by the ratio \( \frac{T_{on}}{\text{CycleTime}} \) and is normally expressed in %.

The CTF-Xtra digital input automatically adapts to the cycle time from 0.03Hz to 100Hz and obtains the power % to be supplied to the load from the \( \frac{T_{on}}{T_{on}+T_{off}} \) ratio.

Connection Example:
Temperature control with Chromalox DIN Controller with SSR Drive (logic) output (cycle time: 0.1sec).

To use Digital PWM the CTF-Xtra can be ordered with the configuration 5 -x - M or must be configured with the parameter dIG (digital input) = 7 within the C-PWR configuration program.
10.3 OVERCURRENT FAULT PROTECTION – “XTRA”

This integrated feature eliminates the need for an external (I\textsuperscript{2}T) extra-rapid fuse to protect the CTF SCR power controller. Additional safety of the IGBT overcurrent switch is provided by an over voltage protection device.

The SHORT_CIRCUIT_CURRENT alarm trips when the peak current on the load exceeds maximum permitted value during the soft-start ramp (corresponding to twice the rating) or at first power-on (with soft-start ramp disabled).

If configured (Fr.n parameter other than zero), the device restarts automatically in soft-start for a maximum number of Fr.n of attempts.

If this number of attempts is exceeded, the controller will remain off (switching component is deactivated) and it will wait for a manual reset with front panel key BUT or with the control via serial (bit 16).

<table>
<thead>
<tr>
<th>83</th>
<th>Fr.n</th>
<th>R/W</th>
<th>Number of restarts in case of FUSE_OPEN</th>
</tr>
</thead>
<tbody>
<tr>
<td>16 bit</td>
<td>Reset alarms SHORT_CIRCUIT_CURRENT_e_FUSE_OPEN</td>
<td>R/W</td>
<td>OFF=</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>ON = Reset alarms SHORT_CIRCUIT_CURRENT e FUSE_OPE</td>
</tr>
</tbody>
</table>

This feature **DOES NOT** replace any of the safeties on the system (such as thermal magnetic switches, delay fuses, etc.).

This feature protects the controller (and therefore also the load) by replacing the high-speed fuse needed to protect the control SCRs against electrical faults (without creating any additional cost to replace the fuse and reducing machine downtime).

This feature has 2 function states:
1. Normal (On-Off control of load power)
2. Fuse-Open: CTF is open (a short occurred during normal operation).

Specification / Conditions of use:
- Breaking capacity: 5 KA - 480V
- Maximum system inductance: 500 µH

<table>
<thead>
<tr>
<th>Considerations</th>
<th>Fuses</th>
<th>Thermal Magnetic</th>
<th>Overcurrent Fault Protection</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cause of Failure</td>
<td>• Filament Melts (Fuse) Failure</td>
<td>• Thermal Effect</td>
<td>• Current Threshold</td>
</tr>
<tr>
<td></td>
<td>• Contact Withdrawal with Preloaded Spring</td>
<td>• Magnetic Effect</td>
<td>• Device Shutdown</td>
</tr>
<tr>
<td>Arc Quenching</td>
<td>• Arc In Air / Sand</td>
<td>• Mechanical Separation of 2 Contacts</td>
<td>• No Arc In Air</td>
</tr>
<tr>
<td></td>
<td>• Quenching with Silica Sand / Spring Effect</td>
<td>• Arc in Air with Quenching in Chamber</td>
<td>(Current Shuts Down in Silica)</td>
</tr>
<tr>
<td>Opening Energy (I\textsuperscript{2}T to Open)</td>
<td>Depending on Model:</td>
<td>Depending on Model:</td>
<td>• Always Very Low</td>
</tr>
<tr>
<td></td>
<td>• Low – Medium – High</td>
<td>• Medium – High</td>
<td></td>
</tr>
<tr>
<td>Opening Time</td>
<td>Depending on Model:</td>
<td>Depending on Model:</td>
<td>• Always Extremely Fast</td>
</tr>
<tr>
<td></td>
<td>• Fast – Moderate – Slow</td>
<td>• Moderate – Slow</td>
<td>(Micro-Seconds)</td>
</tr>
<tr>
<td>Method To Reset / Restart</td>
<td>• Replacement</td>
<td>• Manual Reset</td>
<td>• Automatic Reset (“Fr.n” Times)</td>
</tr>
<tr>
<td></td>
<td>• Labor Cost + Fuse Change</td>
<td></td>
<td>• Remote Reset (Via Comms)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>• Manual Reset</td>
</tr>
</tbody>
</table>
11. Communications Port (Modbus RTU/RS485)

A network typically has a Master that “manages” communication by means of “commands,” and Slaves that carry out these commands.

