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Section 1.0 Introduction

AutoScope's OCS-200 is an advanced capability observatory controller that controls roll off roofs, domes, or rotating building (MMT-type) enclosures of any size. The OCS-200 senses and keeps track of shutter and dome positions, monitors and controls power, senses emergency conditions, provides automatic call ups and alarms, and monitors weather conditions. The OCS-200 consists of the following hardware:

- OCS-200 observatory controller
- PCS-100 power control system
- Oregon Microsystems PC-34 observatory controller card
- American Power Conversion 1.2 KW UPS
- Weather Station
- Cloud Detector
- Precipitation Detector
- Cables and connectors to limit switches and motors
- Audible alarms for roof/dome movements and emergency conditions
- Interface electronics for dome shutter or roll off roof
- RCS-100 Roof Control Unit (optional)
- Air conditioner/heater unit (optional)
- Insulated blanket for equipment rack (optional)

Section 2.0 Theory of Operation

In manned observatories, the human operator has the responsibility of opening the observatory only when conditions are appropriate. If conditions deteriorate, the operator must close the observatory promptly. These responsibilities can be automated completely using AutoScope's OCS-200.

The decision to open an observatory can be fairly straightforward. The computer must be functioning, the wind must not be too strong, there must be no precipitation falling (either as rain or snow,) the relative humidity should not be too near 100%, and opening observatory should not occur in the presence of daylight or cloud cover.

This decision can be made by a computer once various environmental sensors are read and the position of the sun is calculated.

Our approach to observatory closure under normal circumstances is to rely totally on the computer with the single exception of failure of the computer itself. To detect computer failures (including any software failures,) the OCS-200 requires the computer to check the weather and other sensors frequently. Upon successful monitoring, a hardwired "watchdog" timer is reset. If, for any reason whatsoever, the computer fails to reset the watchdog timer, the watchdog will time out in a short time and the observatory will close.

If the AC power should fail for much longer than an instant, which is not an unusual occurrence on mountain tops, the dome shutter should be closed. The telescope and observatory control computer monitors the power status, and should the input to the UPS drop out, the computer can shut down the observatory through the OCS-200 in an orderly manner. After closing the observatory, the control computer continues to monitor AC power and, when power is reestablished, the observatory is opened and observations are resumed.

2.1 OCS–200 Observatory Control Card

The Observatory Control Card used in AutoScope systems is an Oregon Micro Systems PC-34 motion control card. It is located in the computer dedicated to telescope/observatory control (or TOCC). The card allows access to several axes of motion control, ideal for AutoScope telescope systems using an ALT-AZ format. Although motion control is an outstanding feature of the OMS card, it is mainly used for its user defined input/output capabilities. For a more detailed description of the OMS PC-34, see Appendix A.4. For information on PC-34 default settings see the TCS-200 Technical Reference Manual.

2.2 OCS–200 Input/Output

The OCS-200 observatory controller has a number of optically isolated inputs and outputs via individual Opto-22 modules. The I/O modules are located within the OCS-200 and communicate with the Observatory Control Card through the cable labeled P208A/P208B attached at port J208A. For I/O module specifications, see Appendix A.2.

Input Modules 201 and 202 (or IM201 and IM202) are respectively the Shutter Open Limit and Shutter Close Limit. These are limit switches mounted on the observatory's roll off roof track. When operating the roof either automatically or manually, these limit detectors signal to the computer that the roof is either opened or closed. If no switch is enabled, the roof is assumed to be in transit. The Shutter Open Limit switch is connected to the OCS-200 module

via the cable labeled P201A/P201B at the port J201A. The Shutter Close Limit switch's cable is labeled P202A/P202B and mounts to the module at port J202A.

Input Module 205 (or IM205) is used for precipitation detection. An external precipitation detector is mounted outside of the enclosure. It determines either rain or snow conditions, using a built in heater to melt the snow should the condition arise. The output of this detector is either HI, signaling precipitation, or LO, signaling dry conditions. It is connected to the control module via the cable labeled P204A/P204B at the OCS-200 port J204A. For more information on the Precipitation Detector, see Appendix A.8.

Two auxiliary inputs are available on the OCS-200 that can be tailored to meet the specific needs of the user. As an example, the modules IM203 and IM204 can be used as limit switches for louver control. Limit switches are mounted on the louvers to determine if they are completely open or completely closed. If neither of the switches are enabled, it is assumed the louvers are in transit. The cables used for these inputs are labeled P212A/P212B and P213A/P214B. Respectively, these cables connect the Louver Open Limit and Louver Close Limit to the OCS-200 at the ports labeled J212A and J213A. If Louver control is used for the telescope system, the Louver Motors would be driven by the OMS PC-34 Card.

Three I/O modules are used to monitor the Uninterruptable Power Supply (UPS) and whether the telescope system is on external or internal power. Module IM206 is the Low Battery Indicator which receives a TTL level signal generated by the UPS. A HI signal corresponds to battery low condition. During normal operation the signal is LO, indicating that UPS power is available. Module IM207 is the UPS Power Fail signal. Upon input to the module from LOW to HI, the UPS shuts itself down. The UPS is assumed in normal operation when this input is LO. Output Module 202 (or OM202) executes a UPS shutdown signal initiated by the telescope control system user. A TTL HI level signal is sent to the UPS informing the supply to shut down immediately. Normal operation is assumed when this signal is LO. The three preceding OCS-200 output modules are connected to the UPS via the cable labeled P203A/P203B at port J203A. For more information on the UPS, see Appendix A.6.

