TELEDYNE API
Everywhereyoulook™

Model SCI-552
System Controller Interface

User Manual

© TELEDYNE API (TAPI)
9970 CARROLL CANYON ROAD
SAN DIEGO, CALIFORNIA 92131-1106
USA

Toll-free Phone: 800-324-5190
Phone: +1 858-657-9800
Fax: +1 858-657-9816
Email: api-sales@teledyne.com
Website: http://www.teledyne-api.com/

08626D DCN8613
22 August 2024

NOTICE OF COPYRIGHT

TRADEMARKS

SAFETY MESSAGES

Important safety messages are provided throughout this manual for the purpose of avoiding personal injury or instrument damage. Please read these messages carefully. Each safety message is associated with a safety alert symbol and is placed throughout this manual; the safety symbols are also located inside the instrument. It is imperative that you pay close attention to these messages, the descriptions of which are as follows:

WARNING: Electrical Shock Hazard

HAZARD: Strong oxidizer

GENERAL WARNING/CAUTION: Read the accompanying message for specific information.

CAUTION: Hot Surface Warning

Do Not Touch: Touching some parts of the instrument without protection or proper tools could result in damage to the part(s) and/or the instrument.

Technician Symbol: All operations marked with this symbol are to be performed by qualified maintenance personnel only.

Electrical Ground: This symbol inside the instrument marks the central safety grounding point for the instrument.

CAUTION

This product should only be installed, commissioned, and used strictly for the purpose and in the manner described in this manual. If you improperly install, commission, or use this instrument in any manner other than as instructed in this manual or by our Technical Support team, unpredictable behavior could ensue with possible hazardous consequences.

Such risks, whether during installation and commission or caused by improper installation/commissioning/use, and their possible hazardous outcomes include but are not limited to:

RISK	HAZARD
Liquid or dust/debris ingress	Electrical shock hazard
Improper or worn power cable	Electrical shock or fire hazard
Excessive pressure from improper gas bottle connections	Explosion and projectile hazard
Sampling combustible gas(es)	Explosion and fire hazard
Improper lift & carry techniques	Personal injury

Note that the safety of a system that may incorporate this product is the end user's responsibility.

For Technical Assistance regarding the use and maintenance of this instrument or any other Teledyne API product, contact Teledyne API's Technical Support Department:

Telephone: 800-324-5190
Email: api-techsupport@teledyne.com

or access any of the service options on our website at http://www.teledyne-api.com/

CONSIGNES DE SÉCURITÉ

Des consignes de sécurité importantes sont fournies tout au long du présent manuel dans le but d'éviter des blessures corporelles ou d'endommager les instruments. Veuillez lire attentivement ces consignes. Chaque consigne de sécurité est représentée par un pictogramme d'alerte de sécurité; ces pictogrammes se retrouvent dans ce manuel et à l'intérieur des instruments. Les symboles correspondent aux consignes suivantes :

AVERTISSEMENT : Risque de choc électrique

DANGER : Oxydant puissant

AVERTISSEMENT GÉNÉRAL / MISE EN GARDE : Lire la consigne complémentaire pour des renseignements spécifiques

MISE EN GARDE : Surface chaude

Ne pas toucher : Toucher à certaines parties de l'instrument sans protection ou sans les outils appropriés pourrait entraîner des dommages aux pièces ou à l'instrument.

Pictogramme « technicien » : Toutes les opérations portant ce symbole doivent être effectuées uniquement par du personnel de maintenance qualifié.

Mise à la terre : Ce symbole à l'intérieur de l'instrument détermine le point central de la mise à la terre sécuritaire de l'instrument.

MISE EN GARDE

Ce produit ne doit être installé, mis en service et utilisé qu'aux fins et de la manière décrites dans le présent manuel. Si vous installez, mettez en service ou utilisez cet instrument de manière incorrecte autre que celle indiquée dans ce manuel ou sous la direction de notre équipe de soutien technique, un comportement imprévisible pourrait entraîner des conséquences potentiellement dangereuses.

Ce qui suit est une liste, non exhaustive, des risques et résultats dangereux possibles associés avec une mauvaise utilisation, une mise en service incorrecte, ou causés mauvaise commission.

RISQUE	DANGER
Pénétration de liquide ou de poussière/débris	Risque de choc électrique
Câble d'alimentation incorrect, endommagés ou usé	Choc électrique ou risque d'incendie
Pression excessive due à des connexions de bouteilles de gaz incorrectes	Risque d'explosion et d'émission de projectile
Échantillonnage de gaz combustibles	Risque d'explosion et d'incendie
Techniques de manutention, soulevage et de transport inappropriées	Blessure corporelle

Notez que la sécurité d'un système qui peut incorporer ce produit est la responsabilité de l'utilisateur final.

WARRANTY

WARRANTY POLICY (02024J)

Teledyne API (TAPI), a business unit of Teledyne Instruments, Inc., provides that:

Prior to shipment, TAPI equipment is thoroughly inspected and tested. Should equipment failure occur, TAPI assures its customers that prompt service and support will be available. (For the instrument-specific warranty period, please refer to the "Limited Warranty" section in the Terms and Conditions of Sale on our website at www.teledyne-api.com).

COVERAGE

After the warranty period and throughout the equipment lifetime, TAPI stands ready to provide on-site or in-plant service at reasonable rates similar to those of other manufacturers in the industry. All maintenance and the first level of field troubleshooting are to be performed by the customer.

NON-TAPI MANUFACTURED EQUIPMENT

Equipment provided but not manufactured by TAPI is warranted and will be repaired to the extent and according to the current terms and conditions of the respective equipment manufacturer's warranty.

PRODUCT RETURN

All units or components returned to Teledyne API should be properly packed for handling and returned freight prepaid to the nearest designated Service Center. After the repair, the equipment will be returned, freight prepaid.

The complete Terms and Conditions of Sale can be reviewed on our website at www.teledyne-api.com.

CAUTION – Avoid Warranty Invalidation

Failure to comply with proper anti-Electro-Static Discharge (ESD) handling and packing instructions and Return Merchandise Authorization (RMA) procedures when returning parts for repair or calibration may void your warranty. For anti-ESD handling and packing instructions please refer to the manual, Fundamentals of ESD, PN 04786, in its "Packing Components for Return to Teledyne API's Customer Service" section. The manual can be downloaded from our website at http://www.teledyne-api.com. RMA procedures can also be found on our website.

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

1. INTRODUCTION

The Teledyne API Model SCI-552 is a system controller for ozone delivery systems. The SCI-552 provides electronic control interfaces for a number of typical system components, including ozone generators, EV valves, mass flow controllers (MFC), back-pressure controllers (BPC), Model 452 ozone sensors, and a water chiller. The SCI-552 also provides hardware and software support for a number of system interlock functions.

The SCI-552 provides flexibility for the end user, allowing control of the system via the front panel user interface, MODBUS serial interface, or using various discrete digital and analog I/O points.