CTF-Xtra modules are considered Slaves to the network master, which is usually a supervision terminal or a PLC.

It is positively identified by means of a node address (ID) set on rotary switches (tens + units).

A maximum of 99 CTF-Xtra modules can be installed in a serial network, with node address selectable from “01” to “99”

The CTF-Xtra may be ordered with an optional modbus serial port.

The MODBUS RTU port 1 has the following factory settings (default):

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Default</th>
<th>Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>ID</td>
<td>1</td>
<td>1...99</td>
</tr>
<tr>
<td>BaudRate</td>
<td>19.2 Kbit/s</td>
<td>1200...19200bit/s</td>
</tr>
<tr>
<td>Parity</td>
<td>None</td>
<td>Odd/Even/None</td>
</tr>
<tr>
<td>StopBits</td>
<td>1</td>
<td>-</td>
</tr>
<tr>
<td>DataBits</td>
<td>8</td>
<td>-</td>
</tr>
</tbody>
</table>

The following procedures are mandatory for the Modbus protocol.

Set the rotary switch at “0+0” for AutoBaud function.

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Position Rotary Switches</th>
<th>Tens</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>AutoBaud</td>
<td></td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>

Allows setting of the correct BaudRate value automatically detecting the master transmission frequency

NEVER connect TTL adaptator to RS485 serial port of CTF or CTF-Xtra.

NEVER connect TTL connector or CTF or CTF-Xtra to a RS485 serial web.

This will cause damage to the product!!

11.1 Controller Configuration

Controller Configuration and programming is accomplished by connecting the CTF or CTF-Xtra to a PC which is equipped with the Chromalox C-PWR configuration Software program. Connection between the PC and the controller MUST be done with a custom USB to TTL or USB to RS485 adapter cable supplied by Chromalox. See adapter cable options below.

Complete configuration and programming instructions can be found in the CTF & CTF-Xtra Programming Manual.
12. Autobaud Function

The Autobaud function automatically adjusts the serial communication speed and parity of the CTF modules to the connected supervision terminal or PLC.

The “RUN” and “STATUS” LEDs mentioned in the procedure can vary its behavior based on the parameters Ld.1 and Ld.2.

Procedure
1. Connect the serial cables for all modules on the network to serial 1 and to the supervisory terminal.
2. Set the rotary switch on the CTF modules to be installed, or on all modules present in case of first installation, to position “0+0”. *
3. Check that the “RUN” and “STATUS” LEDs flash at high frequency (10Hz).
4. The supervision terminal must transmit a series of generic “MODBUS” read messages to the network.
5. The procedure is over when all of the “RUN” and “STATUS” LEDs on the CTF modules flash at a normal frequency (2Hz) (if parameter 50 Ld.1 = 16 as default).

The new speed parameter is saved permanently in each CTF; therefore, the “AUTOBAUD SERIAL” sequence does not have to be run at subsequent power-ups.

When the rotary switch is turned, the green “STATUS” LED stays on steadily for about 6 seconds, after which it resumes normal operation and saves the address.

* Note: the address set by the rotary switches is acquired only at power-on.
# 13. Specifications

## INPUTS

<table>
<thead>
<tr>
<th>Function</th>
<th>Acquisition of control power</th>
</tr>
</thead>
<tbody>
<tr>
<td>Max. error</td>
<td>1% f.s. +/- 1 scale point at ambient temperature of 25°C</td>
</tr>
<tr>
<td>Thermal drift</td>
<td>&lt; 100 ppm/°C of f.s.</td>
</tr>
<tr>
<td>Sampling time</td>
<td>60 ms</td>
</tr>
<tr>
<td>Scale 0-10 V</td>
<td>Input impedance &gt; 40 K ohms</td>
</tr>
<tr>
<td>Scale 0-5 V</td>
<td>Input impedance &gt; 40 K ohms</td>
</tr>
<tr>
<td>Scale 0-20 mA or 4-20 mA</td>
<td>Internal Shunt resistance: 125 ohm</td>
</tr>
<tr>
<td>Potentiometer input</td>
<td>Potentiometer resistance: from 1 K Ω to 10 K Ω Potentiometer supply: +5 V (supplied by CTF, max 10 mA)</td>
</tr>
<tr>
<td>Linear input read scale</td>
<td>0 .... 100.0 %</td>
</tr>
</tbody>
</table>