Two I/O modules are used to monitor the status of the Watchdog Timer. OM201 is the Watchdog Reset module for the OCS-200. This output, which must be turned on and off rapidly, resets the watchdog timer. Upon reset, the timer immediately begins its countdown to time out. The rapid on/off sequence, as opposed to just turning on, is required to preclude a situation where the computer hung up for some reason and left this output in a permanent "on" position. Upon timing out, the roofs begin to close using the Roof Control Unit (RCS-100) until the "close limits" are reached. For communication between the OCS-200 Watchdog and the RCS-100, cable P217A/P502A is fastened to port J217A on the observatory controller and port J502A on the roof controller. For more information on the Roof Control Unit (RCS-100), see section 2.5. Module IM208 is the Watchdog Sense which signals the computer either HI implying timed out, or LO for Reset. For more information on the Watchdog Timer, see Appendix A.7.

Modules OM205 and OM206 are the Shutter Power and Shutter Direction outputs respectively. When OM205 is enabled, via observatory control card, power to the shutter motors becomes available to the RCS-100. With OM205 disabled, no power is available to the shutter motors. OM206 is the direction output from the observatory control card. Enabling OM206, corresponds to the open direction of the shutters. Conversely, disabling this module corresponds to closing the shutters. These OCS-200 outputs are connected to the RCS-100 via cable P214A/P501A fastened at ports J214A and J501A.

Output module OM203 is the Emergency Alarm indicator. The alarm is mounted within the observatory and is used strictly for any class I emergencies detrimental to proper operation of the AutoScope system. The cable connecting the alarm and OCS-200 is labeled P206A/P206B and fastens to port J206A.

Output module OM204 is the Audible Alarm which operates a horn located in the observatory informing the system user of shutter or roof movement. The cable connecting the alarm and the OCS-200 is labeled P205A/P205B and fastens to port J205A.

Two additional output modules are available to the telescope system users for their own definition. OM207 and OM208 may be accessed at OCS-200 ports J215A and J216A respectively. They can be used to close external relays (such as the +24 Volt Coil Guardian 1415-2C used in AutoScope control systems) to control the power of remote devices. In a more specific case, port J215A is used to power the Omega A/D Transmitter used for cloud detection.

Table 2-1 below lists the required cables for input and output to the OCS-200 and their corresponding ports.

Table 2-1
OCS-200 I/O Cables and Respective Ports

Cable	Port	Description
P201A/P201B	J201A	Shutter Open Limit
P202A/P202B	J202A	Shutter Close Limit
P203A/P203B	J203A	Uninterruptable Power Supply
P204A/P204B	J204A	Precipitation Detector
P205A/P205B	J205A	Audible Alarm
P206A/P206B	J206A	Emergency Alarm
P208A/P208B	J208A	Observatory Control Card
P209A/P209B	J209A	Dome Motor Control
P210A/P210B	J210A	Auxiliary Motor Control
P212A/P212B	J212A	Auxiliary Input #1
P213A/P213B	J213A	Auxiliary Input #2
~~P214A~~/P501A *J501A	J214A	Shutter PWR/DIR
P215A/P215B	J215A	Auxiliary Control #1
P216A/P216B	J216A	Auxiliary Control #2
P217A/P502A *J502A	J217A	Watchdog Control

*Located on the optional RCS-100 Roof Control Unit

2.3 PCS–100 Power Control System

The PCS-100 Power Controller controls the AC power for the entire telescope system. All power to the equipment passes through the power control system. At the power entry, there is single socket surge suppressor to guard against detrimental lightning strikes and other unpredictable voltage spikes. Power from this entry point passes through two relays, one for air conditioning/heater power and the other for general purpose power. Both relays can be controlled manually from the front panel.

The general power relay is controlled is also controlled by a temperature controller. The controller senses and displays the current cabinet temperature. Should this temperature fall out of preset limits (i.e., above HI limit or below LOW limit), then the general power relay is

deenergized and all power to the equipment is removed (except for the air conditioner/heater.) Power is automatically restored when the temperature comes back within the allowable range.

For safety reasons, there is also an emergency stop latching relay that removes all general power upon activation of the emergency stop switch. The emergency stop relay latches in the power off position and can only be unlatched by pressing the reset switch on the front panel. All UPS provided power is routed through a separate section of the emergency stop latching relay. Power to all UPS supplied equipment is removed upon emergency stop activation. Table 2-2 below lists the required cables for input and output to the PCS-100 and their corresponding ports.