The Teledyne API (TAPI) Model SCI-552 system controller interface (SCI) is designed to support two ozone generators providing two channels (A and B) of ozone output per controller. The SCI-552 directly interfaces with the following Ozone Delivery System (ODS) components and interfaces:

- Host Computer via a bi-directional RS232 serial communications link
- 2 Ozone Generators (one for each channel)
- 2 Model 452 Ozone Sensors (one for each generator/channel)
- 4 Mass Flow Controllers (MFC) that control the flow rate of each process gas (one O_2 MFC and one N_2 MFC per channel)
- 2 Backpressure Controllers (one for each channel)
- 2 EV Valves (one for each channel)
- Water Chiller (global to both channels)
- System Interlocks (global to both channels)
- Remote system-level controls and status I/O

CAUTION

As with all equipment, ensure a thorough understanding of safety considerations and system startup/shutdown procedures, including:

- System Safety
- System/Subsystem Descriptions
- System Startup
- System Interlock Testing
- System Shutdown
- Lockout/Tagout Procedures

1.1. SPECIFICATIONS

Table 1-1. Specifications

PARAMETER	SPECIFICATION
Display	2 lines x 40 character, alphanumeric, vacuum fluorescent
Resolution	0.01% w/w
Cycle Time	Continuous measurement, refreshed every 2 sec or 0.5 Hz
Digital I/O	RS-232-C, bi-directional
Device I/O	
Generator Support	Designed to support 2 Ozone Generators, industry standard pinout
MFC Control	4 - DB-9 Connectors for 4 MFC's
Backpressure Controller	2 - DB-15 Connector for 2 Electronic Backpressure regulators
Ozone Generator	2 - 10 pin IDC header for 2 Ozone Generators
EV Valve	2 - 2 Pin Connector – 24 VDC
Chiller	1 - DB-15 Connector for chiller
Customer System I/O	
Interlocks	1 - System Hardware Interlocks 1 - Communications Interlocks (User Configurable) 1 - Software Interlock (Backpressure)
Serial Digital	RS-232, DB-25 (Modbus standard – other options available)
AC Power	90 to 240VAC, 50/60 Hz
Typical Power Consumption	Less than 225 W
Dimensions (W x H x D)	19" x 7" x 9" (483 mm x 178 mm x 229 mm)
Weight	10.9 Lbs. (4.94 kg)
Environmental	Designed for indoor use only
Operating Temperature	5 - 35°C
Relative Humidity	80%, non-condensing

1.2. COMPLIANCE AND CERTIFICATIONS

This product is CE compliant and adheres to the Low Voltage and ElectroMagnetic Compatibility directives.

For any other certifications, please refer to this product's specifications sheet on our website.

2. GETTING STARTED

This section introduces the controller panels and the rear panel connections.

2.1. INSTALLATION

The system is designed for installation in a standard 19-inch rack mount location. Figure 2-1 shows dimensions. Ensure the minimum clearance requirements are met: 24” (60 cm) at both front and rear.

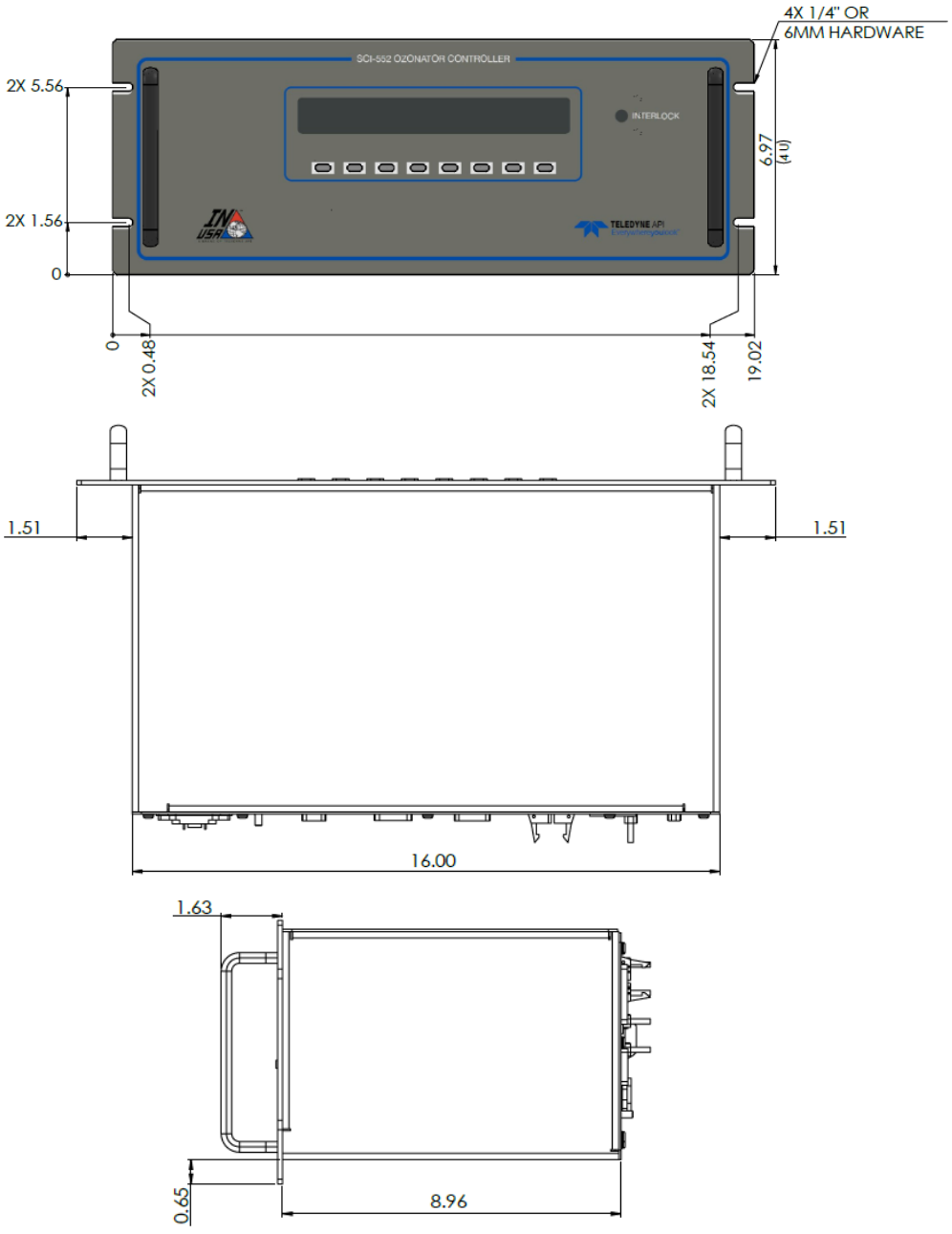

Figure 2-1. SCI-552 Dimensions (from top to bottom: front, top, side views)

2.2. INSTRUMENT LAYOUT

This section illustrates the front and rear panels and the internal chassis layout.

2.2.1. FRONT PANEL

The front panel (Figure 2-2) includes a display of concentration, other parameter readings, and the status of the system components, and a row of operational keys corresponding to selectable fields in the display.

Figure 2-2. Front Panel Layout

Information that can be viewed includes:

- Ozone Concentration
- Ozone Sensor Operating Parameters
- MFC Flow Reading
- Generator ON/OFF Status

User-definable parameters and functions include:

- Zero Ozone Sensor
- Generator Setpoint
- Generator Parameters Menu
- MFC Flow Setpoint
- MFC Parameters Menu
- EV Valve On/Off

2.2.2. REAR PANEL

The rear panel (Figure 2-3) includes connectors for power and interface components.

