TELEDYNE
ADVANCED POLLUTION INSTRUMENTATION
Everywhereyoulook™

USER MANUAL

Model 702H
Converter Efficiency Tester

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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 are placed throughout this manual and inside the instrument. The symbols with messages are defined 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 instrument should only be used for the purpose and in the manner described in this manual. If you use this instrument in a manner other than that for which it was intended, unpredictable behavior could ensue with possible hazardous consequences.

NOTE

Obtain technical assistance in the use and maintenance of this instrument or any other Teledyne API product by contacting Teledyne API's Technical Support Department:

Telephone: 800-324-5190 Email: sda_techsupport@teledyne.com

or by accessing various service options on our website at 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

Cet instrument doit être utilisé aux fins décrites et de la manière décrite dans ce manuel. Si vous utilisez cet instrument d'une autre manière que celle pour laquelle il a été prévu, l'instrument pourrait se comporter de façon imprévisible et entraîner des conséquences dangereuses.

WARRANTY

WARRANTY POLICY (02024G)

Teledyne Advanced Pollution Instrumentation (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.

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 at http://www.teledyne-api.com/terms_and_conditions.asp

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 under Help Center > Product Manuals in the Special Manuals section; RMA procedures are under Help Center > Return Authorization.

ABOUT THIS MANUAL

The Model 702H manual is comprised of multiple documents, assembled in PDF format, as listed below.

Part No.	Rev	Name/Description
08238	A	Model 702H User Manual (this manual)

NOTE

We recommend that this manual be read in its entirety before making any attempt to operate the instrument.

REVISION HISTORY

This section provides information regarding the initial release and subsequent changes to this manual.

Model 702H User Manual			
Date	**Rev**	**DCN**	**Change Summary**
31 Mar 2015	A	7070	Initial Release

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1 INTRODUCTION

The Teledyne API Model 702H Converter Efficiency Tester is a low-cost, simple, light-weight instrument for checking the converter efficiency of NOx analyzers. The basic unit uses two bottles of different NO concentrations (0-10 PPM and 0-100 PPM) to generate NO_2 to perform converter efficiency checks. A high concentration ozone generator supports GPT calibration.

The Model 702H features:

- two cal gas inputs
- one dry air input connection,
- two ozone and GPT concentration presets,
- one cal gas out connection

When the two NO cylinders are connected with the appropriate concentrations, the Model 702H will produce two concentrations, such as (20% URL) and "span" (80% URL) as well as "zero".

NOTE

The Model 702H has been checked out at the factory and meets all of our test criteria. However, during shipment, regulator settings may have shifted. Check the flows using NIST-Traceable flow standards before using the Model 702H. See Section 4.3 for flow verification.

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2 SPECIFICATIONS

Table 2-1: Model 702H Specifications

2 – 5 lpm	
5 – 50 psig	
400 ppm (@ 1 slpm); 5000 ppm @ 80 cc (maximum)	
Bench (standard) Rack (optional)	
5 to 40°C	
5.22 H x 19 W x 15-3” D (133 x 483 x 362 mm)	
20 lbs. (9.1 Kg)	
Rating 100 - 120 V~ 63 Hz, 2.0 A 220 - 240 V~ 47 Hz, 2.0 A	Typical Power Consumption 15 W 14 W
Installation Category (Over Voltage Category) II Pollution Degree 2 Intended for Indoor Use Only at Altitudes ≤ 2000 m	

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3 GETTING STARTED

3.1 Unpacking

Verify that there is no shipping damage.

If there are signs of damage, immediately contact the shipper, then Teledyne API.

Remove the cover and check for damage inside, particularly the glass GPT reaction chamber.

Check the line voltage decal on the rear panel. Verify that it matches your local power. (The Model 702H is not frequency-sensitive.)

3.2 Installation

The rack-mounting is designed for a standard 19” RETMA rack. When installing the 702H, check the following points:

- At least 3” (75mm) at each side for proper ventilation.
- Adequate support for the weight: 20 lbs (9.1 Kg).
- Access at the rear for making pneumatic and electrical connections.
- Access at the front for control and adjustments.