Table 2-2
PCS-100 I/O Cables and Respective Ports

Cable	Port	Description
P305A/P506A *J506A	J305A	RCS-100 Emergency Stop
P308A/P308B	J308A	Remote Emergency Stop

*Located on the optional RCS-100 Roof Control Unit

2.4 RCS–100 Roof Control Unit

The AutoScope Roof Control Unit (RCS-100) is installed with your Control System. The Unit allows for automatic and manual control of the Shutter and Tilt Motors mounted on the observatory. The RCS-100 is equipped with two 12 Volt Car batteries used in series to produce a high current +24 Volt and +12 power supply to operate the motors. The batteries are hard wired to a battery charger which maintains the voltage requirement by charging the power sources while they are not being used. Table 2-3 below lists the required cables for input and output to the RCS-100 and their corresponding ports.

Table 2-3
RCS-100 I/O Cables and Respective Ports

Cable	Port	Description
P503A/P503B	J503A	Main Roof Close Limit
P504A/P504B	J504A	Main Roof Open Limit
P505A/P505B	J505A	Tilt Roof Open/Close Limit
P507A/P507B	J507A	Shutter Motor Power
P508A/P508B	J508A	Tilt Motor Power

2.5 Air Conditioner/Heater

A McLean Midwest Air Conditioner/Heater is mounted on top of the equipment rack. It is controlled manually from the PCS-100 power controller. In cases of extreme temperatures within the cabinet, the Air Conditioner/Heater may be used to bring the cabinet temperature

back to within the operating temperature range as defined by the temperature controller. For more information on the Air Conditioner/Heater, see Appendix A.1.

2.6 Uninterruptable Power Supply

The OCS-200 is quite sophisticated in its handling of any power failures. If the commercial power should fail, an orderly observatory shutdown procedure is initiated if power is not restored within a short period of time. This procedure uses an American Power Conversion UPS to close the observatory. The system will then shut off power to itself to conserve what battery power is left. When external power is restored, the system will restart immediately if the temperature in the equipment enclosure is within limits. For more information on the UPS, see Appendix A.7.

2.7 Weather Sensors

2.7.1 Weather Station

A digital computer weather station is mounted on the control panel with the control system modules. We use a Texas Weather Instruments Weather Report to sense wind direction and speed, the outside temperature, the inside temperature, the cabinet temperature, barometric pressure, and humidity. These sensed values are displayed on the main weather station, and are also read by the observatory control computer via RS-232. The weather station is accessed via the serial port COM2 of the telescope and observatory control computer. For more information on the weather station, see Appendix A.9.

2.7.2 Cloud Sensor

An AutoScope designed cloud sensor is mounted on the observatory weather box to inform the computer of adverse cloud coverage. The sensor uses an Optec A/D Digital Transmitter to translate analog signals from the cloud sensor to digital format such that it can be read by the observatory control computer via RS-232. The cloud sensor is accessed via the serial port COM1 of the TOCC computer.

2.7.3 Precipitation Detector

An Optec precipitation detector is mounted on the observatory weather box. It determines either rain or snow conditions using a built in heater to melt the snow should the condition arise. The output of this detector is either HI, signaling precipitation, or LO signaling dry conditions. It is connected to the control module via the cable labeled P204A/P204B at the OCS-200 port J204A.

2.8 Insulated Blanket for Equipment Rack

To protect the control system cabinet from adverse conditions, an insulated blanket for the equipment rack is provided. The front of the cover zippers off for easy access to the control panels and computers of the AutoScope system. The insulated cover is water resistant and contains 2.5 cm of insulation.

Section 3.0 Operating Procedure

3.1 Safety Precautions

WARNING!

Be careful not to touch any exposed ports on the back panel of the control modules while the system is powered-up. The exposed leads may be carrying AC and/or DC voltages which can cause electrical shock both to the user and system if grounded improperly. Also, do not remove the cover to any of the control system modules for troubleshooting the system.

3.2 Power–Up System Procedure

To power up the system it is necessary to turn on the master power using the key switch on the PCS-100 Power Controller and then the main power switch and the air conditioning power switch (if applicable). Finally, turn on the UPS to provide power for units which are power protected.

3.3 OCS–200 Observatory Controller

To operate the OCS-200 observatory controller, simply engage the POWER switch to its ON position. Also, on the RCS-100 roof controller flip the AUTO/MANUAL switch to its automatic position. The OCS-200 will now run fully automatic.

3.4 PCS–100 Power Controller

To operate the PCS-100 the SYSTEM ENABLE switch must be turned to its ON position. For power to be available to the rest of the telescope system, several conditions must be met. Firstly, the MAIN POWER switch must be engaged. All system power (except for the Air Conditioner/Heater) enters through this switch. The second condition that must be met is to be within the temperature limits defined by the temperature controller. If the cabinet temperature is out of range, power will not be available to the telescope system. Lastly, the EMERGENCY STOP switch must not be latched. Power will not be available until the RESET switch is pushed.

Power to the Air Conditioner/Heater is connected directly to the system input AC power. To operate the Air Conditioner/Heater at any time engage the AIR CONDITIONER switch. To turn the Air Conditioner/Heater off, disengage the AIR CONDITIONER switch.