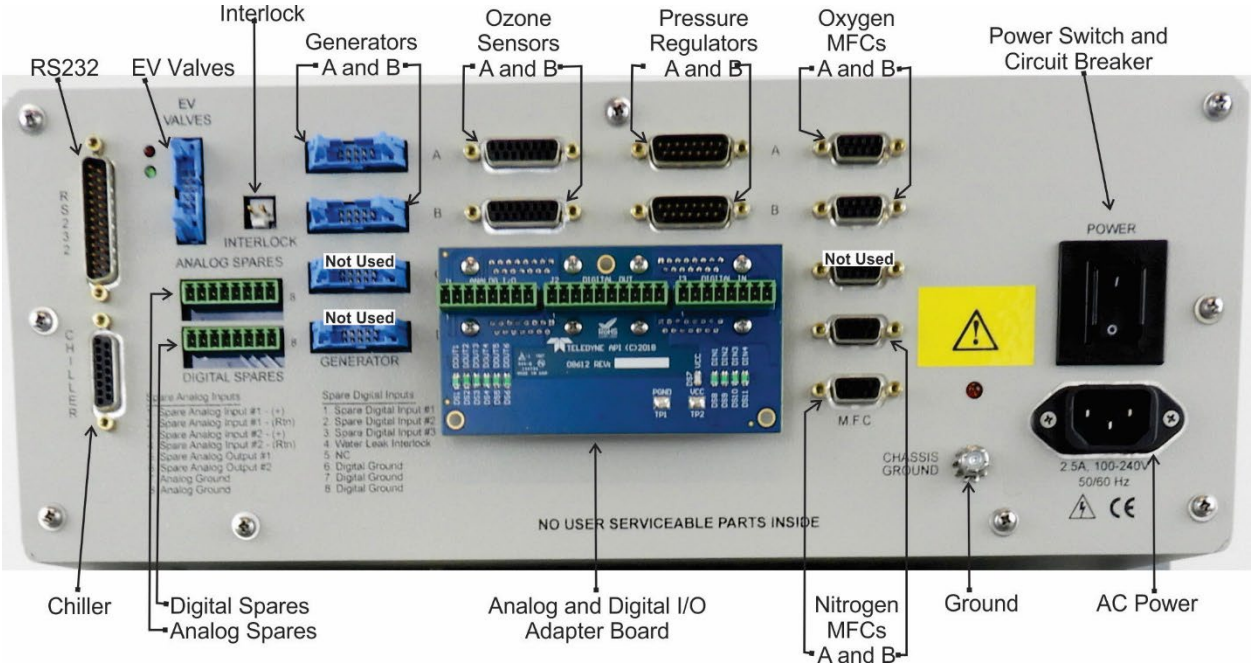

Figure 2-3. Rear Panel Layout

Table 2-1. Rear Panel Description

CONNECTOR PORT	FUNCTION
CHILLER	Connects to the external chiller to cool the generators.
RS232	Provides bi-directional communication between controller and the host computer.
LED Indicators	Top (red) blinking = receive; bottom (green) blinking = transmit [not lit = no activity]
EV VALVES	Connects to the shutoff valves if present.
INTERLOCK	Puts the system in a “Safety state”
ANALOG SPARES	[reserved for future development)
DIGITAL SPARES	[reserved for future development)
ANALOG and DIGITAL I/O ADAPTER BOARD	Option. Connects Signal I/Os
GENERATOR A	Connects to the Channel A generator.
GENERATOR B	Connects to the Channel B generator.
GENERATOR C	Not Used
GENERATOR D	Not Used
OZONE SENSOR A	Connects to the Channel A ozone sensor.
OZONE SENSOR B	Connects to the Channel B ozone sensor.
OZONE SENSOR C	Not Used
OZONE SENSOR D	Not Used
PRESSURE REGULATOR A	Connects to the Channel A Back Pressure Controls (BPC)
PRESSURE REGULATOR B	Connects to the Channel B Back Pressure Controls (BPC)
PRESSURE REGULATOR C	Not Used
PRESSURE REGULATOR D	Not Used
MFC A	Connects to the Channel A Mass Flow Controller for oxygen.
MFC B	Connects to the Channel B Mass Flow Controller for oxygen.
MFC C	Not Used
MFC D	Connects to the Channel B Mass Flow Controller for nitrogen
MFC N_2	Connects to the Channel A Mass Flow Controller for nitrogen.
CHASSIS GROUND	Connects ground to the system chassis
LED 	Power indicator: steady lit red when powered ON; not lit when powered OFF. **WARNING: There is still power in the chassis even if this LED is not lit, unless all power is removed from the chassis by disconnecting the power cord.**
POWER	Rocker switch is a combination Power on/off and circuit breaker switch. Press the switch to turn the SCI-552 on or to reset the circuit breaker
AC Power Receptacle	Rated for 90 to 240VAC, 50/60 Hz
Model Label	Includes voltage and frequency specifications

2.3. CONNECTIONS AND CONFIGURATION

This section presents the electrical connections and startup process for setting up and preparing the instrument for operation.

2.3.1. ELECTRICAL CONNECTIONS

WARNING – Electrical Shock Hazard

- **High Voltages are present inside the instrument's case.**
- **Power connection must have functioning ground connection.**
- **Do not defeat the ground wire on power plug.**
- **Turn off instrument power before disconnecting or connecting electrical subassemblies.**

CAUTION – Avoid Damage to the Instrument

Ensure that the AC power voltage matches the voltage indicated on the instrument's model/specs label before plugging it into line power.

2.3.1.1. CONNECTING RS232 COMMUNICATION INTERFACE

Connect a 25-pin connector cable between the RS232 connection port and a host computer for remotely setting up and controlling the system components and for data uploads.

The RS-232 communication protocol is MODBUS RTU (Section Table 3-3).

- Baud Rate: 9600
- Parity: Even
- Data Bits: 8
- Stop Bits: 1
- Flow Control: None

Table 2-2. RS-232 Pin Assignments

PIN	SIGNAL	TYPE	FUNCTION
2	RX	Input	Receive line
3	TX	Output	Transmit line
7	GND	Power	

All other pins are not used.

2.3.1.2. Connecting the Chiller (Optional Device)

Connect a 15-pin connector cable between the Chiller and the rear-panel connector port labeled CHILLER.

Table 2-3. Chiller Pin Assignments

PIN	DESCRIPTION	REMARKS	OZONE CONTROLLER I/O
1	Chassis GND		
2	No Connection		
3	Remote Start	GND for remote start, float to stop	Digital Output
4	Remote Start +24 V	+24V (100mA max) to drive chiller relays	+24V Output
5	No Connection		
6	Analog GND	Analog ground	Analog Return
7	Water Temp	Chiller water temperature	Analog Input
8	Setpoint Out	Not Used	
9	No Connection		
10	Chiller ON Status -	Dry contact '-' for chiller status ON/OFF	Digital Return
11	Chiller ON Status +	Dry contact '+' for chiller status ON/OFF	Digital Input
12	Digital Display Input	Not Used	
13	No Connection		
14	No Connection		
15	Water Temp Setpoint	Signal from controller for water temp	Analog Output

2.3.1.3. Connecting the EV Valves (Optional Devices)

Connect a 10-pin connector cable between the EV (shutoff) valves and the top connector port with locking ramp labeled EV VALVES.

Table 2-4. EV Valves Pin Assignments

PIN	DESCRIPTION	OZONE CONTROLLER I/O
1	+24 for EV1	+24 Digital Output
2	EV1 Return	
3	+24 for EV2	+24 Digital Output
4	EV2 Return	
5	NC	
6	NC	
7	NC	
8	NC	
9	NC	
10	NC	

2.3.1.4. Connecting the Interlock

A hardware interlock is provided on the rear panel of the controller; its connector port is a two pin Molex (0.157") w/Locking Ramp, labeled INTERLOCK; the mating connector for this port should be a Molex PN 0009503021 or equivalent. Connect the facilities interlock system into this connector port to remotely disable the generator(s) in the event of a facilities malfunction.

When the pins of these connectors are shorted together, which must be done with less than 50 Ohms resistance, the INTERLOCK is satisfied and the ozone generators and EV valves will function. When the pins are open, it is in an interlocked state and the ozone generators and EV valves are disabled.