## INDIG Digital Input

<table>
<thead>
<tr>
<th>Function</th>
<th>Disable Power input or PWM input</th>
</tr>
</thead>
<tbody>
<tr>
<td>Voltage range</td>
<td>5-30 V (max 7 mA)</td>
</tr>
<tr>
<td>State “0” read safe voltage</td>
<td>&lt; 2 V</td>
</tr>
<tr>
<td>State “1” read safe voltage</td>
<td>&gt; 5 V</td>
</tr>
<tr>
<td>PWM input</td>
<td>Max. frequency: (0.03 Hz,...,100 Hz) max. resolution 1% (0.1ms)</td>
</tr>
</tbody>
</table>

## Voltage and Line Current Measurement

<table>
<thead>
<tr>
<th>Function</th>
<th>Measures RMS voltage by integral calculation of sampled values Meas. range: 0 ... 2 * rated_product</th>
</tr>
</thead>
<tbody>
<tr>
<td>Accuracy RMS current</td>
<td>measurement 3 % f.s. at room temperature of 25°C In PA mode with conduction angle &gt;90° : 5% fs Thermal drift: &lt; 200 ppm/°C</td>
</tr>
<tr>
<td>RMS line current measurement function</td>
<td>RMS voltage meas. by integral calculation of sampled values Work voltage range: 90...600 Vac</td>
</tr>
<tr>
<td>Accuracy RMS voltage measurement</td>
<td>1 % f.s. at room temperature of 25°C Thermal drift: &lt; 100 ppm/°C</td>
</tr>
<tr>
<td>Sampling time current/voltage</td>
<td>0.25 ms</td>
</tr>
<tr>
<td>Line frequency</td>
<td>50 / 60 Hz</td>
</tr>
</tbody>
</table>

## OUTPUTS

### Control Output Master/Slave

| Function | Control for synchronizing another CTF-Xtra slave (4 slave max.) Voltage: 7.5V, max 25 mA |

### HB Alarm Output (Optional)

<table>
<thead>
<tr>
<th>Function</th>
<th>HB alarm output or of other configurable alarms</th>
</tr>
</thead>
<tbody>
<tr>
<td>Type</td>
<td>Solid state relay (MOS opto) Isolated contact, normally open I_max: 150 mA V_max: 30 Vac / Vdc Closing resistance &lt; 15 ohm</td>
</tr>
</tbody>
</table>
**COMMUNICATIONS**

**RS485 Modbus (Optional)**

<table>
<thead>
<tr>
<th>Function</th>
<th>Local serial communication</th>
</tr>
</thead>
<tbody>
<tr>
<td>Protocol</td>
<td>ModBus RTU</td>
</tr>
<tr>
<td>Baudrate</td>
<td>Settable 1200 ...19200 bit/s (default 19.2 Kbit/s)</td>
</tr>
<tr>
<td>Node address</td>
<td>Settable with two rotary-switches</td>
</tr>
<tr>
<td>Type</td>
<td>RS485 - double connector RJ10 telephone type 4-4</td>
</tr>
<tr>
<td>Isolation</td>
<td>500V</td>
</tr>
</tbody>
</table>

**TTL Serial Connector (Standard)**

<table>
<thead>
<tr>
<th>Function</th>
<th>For product initial configuration only, via PC. Use a PC connected to CTF, ONLY via special adapter</th>
</tr>
</thead>
<tbody>
<tr>
<td>Isolation</td>
<td>TTL serial NOT isolated of CPU</td>
</tr>
</tbody>
</table>

**LOAD, FIRING, DIAGNOSTICS & RATINGS**

**CATEGORY OF USE**

(Tab. 2 EN60947-4-3)

- AC 51 resistive or low inductance loads
- AC 55b infrared lamps
- AC 56a: transformer loads

**Trigger Mode**

- **PA** - Load management by adjusting the firing angle (only configuration single-phase or delta open)
- **ZC** - Zero Crossing with constant cycle time (settable in range 1-200sec)
- **BF** - Burst Firing, or D.O.T. with variable cycle time optimized min.
- **HSC** - Half Single Cycle corresponds to Burst Firing that includes ON and OFF half-cycles. Useful for reducing flicker with short-wave IR loads (applied only to single-phase resistive or 3-phase 6-wire open delta loads).