3.5 RCS–100 Roof Controller

To operate the RCS-100 simply engage the power switch to its ON position and select the AUTO/MANUAL switch for automatic operation. Only in rare instances will you need to operate the observatory roofs in the manual position. If the situation arises, flip the AUTO/MANUAL switch to its manual position. The OPEN/STOP/CLOSE switch is now enabled, and manual operation of the roof is possible. Be sure to change the AUTO/MANUAL switch back to its automatic position when you are finished operating the roof manually. **Note: The batteries inside the RCS-100 must remain fully charged. Leave power to the RCS-100 ON at all times.**

3.6 Omega Temperature Controller

The Omega Temperature Controller is initially programmed by AutoScope Corporation. However, if AC power should fail to the control system, the controller can lose all AutoScope predefined parameters. This brief guide will demonstrate how to reset or change the control parameters for the operating environment. Only the parameters that will not affect the practical operation of the control system module will be discussed in this guide. For a more detailed guide, see the Omega Operator's Manual for the CN9000A Series Temperature Controller or Appendix A.5.

The temperature controller can be programmed through the four (4) front panel keys. The keys on the temperature control panel will be referenced to throughout this manual as STAR, P, DOWN, and UP (from left to right.) There are 25 programmable functions, but only a few are of interest to the telescope user. Before attempting to program the controller, make sure that it is displaying the current temperature, thus confirming power is available.

The first step in programming the temperature controller is to set the ideal operating temperature for the system. This value is referred to as Setpoint 1 or SP1. As an AutoScope default, SP1 is set to 21.1 Celsius Degrees. To set SP1, press and hold in the STAR button. The current SP1 value is now displayed. To change SP1, hold the STAR button in and press either the UP button to increase setpoint or the DOWN button to decrease the setpoint temperature. (Note: If the temperature does not change, you must "unlock" SP1 by following the steps for Function 3 Setpoint Lock/Unlock.) When you arrive at the desired temperature release the STAR button. The current temperature is now displayed. Press the STAR button to check the setpoint value. It should be noted that all temperatures are in Celsius degrees. If Fahrenheit degrees is desired, it can be changed by following the steps in this manual.

To initiate a programming session, push the P button once. The display should now have the readout 0.0 with the trailing zero blinking. The readout is in the format of (Option#).(Function#). In this case, option 0 and function 0. This is a default setting, and many of the functions will be left in this state when programming the controller. Save this default setting by pushing the UP button.

Function 1 (Manual Reset) should now appear in the format 0.0.1. Save this default setting by pressing the UP button once.

Function 2 (Setpoint 2 Adjust) should now appear in the format X.X.2 where X.X is the Setpoint 2 (SP2) adjust. This setpoint X.X is the Celsius degree offset from SP1 programmed earlier. As an AutoScope default, SP2 is set to 5.5 Celsius Degrees (therefore, an 11.0 Celsius Degrees range since the magnitudes of SP2 and -SP2 track one another.) To change the SP2 offset, press the STAR button while the Function 2 display is blinking. The SP2 offset should now be blinking. Use the UP and DOWN keys to adjust the temperature range of SP2. Adjusting SP2 higher causes the operating range of the power controller to become wider. Decreasing SP2 causes the operating range of the power controller to become narrower. See

the setpoint map in Figure 3-1 below for relative positions of SP1 and SP2 After setting the desired SP2 offset, press the STAR button once to return to the blinking function number. Save the current setting by pressing the UP button once.

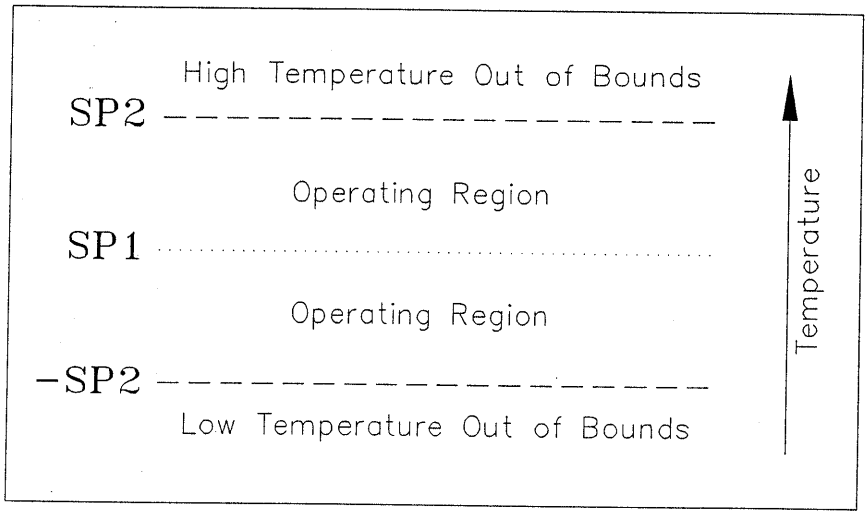

Figure 3–1

Temperature Controller Setpoint Map for PCS–100

Function 3 (Setpoint Lock) should now appear in the format X.3 where X is the option number. Option 0 means that SP1 is unlocked and can be changed as mentioned earlier in this guide. Option 1 locks SP1 such that it cannot be changed inadvertently. To select either option, press the STAR key. Use the UP or DOWN buttons to select either option. After setting the desired option, press the STAR button once to return to the blinking function number. Save the current setting by pressing the UP button once.

Function 4 (On/Off Output) should now appear in the format 7.4. The function 4 option should always be set to "7". Press the UP button once to keep this setting.