For additional information on the interlocks, see Section 4.

2.3.1.5. CONNECTING THE GENERATORS

In the column of connection ports labeled GENERATOR, connect a 10-pin connector cable between the connector port labeled A and the ozone generator assigned Channel A, and another 10-pin connector cable between the connector port labeled B and the ozone generator assigned Channel B.

Table 2-5. Ozone Generator Pin Assignments

10-PIN AT SCI	DESCRIPTION	REMARKS	OZONE CONTROLLER I/O
1	To + LED Opto Isolator + 24 Volts	Power required for Generator ON	
3	Opto Isolator Return	Connect to +24 V Common to start generator (16 mA)	Digital Output
5	Power Setpoint (1-10)	0 to 10 Volts (drives 10k Ω load)	Analog Output
7	Analog GND	Ground for analog output	
9	Not Used		
2	Generator ON Status	GND = ON, Floating = OFF This pin is connected to 24 GND by an opto isolator.	Digital Input
4	+24 Volt Return	Ground for the 24 Volt subsystem	
6	Not Used		
8	No Connection		
10	Not Used		

2.3.1.6. CONNECTING THE OZONE SENSORS

In the column of connection ports labeled M452 OZONE connect a 15-pin connector cable from the ports labeled A and B to their respective Model 452 ozone sensors.

Communication includes serial, analog, and digital signals:

- Analog signals from the sensors are the concentration; the serial communication sends the values of pressure and temperature inside the ozone sensor.
- The digital signals report status of the sensor.

Table 2-6. Ozone Sensor Pin Assignments

PIN	DESCRIPTION	REMARKS	OZONE CONTROLLER I/O
1	O_3 Concentration	Signal Return	Analog Input -
2	O_3 Concentration	Signal Positive	Analog Input +
3	Power Common		
4	+15 Volt Supply		
5	+15 Volt Supply		
6	Zero O_3 Sensor	Pulse to Power Common for 1 second for Zero Cal	Digital Output
7	Not Used		
8	Sensor OK	On - Normal, Off - Warning	Digital Input #1
9	Invalid Reading	On - Warning Off - Normal	Digital Input #2
10	Lamp Low	On - Warning Off - Normal	Digital Input #3
11	Cell Dirty	On - Warning Off - Normal	Digital Input #4
12	Digital Output Common		Digital Input Common
13	RS-485 – A		RS-485 comm
14	RS-485 – B		RS-485 comm
15	Power Common		

2.3.1.7. Connecting the Pressure Regulators (Optional Devices)

In the column of connection ports labeled PRESSURE REGULATOR (refer to Figure 2-3), connect two 15-pin connector cables from the ports labeled A and B to their respective electronic backpressure controllers.

Table 2-7. Pressure Regulator Connector Pin Assignments

PIN	DESCRIPTION	REMARKS	OZONE CONTROLLER I/O
1	Valve Test Point	Not Used	
2	Pressure Reading	0 to 5 Volt	Analog Input
3	Valve Close	Not Used	
4	Valve Open	Use to ensure valve open for purge	Digital Output
5	PWR Common	400 mA max	
6	-15 Volts Power	200 mA max	
7	+15 Volts Power	200 mA max	
8	Pressure Setpoint	0 to 5 Volt	Analog Output
9	No Connection		
10	Optional Input	Not Used	
11	Signal Common	Analog GND	
12	Signal Common	Analog GND	
13	Trip Point A Out	Not Used	
14	Trip Point B Out	Not Used	
15	Chassis GND	Chassis GND	

2.3.1.8. Connecting the MFCs

In the column of connector ports labeled MFC, connect a 9-pin connector cable between each of the connector ports and their respective MFCs.

Table 2-8. Mass Flow Controller Connector Pin Assignments

PIN	DESCRIPTION	REMARKS	OZONE CONTROLLER I/O
1	Purge/Close Valve	Not Used	
2	Flow Reading	0 to 5 Volt	Analog Input
3	+15 Volts Power	150 mA max	
4	Power Common	300 mA max	
5	-15 Volts Power	150 mA max	
6	Flow Setpoint	0 to 5 Volt	Analog Output
7	Signal Common	Analog GND	
8	Signal Common	Analog GND	
9	VTP	Not Used	

2.3.1.9. CONNECTING THE SIGNAL I/O (OPTION)

The expansion board option allows extended functionality.

ANALOG I/O

Table 2-9. Signal I/O Option Analog I/O Connector Pin Assignments

PIN	DESCRIPTION	ELECTRICAL SPECS	FUNCTION
1	Analog Out 1	0-10 VDC, 5mA max	Ch A Ozone Concentration; 0-25 wt%
2	Ground		
3	Analog Out 2	0-10 VDC, 5mA max	Ch B Ozone Concentration; 0-25 wt%
4	Ground		
5	Analog In 1	0-5 VDC	Ch A Generator Power Setting[1]
6	Return 1		
7	Analog In 2	0-5 VDC	Ch B Generator Power Setting[1]
8	Return 2		

[1] Only used when Servo Mode is DISABLED (front panel: SETUP>O3>CH [A/B]>SERV>OFF).

DIGITAL OUT

Table 2-10. Signal I/O Option Digital Out Connector Pin Assignments

PIN	DESCRIPTION	ASSOCIATED LEDS	ELECTRICAL SPECS	FUNCTION
1	Digital Out 1	DOUT 1	Dry Relay Contacts, 1A max	Gen A On/Off Status
2	Common[1]			
3	Digital Out 2	DOUT 2	Dry Relay Contacts, 1A max	Gen B On/Off Status
4	Common[1]			
5	Digital Out 3	DOUT 3	Dry Relay Contacts, 1A max	Undefined
6	Common[1]			
7	Digital Out 4	DOUT 4	Dry Relay Contacts, 1A max	Undefined
8	Common[1]			
9	Digital Out 5	DOUT 5	Dry Relay Contacts, 1A max	Undefined
10	Digital Out 6	DOUT 6	Dry Relay Contacts, 1A max	Undefined

[1]Common side of all relay contacts are interconnected.

DIGITAL IN

Table 2-11. Signal I/O Option Digital In Connector Pin Assignments

PIN	DESCRIPTION	ASSOCIATED LEDS	ELECTRICAL SPECS	FUNCTION
1	Digital In 1	DIN1	Connect 24VDC (20mA min.) to the input and 24VDC RTN to the respective Return Pin to enable the generator.	Ch A Generator On/Off Control, edge-triggered
2	Digital In 1 RTN			
3	Digital In 2	DIN2	Connect 24VDC (20mA min.) to the input and 24VDC RTN to the respective Return Pin to enable the generator.	Ch B Generator On/Off Control, edge-triggered
4	Digital In 2 RTN			
5	Digital In 3	DIN3	Connect 24VDC (20mA min.) to the input and 24VDC RTN to the respective Return Pin to enable the valve.	Ch A EV Valve On/Off Control, edge-triggered
6	Digital In 3 RTN			
7	Digital In 4	DIN4	Connect 24VDC (20mA min.) to the input and 24VDC RTN to the respective Return Pin to enable the valve.	Ch B EV Valve On/Off Control, edge-triggered
8	Digital In 4 RTN			

2.3.1.10. CONNECTING THE CHASSIS GROUND

Connect a grounding wire to the system chassis.

2.3.1.11. CONNECTING THE POWER

Connect a power cable, capable of carrying the power rating of the SCI-552, between the plug receptacle of the SCI-552 and the power source.