**Feedback Mode**

- **V, V2**: Voltage feedback proportional to RMS voltage value on load (useful to compensate possible variations in line voltage).
- **I, I2**: Current feedback: bound to RMS current value on load to compensate variations in line voltage and/or variations in load impedance.
- **P**: Power feedback: proportional to real power value on load (useful to keep constant values of electrical power assigned regardless of load impedance or line voltage variations).

**Max rated voltage** 480 Vac

**Work voltage range** 90 - 530 Vac

**Non-repetitive voltage** 1200 Vp

**Rated Frequency** 50/60Hz Auto-Synchronization

**CTF MODEL**

<table>
<thead>
<tr>
<th>CTF MODEL</th>
<th>CTF-025</th>
<th>CTF-040</th>
<th>CTF-050</th>
<th>CTF-060</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rated Current, AC51 - AC55b Resistive Load (@ 40°C contin. service)</td>
<td>25A</td>
<td>40A</td>
<td>50A</td>
<td>60A</td>
</tr>
<tr>
<td>Rated current AC56A permitted trigger modes: <strong>ZC, BF/DOT with DT</strong> (Delay Trigger), <strong>PA</strong> with softstart (@ Tamb = 40 °C)</td>
<td>20A</td>
<td>32A</td>
<td>40A</td>
<td>50A</td>
</tr>
<tr>
<td>Maximum Surge Current (t = 10 ms) A</td>
<td>400A</td>
<td>520A</td>
<td>520A</td>
<td>1150A</td>
</tr>
<tr>
<td>Maximum f’t for fusing (blowout) A²s</td>
<td>450</td>
<td>1,800</td>
<td>1,800</td>
<td>6,600</td>
</tr>
<tr>
<td>Critical dV/dt Off-state (minimum)</td>
<td>1,000V/µs</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Nom. Impulse Voltage</td>
<td>4KV</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Nominal SCCR</td>
<td>5KA</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
### FUNCTION

<table>
<thead>
<tr>
<th>Diagnostics</th>
<th>Detection of shorted load circuit, absence of line voltage, HB alarm (partial break of load)</th>
</tr>
</thead>
</table>

### OPTIONS

| Options                                                                 | - Timed Soft-Start firing ramp, with or without peak current control  
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>- Soft-Start firing ramp (specific for infrared lamps)</td>
</tr>
<tr>
<td></td>
<td>- Timed shut-off ramp</td>
</tr>
<tr>
<td></td>
<td>- Limitation of RMS current in load</td>
</tr>
<tr>
<td></td>
<td>- 0–90° Delay-Triggering for firing inductive loads in ZC and BF/DOT modes.</td>
</tr>
</tbody>
</table>

| Diagnostic                                                            | - SCR in short circuit (presence of current with OFF control)           |
|                                                                      | - Absence of SCR current when under load.                               |
|                                                                      | - Overtemperature alarm                                                 |
|                                                                      | • HB alarm: interrupted or partially interrupted load                   |
|                                                                      | • Automatic calibration of HB alarm setpoint starting from current value in load |
|                                                                      | • Alarm for load in short circuit or overcurrent                        |
|                                                                      | Voltage read                                                            |
|                                                                      | • No line voltage                                                       |