Function 5 (Deadband Output 1) should now appear in the format X.5 where X is the option number. The options here are defined by the amount the temperature must fall back into the operating range before the Output 1 relay returns to its normal operating state. For example, option 0 refers to 1.25% times the span defined by the SP2 temperature range. If the SP2 range is set at 10.0 Celsius degrees and the temperature rose above the SP2 out of bounds marker, then the Output 1 relay will return to its normal operating state once the temperature drops 0.125 Celsius degrees below the SP2 out of bounds marker. The options for this function are listed below in Table 3-1. After setting the desired deadband, save the setting by pressing the UP button once.

Functions 6 through 9 should always be left at their default states. Press the UP button until Function 10 is reached.

Function 10 (On/Off Output 2) should now appear in the format 0.10. The function 10 option should always be set to "0". Press the UP button once to keep this setting.

Function 11 (Deadband Output 2) should now appear in the format X.11 where X is the option number. The options here are defined by the amount the temperature must fall back into the operating range before the Output 2 relay returns to its normal operating state. These options are set as are the options for Function 5. After setting the desired deadband, save the setting by pressing the UP button once.

Functions 12 through 15 should always be left at their default states. Press the UP button until Function 16 is reached.

Function 16 (Input Sensor Select) should now appear in the format 6.16. The function 16 option should always be set to "6". Press the UP button to keep this setting.

Function 17 (Negative Temperatures) should now appear in the format 1.17. The function 17 option should always be set to "1". Press the UP button to keep this setting.

Table 3-1

PROPORTIONAL BAND/DEADBAND (OUTPUT 1)

(Op#).(Fn#)	Parameter/Comment	
	SP1 Proportional band/Gain	SP1 Hysteresis in ON/OFF mode (Deadband)
0.5	2.5% x range	1.25% x span
1.5	0.5%	0.25%
2.5	1%	0.5%
3.5	2%	1%
4.5	3%	1.5%
5.5	5%	2.5%
6.5	10%	5%
7.5	20%	10%
8.5	1.5%	0.75%
9.5	4%	2%
10.5	6%	3%
11.5	7%	3.5%
12.5	8%	4%
13.5	14%	7%
14.5	100%	50%
*15.5	AT value	

Function 18 (Display Resolution) should now appear in the format 1.18. The function 18 option should always be set to "1". Press the UP button to keep this setting.

Function 19 (SP2 Operating Mode) should now appear in the format 3.19. The function 19 option should always be set to "3". Press the UP button to keep this setting.

Functions 20 and 21 should always be left at their default states. Press the UP button until Function 22 is reached.

Function 22 (Celsius/Fahrenheit Selection) should now appear in the format 0.22. This default setting causes the temperature controller to display Celsius degrees at all times. To change to Farenheit the P button once. This exits you from the programming mode and the new settings, if any, are now in effect.

3.7 Power–Down System Procedure

To completely power down the system turn off the keyswitch in the PCS-100 Power Controller and also turn off the UPS.

Table 3-2

PROPORTIONAL BAND/DEADBAND (OUTPUT 2)
Set similarly to first setpoint Proportional Band (Function .5).

(Op#). (Fn#)	SP2 Proportional Band/Gain	SP2 Hysteresis in ON/OFF mode (Deadband)
0.11	2.5% x range	1.25%
1.11	0.5% x range	0.25%
2.11	1% x range	0.5%
3.11	2% x range	1%
4.11	3% x range	1.5%
5.11	5% x range	2.5%
6.11	10% x range	5%
7.11	20% x range	10%
8.11	1.5% x range	0.75%
9.11	4% x range	2%
10.11	6% x range	3%
11.11	7% x range	3.5%
12.11	8% x range	4%
13.11	14% x range	7%
14.11	100% x range	50%

Section 4.0 Troubleshooting Guide

The purpose of this guide is to help the user locate sources of possible malfunctions. It is not intended for the user to dismantle the control system to pinpoint error sources. This could prove dangerous to both the user and the control system itself.

If it is determined that the failure of any internal component has occurred, return the control system module to AutoScope Corporation for replacement.

4.1 Preliminary Checks

Before proceeding, check the following points to make sure that power to the control system modules is available. Check the power of the three AutoScope control modules (OCS-200, PCS-100 and RCS-100.)

Specifically, with the power switch OFF on the OCS-200 check the fuse in fuse holder F201 on the back panel. If the fuse has failed, replace it with an AGC Series Fast Acting 3 Amp fuse. Securely fasten power cord J211 on back panel.

With the power OFF on the PCS-100, check the fuse in fuse holder F304 on the back panel. If the fuse has failed, replace it with an AGC Series Fast Acting 3 Amp fuse. Also, check the fuses in fuse holders F301, F302, and F303 on the back panel. If any of these fuses has failed, replace it with an ABC Series Fast Acting 15 Amp fuse. Securely fasten power cord J304 on back panel.

With the power OFF on the RCS-100, check the fuse in fuse holder F501 on the back panel. If the fuse has failed, replace it with an AGC Series Fast Acting 3 Amp fuse. Securely fasten power cord J509 on back panel.