2.3.2. STARTUP AND FUNCTIONAL CHECKS

To turn the SCI-552 Controller on, press the POWER switch on the rear panel. The LED to its left illuminates (red) when the power is ON, and the SCI-552 goes through a multi-step start-up procedure. The following sections provide an orientation to the display screen and initial actions prior to operating the system.

2.3.2.1. Display Description

Figure 2-4 provides an orientation to the display layout. The menu hierarchy is presented in Section 3.1. The eight keys below the display (Figure 2-2, keyboard) correspond to eight fields in the bottom row of the display. Depending on the active menu, the only buttons that function are those below a field with a selectable menu or setting.

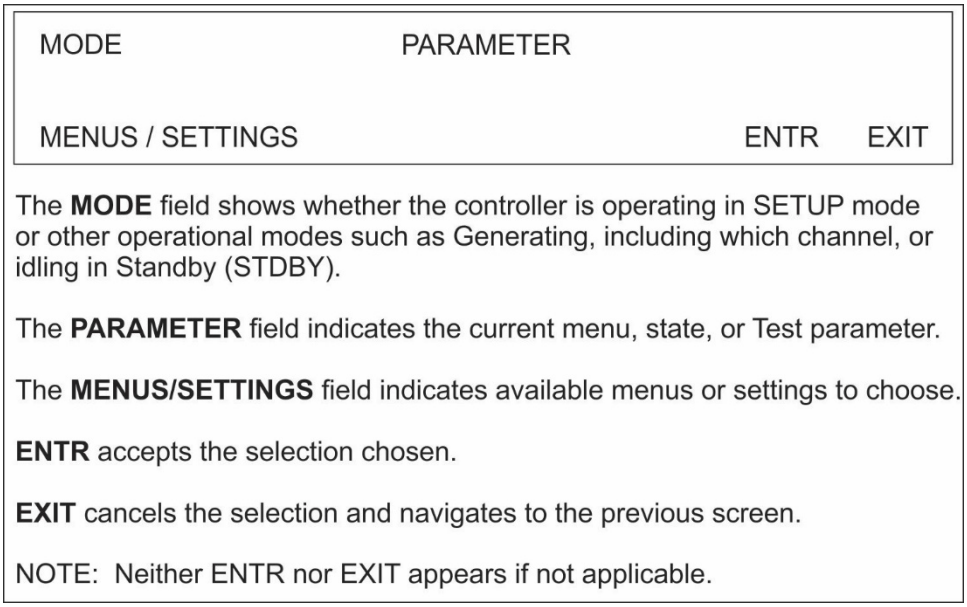

Figure 2-4. Display Layout

2.3.2.2. FUNCTIONAL CHECKS

After start-up, run a functional check from the main screen, TEST MEASUREMENT (Figure 2-5), by scrolling the <TST TST> menus (pressing the first and second keys from the left).

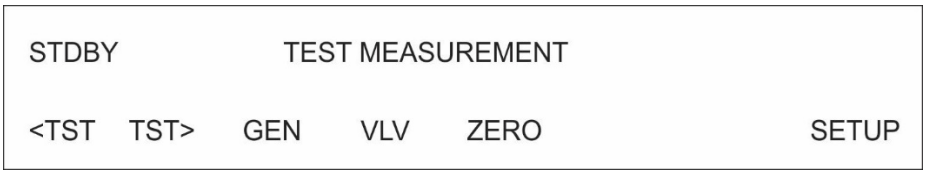

Figure 2-5. Main Screen, Test Measurement

Table 2-12. Test Measurements

DISPLAY TEXT	SIGNAL DESCRIPTION
O2MFC A: X.XX V	Channel A O_2 MFC Actual Voltage
O2MFC B: X.XX V	Channel B O_2 MFC Actual Voltage
N2MFC A: X.XX V	Channel A N_2 MFC Actual Voltage
N2MFC B: X.XX V	Channel B N_2 MFC Actual Voltage
O3 A: XX.X wt%	Channel A O_3 Concentration
O3 B: XX.X wt%	Channel B O_3 Concentration
SEN A_P:	Channel A Ozone Sensor Pressure
SEN B_P:	Channel B Ozone Sensor Pressure
BPC A: X.XX V	Channel A Backpressure Actual Voltage
BPC B: X.XX V	Channel B Backpressure Actual Voltage
GEN A DRV: X.XX V	Channel A O_3 Gen Drive Voltage
GEN B DRV: X.XX V	Channel B O_3 Gen Drive Voltage
GEN A STAT: ON(OFF)	Channel A O_3 Gen ON/OFF Status
GEN B STAT: ON(OFF)	Channel B O_3 Gen ON/OFF Status
EV VALVE A: ON(OFF)	Channel A EV Valve
EV VALVE B: ON(OFF)	Channel B EV Valve
CHILLER IS: X.XXX V	Chiller Actual Voltage
TIME=	System Time

2.3.3. CONFIGURING THE CONTROLLER FOR THE SYSTEM COMPONENTS

In order to properly operate the system, the ozone sensors and mass flow controllers must be configured as follows in Sections 2.3.3.1 and 2.3.3.2, respectively.

2.3.3.1. OZONE SENSOR

Configure the connected ozone sensor with its maximum concentration range: Set each channel, A and B, with the O3_MAX_CONC_[A/B] Var (refer to the ozone sensor's serial tag for the correct value) through the VARS menu using the 929 password.

Configure the displayed concentration units as well. Each channel can be set individually through the VARS menu using the 929 password and configuring the O3 _CONC_UNITS_[A/B] for each channel respectively.

- If the connected sensor concentration units are Wt% then the Controller's concentration units can be set to either Wt% or g/Nm^3.
- If the sensor's units are mg/L, then the Controller's concentration units must be set to mg/L.

NOTE: The Controller will only work properly when both of following conditions are met:

- the ozone sensor's concentration units are set to Wt% or mg/L
- the sensor's analog output is configured for 0-5VDC. This was configured at the factory and is shown in the serial tag.

2.3.3.2. MASS FLOW CONTROLLERS (MFCS)

The Oxygen (O_2) and Nitrogen (N_2) MFCs can be set up in each channel to operate independent from each other or slaved together (this affects both channels as neither can be set individually when slaved). Either setup can be configured in the Controller through the VARS menu (N2_SLAVE_ENABLE [ON/OFF]) using the 929 password.

- ON enables slave mode
- OFF disables slave mode

NOTE: N_2 Flow is slaved to O_2 Flow by default (setpoint automatically calculated based on O_2 Flow Setpoint) and will not appear in the Channel A/B screen unless it is first disabled (N2_SLAVE_ENABLE set to OFF).

2.3.3.1. EV VALVE

When using EV Valves to start or stop flow in the system, enable them with the EV_VALVE_ENABLE [ON/OFF] Var:

- ON allows their operation in conjunction with the MFCs
- OFF allows only the MFCs to control the flow.

2.3.3.2. CONCENTRATION ANALOG OUTPUTS

The ozone concentration analog output can be configured to work with a datalogger or other PLC-type device. Scale the ozone concentration to the user's range with the O3_CONC_SCALE_[A/B] VAR using the 929 password. The scale is based on full-scale concentration range on a 0-10 V output.

3. OPERATING AND CONTROLLING THE SYSTEM

Operating the Ozone Delivery System (ODS) entails setting up its components through the system controller interface, the SCI-552. Refer to Figure 3-1 for the instructions in this section.