"CE" NOTE

When the Model 702H is operating, the cover must be in place and all cover screws must be tightened. Otherwise the Model 702H may violate "CE" standards for electromagnetic radiation.

3.3 Instrument Layout

3.3.1 Front Panel

Figure 3-1 illustrates the front panel of the Model 702H CE Checker.

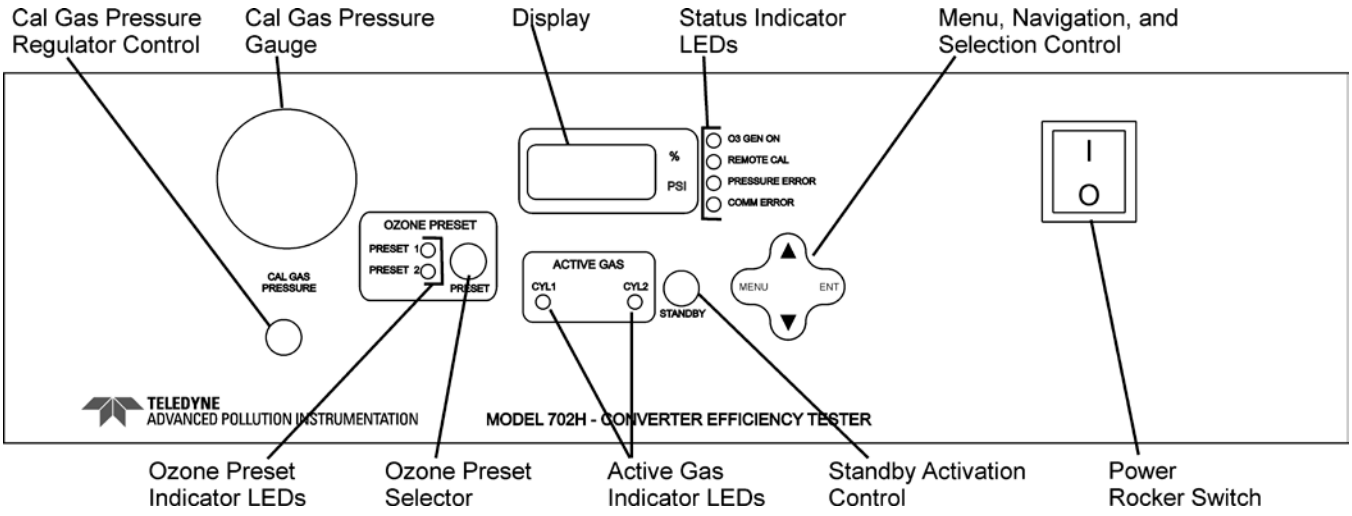


Figure 3-1: Model 702H Front Panel

Table 3-1: Front Panel Description

Front Panel Component	Description	
Cal Gas Pressure Regulator Control	Increases (when turned clockwise) or decreases (when turned counterclockwise) the calibration gas pressure. See Cal Gas Pressure Gauge. **DO NOT EXCEED 50 PSI**	
Cal Gas Pressure Gauge	Needle indicates pressure of the calibration gas. **USE THE CAL GAS PRESSURE REGULATOR CONTROL TO KEEP THE PRESSURE AT OR BELOW 50 PSI**	
Display	Panel showing menu, status, or parameter value.	
Status Indicator LEDs	Each LED indicates current status of the instrument.	
	O3GEN ON	Solid lit when ozone is being generated (Typically during GPT, but if lit when not in GPT mode, place in STDY mode or power down the 702H and call TAPI Tech Support)
	REMOTE CAL	Solid lit during remote operation
	PRESSURE ERROR	Blinks when dry air pressure is outside limits
	COMM ERROR	Blinks when communications fail
Menu, Navigation, and Selection Control	Used to enter and scroll through the menu system (), and to select and set menu items.	
Ozone Preset Indicator LEDs	During GPT mode, lit LED indicates which of two ozone presets is being shown in the Display. (Neither LED is lit when instrument not in GPT mode).	