4.2 Using the BB–100 Test Box

The BB-100 Test Box simply allows access to internal test points without physically opening the control system module. To use the BB-100 as intended, you will need a volt meter with a full scale range of at least 125 Volt RMS. If no meter is available, a simple oscilloscope will suffice.

To setup the BB-100, securely fasten the 37 pin cable labeled TEST between the control system module test port and the test box port. Connect the COMMON lead of your volt meter (or oscilloscope) to Output 01 of the BB-100. With POWER ENGAGED, voltage level measurements can be performed by inserting the test lead of your volt meter to the corresponding test box output.

4.3 OCS–200 Test Points

On the OCS-200 control module, there are 28 (numbers 01 through 28 on the BB-100) accessible test points. To access these points, the 37 pin cable labeled TEST should be connected between the port J207A on the OCS-200 and the port on the back panel of the BB-100. With the BB-100 setup, as explained in Section 4.2, simple voltage measurements can be performed.

With the system power ON, the expected voltage levels of the test box outputs and their respective states are listed below in Table 4-1. Again, this guide **is** designed for the user to locate possible malfunctions. It **is not** designed as a tool for rewiring of the control module. If a significant deviation between the expected and actual voltage occurs, contact AutoScope Corporation promptly thus minimizing system down time.

WARNING!

DO NOT reference the test lead to any output except Output 01. Voltage measurements referenced to other test box outputs could lead to electrical shock and possible damage to the control system module.

Table 4-1
OCS-200 Test Points and Expected Voltages

Output 01: Reference Ground	Requisite: Power On
Output 02: Ground Power Supply 1	Requisite: Power On
State: NA	Voltage : 0.0 VDC
Output 03: Ground Power Supply 2	Requisite: Power On
State: NA	Voltage : 0.0 VDC
Output 04: Signal Ground	Requisite: Power On
State: NA	Voltage : 0.0 VDC
Output 05: Line In	Requisite: Power On
State: NA	Voltage : 125.0 VAC
Output 06: Power Supply 1	Requisite: Power On
State: NA	Voltage : 24.0 VDC
Output 07: Power Supply 2	Requisite: Power On
State: NA	Voltage : 5.0 VDC
Output 08: Shutter Open Limit	Requisite: Power On
State1 : NOT AT LIMIT	Voltage1 : 0.0 VDC
State2 : AT LIMIT	Voltage2 : 24.0 VDC
Output 09: Shutter Close Limit	Requisite: Power On
State1 : NOT AT LIMIT	Voltage1 : 0.0 VDC
State2 : AT LIMIT	Voltage2 : 24.0 VDC
Output 10: Auxiliary Input #1	Requisite: Power On
State1 : NOT AT LIMIT	Voltage1 : 0.0 VDC
State2 : AT LIMIT	Voltage2 : 24.0 VDC
Output 11: Auxiliary Input #2	Requisite: Power On
State1 : NOT AT LIMIT	Voltage1 : 0.0 VDC
State2 : AT LIMIT	Voltage2 : 24.0 VDC
Output 12: Rain Detection	Requisite: Power On
State1 : RAIN	Voltage1 : 0.0 VDC
State2 : NO RAIN	Voltage2 : 5.0 VDC
Output 13: UPS Low Battery	Requisite: Power On
State1 : LOW	Voltage1 : 0.0 VDC
State2 : NOT LOW	Voltage2 : 5.0 VDC

Table 4-1
OCS-200 Test Points and Expected Voltages (continued)

Output 14: UPS Power Fail	Requisite: Power On
State1 : FAIL	Voltage1 : 0.0 VDC
State2 : NO FAIL	Voltage2 : 5.0 VDC
Output 15: Watchdog Sense	Requisite: Power On
State1 : NOT TIMED OUT	Voltage1 : 0.0 VDC
State2 : TIMED OUT	Voltage2 : 5.0 VDC
Output 16: Watchdog Reset	Requisite: Power On
State1 : RESET	Voltage1 : 0.0 VDC
State2 : NORMAL OPER	Voltage2 : 5.0 VDC
Output 17: Timed Out	Requisite: RCS Auto
State1 : NORMAL OPER	Voltage1 : 0.0 VDC
State2 : TIMED OUT	Voltage2 : 24.0 VDC
Output 18: Reset	Requisite: RCS Auto
State1 : NORMAL OPER	Voltage1 : 0.0 VDC
State2 : RESET	Voltage2 : 24.0 VDC
Output 19: Kill UPS	Requisite: Power On
State1 : NORMAL OPER	Voltage1 : 0.0 VDC
State2 : KILL	Voltage2 : 5.0 VDC
Output 20: Emergency Alarm	Requisite: Power On
State1 : ALARM ON	Voltage1 : 0.0 VDC
State2 : ALARM OFF	Voltage2 : 24.0 VDC
Output 21: Audible Alarm	Requisite: Power On
State1 : ALARM ON	Voltage1 : 0.0 VDC
State2 : ALARM OFF	Voltage2 : 5.0 VDC
Output 22: Shutter Power A	Requisite: RCS Auto
State1 : POWER NOT AVAIL	Voltage1 : 0.0 VDC
State2 : POWER AVAIL	Voltage2 : 24.0 VDC
Output 23: Shutter Power B	Requisite: RCS Auto
State : NA	Voltage : 24.0 VDC
Output 24: Shutter Direction A	Requisite: RCS Auto
State1 : CLOSE ROOF	Voltage1 : 0.0 VDC
State2 : OPEN ROOF	Voltage2 : 24.0 VDC
Output 25: Shutter Direction B	Requisite: RCS Auto
State : NA	Voltage : 24.0 VDC
Output 26: Auxiliary Control 1	Requisite: Power On
State1 : NA	Voltage1 : NA
State2 : NA	Voltage2 : NA
Output 27: Neutral In	Requisite: Power On
State : NA	Voltage : 0.0 VAC
Output 28: Auxiliary Control 2	Requisite: Power On
State1 : NA	Voltage1 : NA
State2 : NA	Voltage2 : NA