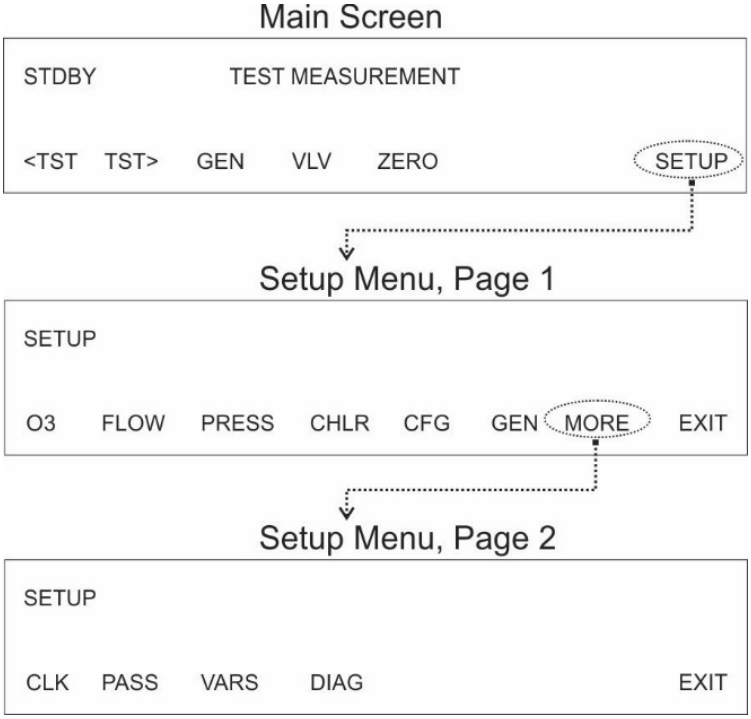

Figure 3-1. Entering the Setup Menu

3.1. CONTROLLING THE SYSTEM COMPONENTS

This section presents the sequential order in which to set up each component before actually running the generator in order to prevent an inadvertent interlock. As noted in the Electrical Connections section, some devices are optional, and their corresponding menus will not show in the software if not enabled. The settings explained next are to set the control voltage to the component. The user is expected to make the conversion between control voltage and units of the component.

3.1.1. CONTROLLING THE MFCS (FLOW)

SETUP>FLOW>CH A [CH B]>[O2/N2*]>[voltage value]>ENTR

* When N2 slave is set to OFF

1. In the SETUP menu, select FLOW.
2. In the FLOW screen, select the channel to set its flow rate: CH A or CH B.
3. In the CH [A/B] screen, select either O2 or N2*.
4. In the CH [A/B] [O2/N2] FLOW SET screen, press the keys to cycle through each value until the desired voltage value is reached.

5. Press ENTR to accept or EXIT to discard and return to the previous screen.
6. Repeat for each gas, each channel.

NOTE: N_2 Flow is slaved to O_2 Flow by default (setpoint automatically calculated based on O_2 Flow Setpoint) and will not appear in the Channel A/B screen unless it is first disabled by setting the N2_SLAVE_ENABLE Var to OFF.

3.1.2. Controlling the EV Valves (VLV)

VLV>CH A [CH B]> OFF [ON]>EXIT

1. In the main screen, select VLV.
2. In the EV VALVE screen, select the channel (CH A or CH B) to change its EV valve state.
3. In the selected channel, press the "ON" button to enable the EV valve (If the display shows "OFF" the EV valve is already enabled).
4. Press EXIT to return to the previous screen.
5. Repeat for the other channel.

NOTE: For the Analog and Digital I/O board (Section 2.3.1.9), activate and stop flow as follows:

- To activate flow for each channel: connect 24VDC to the respective connector pins for each EV Valve. If the MFC voltages are set to 0.000V (No Flow) activating the EV valve will result in a flow interlock.
- To stop flow for each channel, disconnect the respective connector pins.

3.1.3. Controlling the Backpressure Regulators (PRESS)

SETUP>PRESS>CH A [CH B]>[voltage value]>ENTR

1. In the SETUP menu, select PRESS.
2. In the Backpressure screen, select the channel to set its backpressure: CH A or CH B.
3. In the CH [A/B] BACKPRESSURESET screen, press the keys to cycle through each value until the desired voltage value is reached.
4. Press ENTR to accept or EXIT to discard and return to the previous screen.
5. Repeat for the other channel.

3.1.4. Controlling the Chiller (CHLR)

SETUP>CHLR>[voltage value]>ENTR

1. In the SETUP menu, select PRESS.
2. In the CHILLER SET screen, press the keys to cycle through each value until the desired voltage value is reached.
3. Press ENTR to accept or EXIT to discard and return to the previous screen.

3.1.5. ZEROING THE OZONE SENSORS (ZERO)

Setup for controlling the ozone sensors should have been completed prior to this per Section 2.3.3.1; the ZERO menu is provided to run a zero calibration on the sensors.

ZERO>[CH A/CH B]>ZERO

1. Ensure there is flow through the ozone sensor (refer to section 3.1.2 if your system includes EV valves, and/or refer to section 3.1.1).
2. In the main screen, select ZERO.
3. In the SENSOR ZERO CAL screen, select the channel to calibrate: CH A or CH B.
4. In the CH [A/B] SENSOR ZERO screen press ZERO. (If the display shows "- - -" then there is either no flow or the system is interlocked. Resolve by clearing the fault and resetting the MFC flows per Section 3.1.1); when Zero is complete, press EXIT.
5. Repeat for the other channel if needed.

3.1.6. CONTROLLING THE GENERATORS (O3 AND GEN MENUS)

If the generator is to be controlled by Servo, ensure Servo is enabled (Section 3.1.6.1), then set the concentration. If the generator is to be controlled manually, ensure Servo is not enabled and then skip forward to Section 3.1.6.2 to set up the generator power.

3.1.6.1. SERVO CONTROL

SETUP>O3>[CH A/CH B]>SERV>[OFF/ON]

1. In the SETUP menu, select O3.
2. In the O3 CONFIG screen, select the channel for setting the Servo state: CH A or CH B.
3. In the CH [A/B] O3 CONFIG screen, press SERV.
4. In the CH [A/B] SERVO ENABLE screen, press ON or OFF as needed.
5. Press ENTR to accept the setting.
6. Press EXIT to return to each previous screen until reaching the O3 CONFIG screen to repeat for the other channel if needed.

Next, set the concentration.

SETUP>O3>[CH A/CH B]>CONC>[CH A/CH B] SERVO SETPOINT [conc value]

1. In the CH [A/B] O3 CONFIG screen (navigate per Steps 1 & 2 above), press CONC.
2. In the CH [A/B] SERVO SETPOINT screen, press the keys to cycle through each value until the desired concentration value is reached.
3. Press ENTR to accept the value, or press EXIT to discard.
4. Press EXIT to return to each previous screen until reaching the O3 CONFIG screen to repeat for the other channel if needed.
5. Upon completion of setting the concentration value, exit to each preceding screen until reaching the main screen.
6. Skip forward to Section 3.1.6.3 for the GEN menu to generate ozone.

3.1.6.2. MANUAL CONTROL (SERVO DISABLED)

For manual control of the system, ensure that the Servo control is disabled first (Section 3.1.6.1).

SETUP>O3>[CH A/CH B]>PWR

1. In the SETUP menu, select O3.
2. In the O3 CONFIG screen, select the channel for setting the power: CH A or CH B.
3. In the CH [A/B] O3 CONFIG screen, press PWR.
4. In the CH [A/B] GEN POWER [voltage value] screen, press the keys to cycle through each value until the desired voltage value is reached.
5. Press ENTR to accept the value, or press EXIT to discard.
6. Press EXIT to return to each previous screen until reaching the O3 CONFIG screen to repeat for the other channel if needed.
7. Upon completion of setting the concentration value, exit to each preceding screen until reaching the main screen, and continue to Section 3.1.6.3 for the GEN menu.