### GENERAL DATA

<table>
<thead>
<tr>
<th>Power Supply</th>
<th>CTF 25-60 A: 24 Vac 50-60 Hz / Vdc ± 25%, max 3 VA</th>
</tr>
</thead>
<tbody>
<tr>
<td>Power supply for external fan</td>
<td>24 Vdc ± 10%, max 200mA</td>
</tr>
</tbody>
</table>
| Signals                    | 5 leds:  
|                            | RUN: run state of CPU  
|                            | STATUS: operating state  
|                            | ALARM: state of alarm output  
|                            | DIGITAL INPUT: state of digital inputs  
|                            | ON / OVER-TEMP.: state of SCR power / Alarm for overheating           |
| Load Type and Connection   | Single phase load  
|                            | Independent single-phase load in open delta  
|                            | 3-phase load  
|                            | 3-phase load (star without neutral or closed triangle) with 2-leg control |
| Protection                 | IP20                                                                   |
| Ambient Temperature        | 0 to 50°C (32 to 122°F) (Per EN 60947-4-3 § 7.1.1: Average Temperature over 24 hour period shall not exceed 35°C (95°F) |
| Storage Temperature        | -20°C to 70°C (-4°F to 158°F)                                           |
| Relative Humidity          | 20…85% RH non-condensing                                               |
| Ambient Conditions for use | Indoor use, altitude up to 2000m                                       |
| Installation               | DIN Rail EN50022 or panel with screws                                    |
| Installation Requirements  | Installation category II, pollution level 2, double isolation (only for model >120A):  
|                            | - Max. temperature of air surrounding device 40°C; for temperature >40°C refer at derating curves  
|                            | - Device type: “UL Open Type”                                           |
13.1 DERATING CURVES

<table>
<thead>
<tr>
<th>Enclosure / Ambient Temperature °C</th>
<th>CTF-025</th>
<th>CTF-040</th>
<th>CTF-050</th>
<th>CTF-060</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>25</td>
<td>40</td>
<td>50</td>
<td>60</td>
</tr>
<tr>
<td>40</td>
<td>25</td>
<td>40</td>
<td>50</td>
<td>60</td>
</tr>
<tr>
<td>45</td>
<td>22.5</td>
<td>35</td>
<td>45</td>
<td>55</td>
</tr>
<tr>
<td>50</td>
<td>20</td>
<td>30</td>
<td>40</td>
<td>50</td>
</tr>
</tbody>
</table>

**CTF - Current Rating vs. Enclosure/Ambient Temperature**

![Graph for CTF-025 & CTF-040](Image)

![Graph for CTF-050 & CTF-060](Image)
### 14. Ordering Information

#### Model: Advanced SCR Power Controller

<table>
<thead>
<tr>
<th>Code</th>
<th>Voltage</th>
<th>Code Control Options</th>
<th>Code Heater Break Alarm</th>
<th>Code Fusing</th>
<th>Code Communications</th>
</tr>
</thead>
<tbody>
<tr>
<td>25</td>
<td>25 Amps</td>
<td>0 None</td>
<td>1 Heater Break Alarm (partial/total load)</td>
<td>2 Electronic Resettable Fuse</td>
<td>0- None</td>
</tr>
<tr>
<td>40</td>
<td>40 Amps</td>
<td>1 Current Limit</td>
<td></td>
<td></td>
<td>M- Modbus RTU/RS485</td>
</tr>
<tr>
<td>50</td>
<td>50 Amps</td>
<td>2 Current Limit and Feedback V.I.P.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>60</td>
<td>60 Amps</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

#### Code Signal Control

1. 10 V [Default]
2. 5 V/Potentiometer
3. 0-20 mA
4. 4-20 mA
5. PWM/Digital input

#### Code Trigger Modes

- B Burst Fire (DOT) [Default]
- Z Zero Cross
- H Half Single Cycle
- P Phase Angle

#### Code Function Type

- M Master [Default]
- 2 Slave (2-Leg)
- S Slave (3-Leg)

---

CTF-050 48-2120-1B M Typical Model Number
15. Configuration and Programming

15.1 C-PWR Configuration Software Program
See C-PWR Configuration Software Program instruction manual for proper program installation.

15.2 CTF/CTF-XTRA Programming Manual
See CTF/CTF-XTRA Programming Manual for complete controller set-up of communications, inputs, outputs, alarms and control modes.

16. Fuses and Fuse Holders

<table>
<thead>
<tr>
<th>CTF Model</th>
<th>Fuse Rating, Amps</th>
<th>I²t</th>
<th>Power Dissipation</th>
<th>Fuse Size</th>
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<th>Part No.</th>
<th>Fuse Holder Rating (UL)</th>
<th>Fuse Holder Rating (IEC)</th>
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<th>Part No.</th>
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Limited Warranty:
Please refer to the Chromalox limited warranty applicable to this product at http://www.chromalox.com/customer-service/policies/termsofsale.aspx.

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