4.4 PCS–100 Test Points

On the PCS-100 control module, there are 25 (numbers 01 through 25 on the BB-100) accessible test points. To access these points, the 37 pin cable labeled TEST should be connected between the port J307A on the PCS-100 and the port on the back panel of the BB-100. With the BB-100 setup, as explained in Section 4.2, simple voltage measurements can be performed.

With the system power ON, the expected voltage levels of the test box outputs and their respective states are listed below in Table 4-2. Again, this guide IS designed for the user to locate possible malfunctions. It is NOT designed as a tool for rewiring of the control module. If a significant deviation between the expected and actual voltage occurs, contact AutoScope Corporation promptly thus minimizing system down time.

WARNING!

DO NOT reference the test lead to any output except Output 01. Voltage measurements referenced to other test box outputs could lead to electrical shock and possible damage to the control system module.

Table 4-2
PCS-100 Test Points and Expected Voltages

Output 01: Reference Ground	Requisite: Power On
State : NA	Voltage : 0.0 VDC
Output 02: Ground Power Supply 1	Requisite: Power On
State : NA	Voltage : 0.0 VDC
Output 03: Power Supply 1	Requisite: Power On
State : NA	Voltage : 24.0 VDC
Output 04: Line In	Requisite: Power On
State : NA	Voltage : 125.0 VAC
Output 05: Neutral In	Requisite: Power On
State : NA	Voltage : 0.0 VAC
Output 06: Ground In	Requisite: Power On
State : NA	Voltage : 0.0 VAC
Output 07: AC Before Fuse	Requisite: Power On
State1: OFF	Voltage1 : 0.0 VAC
State2: ON	Voltage2 : 125.0 VAC
Output 08: AC After Fuse	Requisite: Power On
State1: OFF	Voltage1 : 0.0 VAC
State2: ON	Voltage2 : 125.0 VAC
Output 09: AC Relay Coil	Requisite: Power On
State1: OFF	Voltage1 : 0.0 VAC
State2: ON	Voltage2 : 125.0 VAC
Output 10: Unused	
Output 11: Unused	
Output 12: Unused	
Output 13: Unused	

Table 4-2
PCS-100 Test Points and Expected Voltages (continued)

Output 14: Temp Controller NO	Requisite: Power On
State : NA	Voltage : 24.0 VDC
Output 15: Temp Controller NC	Requisite: Power On
State : NA	Voltage : 0.0 VDC
Output 16: Temp Controller COM	Requisite: Power On
State1: OUT OF BOUNDS	Voltage1 : 0.0 VDC
State2: IN BOUNDS	Voltage2 : 24.0 VDC
Output 17: Temp Limit Coil	Requisite: Power On
State1: DEENERGIZED	Voltage1 : 0.0 VDC
State2: ENERGIZED	Voltage2 : 24.0 VDC
Output 18: Temp Limit AC	Requisite: Power On
State1: MAIN POWER OFF	Voltage1 : 0.0 VAC
State2: MAIN POWER ON	Voltage2 : 125.0 VAC
Output 19: UPS AC In	Requisite: Power On
State1: UPS NO POWER	Voltage1 : 0.0 VAC
State2: UPS POWER	Voltage2 : 125.0 VAC
Output 20: UPS AC Before Fuse	Requisite: Power On
State1: NO POWER	Voltage1 : 0.0 VAC
State2: POWER	Voltage2 : 125.0 VAC
Output 21: UPS AC After Fuse	Requisite: Power On
State1: NO POWER	Voltage1 : 0.0 VAC
State2: POWER	Voltage2 : 125.0 VAC
Output 22: Non UPS AC Before Fuse	Requisite: Power On
State1: NO POWER	Voltage1 : 0.0 VAC
State2: POWER	Voltage2 : 125.0 VAC
Output 23: Non UPS AC After Fuse	Requisite: Power On
State1: NO POWER	Voltage1 : 0.0 VAC
State2: POWER	Voltage2 : 125.0 VAC
Output 24: Reset Coil	Requisite: Power On
State1: ENGAGED	Voltage1 : 0.0 VDC
State2: NOT ENGAGED	Voltage2 : 24.0 VDC
Output 25: Emergency Stop Coil	Requisite: Power On
State1: ENGAGED	Voltage1 : 0.0 VDC
State2: NOT ENGAGED	Voltage2 : 24.0 VDC

4.5 RCS–100 Test Points

On the RCS-100 control module, there are 22 (numbers 01 through 22 on the BB-100) accessible test points. To access these points, the 37 pin cable labeled TEST should be connected between the port J510A on the RCS-100 and the port on the back panel of the BB-100. With the BB-100 setup, as explained in Section 4.2, simple voltage measurements can be performed.