3.1.6.3. OZONE GENERATION

The ozone generator can be turned on and off for each channel so that one or both can run.

GEN>[CH A/CH B]>[ON/OFF]

1. From the main screen, press the GEN button.
2. In the GENERATE menu select the channel for controlling its generator: CH A or CH B.
3. In the GEN [A/B] screen press ON or OFF as needed. (If the display shows "- - -" then there is either no flow or the system is interlocked. Resolve by clearing the fault and resetting the MFC flows per Section 3.1.1).
4. Press EXIT to return to each preceding screen.

Additional configurations for the generators are in the SETUP>GEN menu.

NOTE: For the Analog and Digital I/O board (Section 2.3.1.9), activate or stop ozone generation as follows:

- To activate: connect 24VDC to the respective connector pins for each generator. However, if the MFC voltages are set to 0.000V (No Flow), activating the Generator will result in a flow interlock. Resolve by clearing the fault and resetting the MFC flows per Section 3.1.1
- To stop: either disconnect the respective connector pins or follow the preceding steps.

3.1.7. SETTING UP OTHER SCI-552 PARAMETERS

The SCI-552's internal clock (CLK), password (PASS), variables (VARS), and diagnostics (DIAG) can be viewed and configured in the 2nd page of the SETUP menu.

3.1.7.1. SETUP> MORE>CLK

In this menu set the Time in hours and minutes and the Date in day, month, year format.

3.1.7.2. SETUP> MORE>PASS

In this menu enable or disable the requirement for a password to make changes to the SC-552 configurations.

3.1.7.3. SETUP> MORE>VARS

In this menu redefine the operational parameters that are defined by certain software variables.

Table 3-1. SCI-552 Software Variables

VAR	DESCRIPTION	DEFAULT
N2_SLAVE_ENABLE	Enables the "slave" operation of the N_2 MFC's	TRUE
N2_SLAVE_MULTIPLIER	Multiplier for determining N_2	1.000
EV_VALVE_AUTO_MODE	Automatically handles EV Valve based on generator control	OFF
EV_VALVE_ON_DELAY	Delay in seconds for O_3 Generator enable after GEN turn-on (only used when EV_VALVE_AUTO_MODE is TRUE).	0.000 Seconds
EV_VALVE_OFF_DELAY	Delay in seconds for EV Valve enable after GEN turn-off (only used when EV_VALVE_AUTO_MODE is TRUE)	0.000 Seconds
O3_CONC_UNITS_A	Selects concentration units for O_3 display and setpoint values. Wt%,g/Nm^3 or mg/L	GNM3
O3_CONC_UNITS_B	Selects concentration units for O_3 display and setpoint values. Wt%, g/Nm^3 or mg/L	GNM3
O3_CONC_SCALE_A	Ch. A O_3 concentration analog output scale factor.	20
O3_CONC_SCALE_B	Ch. B O_3 concentration analog output scale factor.	20
EV_VALVE_ENABLED	Selects whether EV valve is used in system	ON
LATCH_WARNINGS	Determines whether Interlock warnings on display are latching, or real-time.	ON
COMM_TIMEOUT	Maximum time allowed between MODBUS poll requests before triggering COM Interlock	4.0 Seconds

3.1.7.4. SETUP>MORE>DIAG

This menu offers several features, and in its I/O submenu various digital and analog signals can be viewed and some digital signals can be toggled ON and OFF.

3.1.8. FRONT PANEL MENUS

Table 3-2. Menu Hierarchy

MAIN MENU	SUBMENU 1	SUBMENU 2	SUBMENU 4	SUBMENU 5
<TST TST>				
	(Test Meas)			
GEN				
	CH A			
		ON/OFF		
	CH B			
		ON/OFF		
VLV				
	CH A			
		ON/OFF		
	CH B			
		ON/OFF		
ZERO				
	CH A			
		ZERO		
	CH B			
		ZERO		
SETUP				
	O3			
		CH A		
			CONC	
				(conc value)
			SERV (servo cntrl)	
				ON/OFF
			PWR (manual ctrl)	
				(voltage value)
		CH B		
			CONC	
				(conc value)
			SERV	
				ON/OFF
			PWR	
				(voltage value)
	FLOW			
		CH A		
			O2	
				(value)
			N2	
				(value)
		CH B		
			O2	
				(value)
			N2	
				(value)

MAIN MENU	SUBMENU 1	SUBMENU 2	SUBMENU 4	SUBMENU 5
	PRES			
		CH A		
			(value)	
		CH B		
			(value)	
	CHLR			
		(value)		
	CFG			
		Product Info		
	GEN			
		(O3 GEN Tables)		
	MORE			
		CLK		
			TIME	
			DATE	
		PASS		
			ON/OFF	
		VARS		
			(refer to Software Variables table)	
		DIAG (diagnostics)		
			SIGNAL I/O	(set signals in Mv)
			ANALOG OUTPUT	
			D/A CALIBRATION	
			GEN (gen table)	
			FACTORY OPTIONS	

3.2. CONTROLLING/OPERATING THE SYSTEM REMOTELY

After the operating parameters have been configured, the SCI-552 can be controlled with the Analog and Digital I/O board or by the rear panel RS232 port via MODBUS.

MODBUS is the primary means of communication between the SCI-552 ozone Controller and the tool's host computer by offering expanded control capabilities. See section 2.3.1.1 for communication interface connection.

3.2.1. MODBUS REGISTER

Table 3-3. SCI-552 MODBUS Register

MODBUS Register Address (dec., 0-based)	Description	Units
MODBUS Floating Point Input Registers (32-bit IEEE 754 format; read in high-word, low-word order; read-only)		
0	Chiller Actual Voltage	V
10	CH A Ozone Sensor Concentration	g/Nm3
12	CH A Ozone Sensor Concentration (reports in either units, per the sensor units configuration)	Wt% or mg/L
14	CH A BPC Actual Voltage	V
16	CH A O2 MFC Actual Voltage	V
18	CH A N2 MFC Actual Voltage	V
20	CH A Ozone Sensor Pressure	psia
30	CH B Ozone Sensor Concentration	g/Nm3
32	CH B Ozone Sensor Concentration (reports in either units, per the sensor units configuration)	Wt% or mg/L
34	CH B BPC Actual Voltage	V
36	CH B O2 MFC Actual Voltage	V
38	CH B N2 MFC Actual Voltage	V
40	CH B Ozone Sensor Pressure	psia
MODBUS Floating Point Holding Registers (32-bit IEEE 754 format; read/write in high-word, low-word order; read/write)		
0	Chiller Setpoint Voltage	V
10	CH A Servo Setpoint Conc (reports in either units, per the sensor units configuration)	Wt% or mg/L
12	CH A Servo Setpoint Conc	g/Nm^3
14	CH A O3 Gen Voltage Setpoint[1]	V
16	CH A BPC Setpoint Voltage	V