With the system power ON, the expected voltage levels of the test box outputs and their respective states are listed below in Table 4-3. Again, this guide IS designed for the user to locate possible malfunctions. It is NOT designed as a tool for rewiring of the control module. If

a significant deviation between the expected and actual voltage occurs, contact AutoScope Corporation promptly thus minimizing system down time.

WARNING!

DO NOT reference the test lead to any output except Output 01. Voltage measurements referenced to other test box outputs could lead to electrical shock and possible damage to the control system module.

Table 4-3
RCS-100 Test Points and Expected Voltages

Output 01: Reference Ground	Requisite: Power On
State: NA	Voltage : 0.0 VDC
Output 02: Ground Power Supply 1	Requisite: Power On
State: NA	Voltage : 0.0 VDC
Output 03: Power Supply 1	Requisite: Power On
State: NA	Voltage : 24.0 VDC
Output 04: Shutter Power	Requisite: OCS200 On
State1: POWER NOT AVAIL	Voltage1 : 0.0 VDC
State2: POWER AVAIL	Voltage2 : 24.0 VDC
Output 05: Shutter Direction	Requisite: OCS200 On
State1: CLOSE ROOF	Voltage1 : 0.0 VDC
State2: OPEN ROOF	Voltage2 : 24.0 VDC
Output 06: Watchdog	Requisite: OCS200 On
State1: NORMAL OPER	Voltage1 : 0.0 VDC
State2: RESET	Voltage2 : 24.0 VDC
Output 07: Power	Requisite: OCS200 On
State1: POWER NOT AVAIL	Voltage1 : 0.0 VDC
State2: POWER AVAIL	Voltage2 : 24.0 VDC
Output 08: Direction	Requisite: OCS200 On
State1: CLOSE ROOF	Voltage1 : 0.0 VDC
State2: OPEN ROOF	Voltage2 : 24.0 VDC
Output 09: Main Close Limit	Requisite: OCS200 On
State1: ROOF STOP	Voltage1 : 0.0 VDC
State2: ROOF CLOSING	Voltage2 : 24.0 VDC
Output 10: Main Open Limit	Requisite: OCS200 On
State1: ROOF STOP	Voltage1 : 0.0 VDC
State2: ROOF OPENING	Voltage2 : 24.0 VDC
Output 11: Tilt Close Limit	Requisite: OCS200 On
State1: ROOF STOP	Voltage1 : 0.0 VDC
State2: ROOF CLOSING	Voltage2 : 24.0 VDC
Output 12: Tilt Open Limit	Requisite: OCS200 On
State1: ROOF STOP	Voltage1 : 0.0 VDC
State2: ROOF OPENING	Voltage2 : 24.0 VDC

Table 4-3
RCS-100 Test Points and Expected Voltages (continued)

Output 13: +24 Battery	Requisite: None
State : NA	Voltage : 24.0 VDC
Output 14: +12 Battery	Requisite: None
State : NA	Voltage : 12.0 VDC
Output 15: Main Roof Relay	Requisite: OCS200 On
State1: DEENERGIZED	Voltage1 : 0.0 VDC
State2: ENERGIZED	Voltage2 : 24.0 VDC
Output 16: Tilt Roof Relay	Requisite: OCS200 On
State1: DEENERGIZED	Voltage1 : 0.0 VDC
State2: ENERGIZED	Voltage2 : 24.0 VDC
Output 17: Shutter Motor A	Requisite: K503 ENGZ
State1: OPEN ROOF	Voltage1 : 0.0 VDC
State2: CLOSE ROOF	Voltage2 : 24.0 VDC
Output 18: Shutter Motor B	Requisite: K503 ENGZ
State1: CLOSE ROOF	Voltage1 : 0.0 VDC
State2: OPEN ROOF	Voltage2 : 24.0 VDC
Output 19: Tilt Motor A	Requisite: K504 ENGZ
State1: OPEN ROOF	Voltage1 : 0.0 VDC
State2: CLOSE ROOF	Voltage2 : 24.0 VDC
Output 20: Tilt Motor B	Requisite: K504 ENGZ
State1: CLOSE ROOF	Voltage1 : 0.0 VDC
State2: OPEN ROOF	Voltage2 : 24.0 VDC
Output 21: Direction Motor	Requisite: OCS200 On
State1: CLOSE ROOF	Voltage1 : 0.0 VDC
State2: OPEN ROOF	Voltage2 : 24.0 VDC
Output 22: Battery Charger	Requisite: Power On
State1: NOT CHARGING	Voltage1 : 0.0 VDC
State2: CHARGING	Voltage2 : 24.0 VDC

4.6 Last Resort

If a system malfunction cannot be localized using the above troubleshooting guide, remove the control module in question from the rack and return it to AutoScope Corporation. A new module will be shipped promptly upon request.