MODBUS Register Address (dec., 0-based)	Description	Units
18	CH A O2 MFC Setpoint Voltage	V
20	CH A N2 MFC Setpoint Voltage[3]	V
30	CH B Servo Setpoint Conc (reports in either units, per the sensor units configuration)	Wt% or mg/L
32	CH B Servo Setpoint Conc	g/Nm^3
34	CH B O3 Gen Voltage Setpoint[1]	V
36	CH B BPC Setpoint Voltage	V
38	CH B O2 MFC Setpoint Voltage	V
40	CH B N2 MFC Setpoint Voltage[3]	V
MODBUS Discrete Input Registers (single-bit; read-only)		
0	Chiller Status	
1	CH A O3 Gen Status	
2	CH B O3 Gen Status	
5	Cabinet Interlock Status[2]	
6	External Interlock Status[2]	
7	Pressure Interlock Status[2,4]	
8	Flow Interlock Status[4]	
9	Chiller Interlock Status[2]	
10	CH A O3 Sensor OK Flag	
11	CH A O3 Sensor Invalid Reading Flag	
12	CH A O3 Sensor Lamp Low Flag	
13	CH A O3 Sensor Cell Dirty Flag	
30	CH B O3 Sensor OK Flag	
31	CH B O3 Sensor Invalid Reading Flag	
32	CH B O3 Sensor Lamp Low Flag	
33	CH B O3 Sensor Cell Dirty Flag	
MODBUS Coil Registers (single-bit; read/write)		
0	Chiller Start	
1	CH A Servo Enabled	
2	CH B Servo Enabled	
10	CH A EV Valve	

MODBUS Register Address (dec., 0-based)	Description	Units
11	CH A O3 Gen	
12	CH A O3 Sensor Zero	
30	CH B EV Valve	
31	CH B O3 Gen	
32	CH B O3 Sensor Zero	

1 Only updated when CH X Servo Enable = False
2 Only report True if corresponding interlock function is enabled
3 Only update when N2_SLAVE_ENABLE = FALSE, otherwise treat as read-only.
4 True if any respective channel interlock is active

4. INTERLOCKS

The Interlocks will stop one or both generators from generating ozone when triggered. Each interlock can be enabled and disabled per user configuration in the Vars menu. (Also see Sections 2.3.1.4 and 3.1). When an Interlock message appears across the display, the message can be suppressed by pressing the TEST button in order to navigate to and view the parameter values. To return to the message, press the MSG button.

4.1. CABINET INTERLOCK

The SCI-552 Controller provides two interlocks: one is a hardware physical interlock (labeled INTERLOCK on cabinet rear panel); the other is a software interlock. When the hardware interlock is in a closed state, it supplies a 24 VDC control signal to the generator(s) and EV valve(s) for operational readiness. The generator, controlled by the SCI-552, will not produce ozone until the Physical Interlock is in a closed state.

Note that the contacts of this two-pin connector must be closed with less than 50 Ohms resistance.

The software interlock, named Cabinet Interlock, is enabled/disabled through the VARS menu, using the 929 password. When both the Cabinet Interlock is enabled (CAB_INTLK_ENAB=ON) and the hardware Interlock pins are not shorted together (not in a closed state), the software will reset the MFC Flow(s) to 0.0 V, close the EV valve(s) if present, and stop ozone production by the Generator(s).

To clear the CABINET INTERLOCK warning message, ensure the two hardware Interlock pins are shorted together with the prescribed resistance, and press the CLR button.

4.2. CHILLER INTERLOCK

The Controller monitors the Chiller On status via the rear panel Chiller connector, and will interlock the generator if the Chiller On status is not active. The software interlock, named Chiller Interlock, is enabled/disabled through the VARS menu, using the 929 password. When both the software Chiller Interlock is enabled (CHLR_INTLK_ENAB=ON) and the Chiller On status is inactive, the Generators are disabled.

To clear the CHILLER INTERLOCK warning message, ensure the Chiller is powered on (troubleshoot as needed), and press the CLR button.

4.3. PRESSURE INTERLOCK

The Controller monitors the Backpressure Regulator (BPR) output signal and triggers the Pressure Interlock when the process gas pressure goes above a setpoint. The software interlock, named Pressure Interlock, is enabled/disabled through the VARS menu, using the 929 password. When both the software Pressure Interlock is enabled (PRESS_INTLK_ENAB=ON) and the BPR return voltage is greater than the BPR setpoint, the software will reset the MFC Flow(s) to 0.0 V, close the EV valve(s) if present, and stop ozone production by the Generator(s).

To clear the PRESSURE INTERLOCK warning message, ensure the fault is corrected and press the CLR button.

4.4. FLOW INTERLOCK

The Controller monitors the MFC voltages and the states of EV valve(s) if present and Generator(s). The software interlock, named Flow Interlock, is enabled/disabled through the VARS menu, using the 929 password. When both the software Flow Interlock is enabled (FLOW_INTLK_ENAB=ON) and the MFC return voltage differs from MFC setpoint voltage by a value that exceeds its threshold, the software will reset the MFC Flow(s) to 0.0 V, close the EV valve(s) if present, and stop ozone production by the Generator(s).

To clear the FLOW INTERLOCK warning message, ensure the fault is corrected (reset MFC flows, and verify that the N2 or O2 MFC A: and B: values match the corresponding SET value), and press the CLR button.

4.5. COMMUNICATIONS INTERLOCK

When operating the SCI-552 remotely by the serial port, and the communication is interrupted (when data requests are not received within the allotted time), this interlock will shut down the components in a safe manner. The software interlock, named Comm Interlock, is enabled/disabled through the VARS menu, using the 929 password. When both the software Comm Interlock is enabled (COMM_INTLK_ENAB=ON) and communication is established with the controller, the interlock is satisfied.

Once communication is reestablished, this interlock can be cleared by pressing the CLR button.

To adjust the maximum duration between data requests, navigate to the VARS menu and change the value for COMM_TIMEOUT.

4.6. EXTERNAL INTERLOCK

Spare interlock triggered through a rear panel connector if required for customer application.

5. TROUBLESHOOTING

This section presents possible difficulties and their suggested solutions.

Table 5-1. Troubleshooting Guide

CONDITION	SOLUTION
Controller doesn't power up	Check that power cable is connected at both ends.
Controller doesn't activate ozone generation.	Check whether an Interlock was triggered. If so, check the Chiller temp, the backpressures, and the O_2 flows.
Menu items don't appear in the screen.	Menu items only appear when applicable.
Display shows "- - -"	Check whether an Interlock was triggered, or check to ensure there is flow.

Table 5-2. Warning Messages and Solutions

Warning Messages	Cause	Remarks/Possible Solutions
SYSTEM RESET	System restart due to power cycle or power failure	Press CLR
CABINET INTERLOCK	Hardware INTERLOCK connector on rear panel is electrically open.	Troubleshoot the external, facility interlock system
CHILLER INTERLOCK *	Chiller status is set to OFF.	Turn on Chiller and ensure it is set to receive remote commands.
PRESS INTERLOCK A *	Channel A out of pressure range	Check for leaks
PRESS INTERLOCK B *	Channel B out of pressure range	Adjust process pressure to within specification
FLOW INTERLOCK A	Channel A low MFC flow	Adjust flow setpoint
FLOW INTERLOCK B	Channel B low MFC flow	Make sure feed gas valves are open and at proper pressure
COMM INTERLOCK *	Connection to host computer lost or timed out	Check connection with host computer.
EXTERNAL INTERLOCK *	User-defined	Check facilities wiring

* Must be enabled through the Vars menu (default = disabled).

6. MAINTENANCE AND SERVICE

There are no user-serviceable parts in the SCI-552. Please contact the factory for service or troubleshooting.

6.1. TECHNICAL ASSISTANCE

If this manual and its troubleshooting & service section do not solve your problems, technical assistance may be obtained from:

Teledyne API Technical Support
9970 Carroll Canyon Road
San Diego, California 92131-1106 USA

Toll-free Phone: +1 800-324-5190
Phone: +1 858-657-9800
Fax: +1 858-657-9816
Email: api-techsupport@teledyne.com
Website: http://www.teledyne-api.com/