Front Panel Component	Description
Ozone Preset Selector	Functional only when in GPT mode, this selector can be either pressed and released to toggle between presets, or pressed-and-held to edit presets (Section 4.1.2). Presets can also be managed through the menu system, (see Section 4.2).
Active Gas Indicator LEDs	Only one LED or neither will be lit: Lit indicates which cylinder is in use. Not lit indicates not in use. Not lit indicates not in use.
Standby Activation Control	When pressed and immediately released, suspends operation as it places the instrument in Standby mode. (Use the menu system, Section 4.2, to start an operation).
Power Rocker Switch	Powers the instrument on and off.

3.3.2 Rear Panel

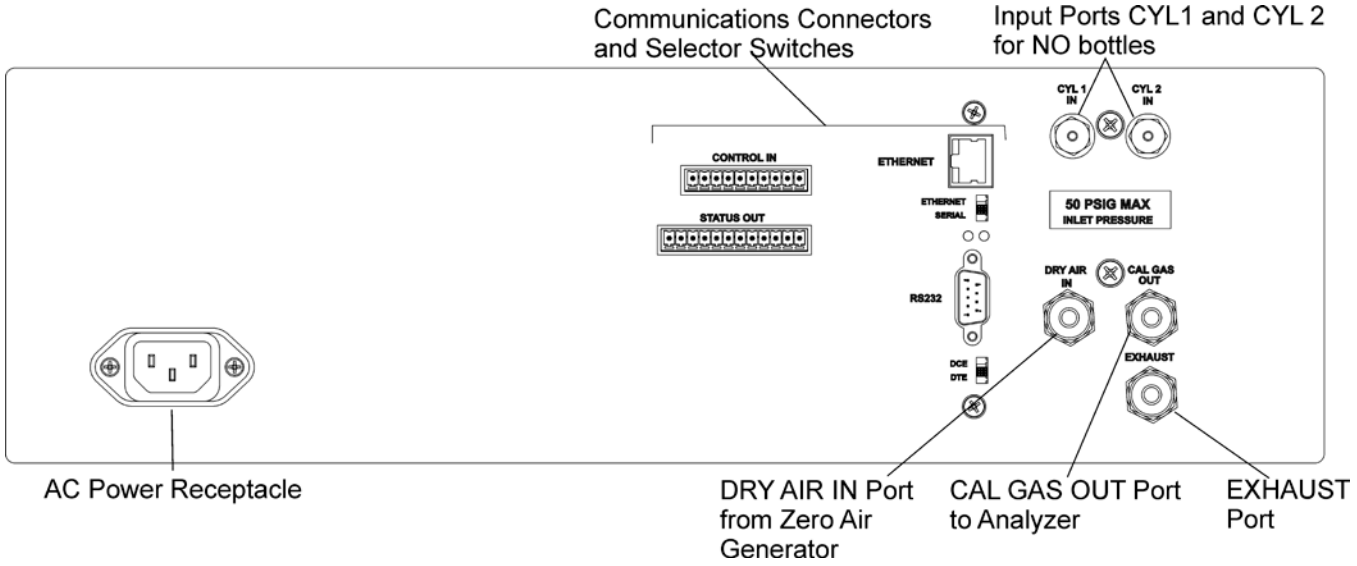


Figure 3-2: Model 702H Rear Panel

Table 3-2: Rear Panel Description

Rear Panel Component	Function
AC power receptacle	Connector for three-prong cord to apply AC power to the analyzer.  **CAUTION! The cord's power specifications (specs) MUST comply with the power specs on the instrument's rear panel label**
Communications Connectors	Currently under development, Ethernet or Serial communications will be available for remote control and for status outputs.
CYL 1 IN	Input port for an NO bottle of known concentration
CYL 2 IN	Input port for an NO bottle of different, known concentration
DRY AIR IN	Input port for zero air from dry air canister
CAL GAS OUT	Output port for calibration gas to the Sample port of the analyzer being calibrated
EXHAUST	Exhaust port to be connected to a proper, unpressurized vent manifold to prevent exposure to ozone

3.3.3 Internal Chassis Layout

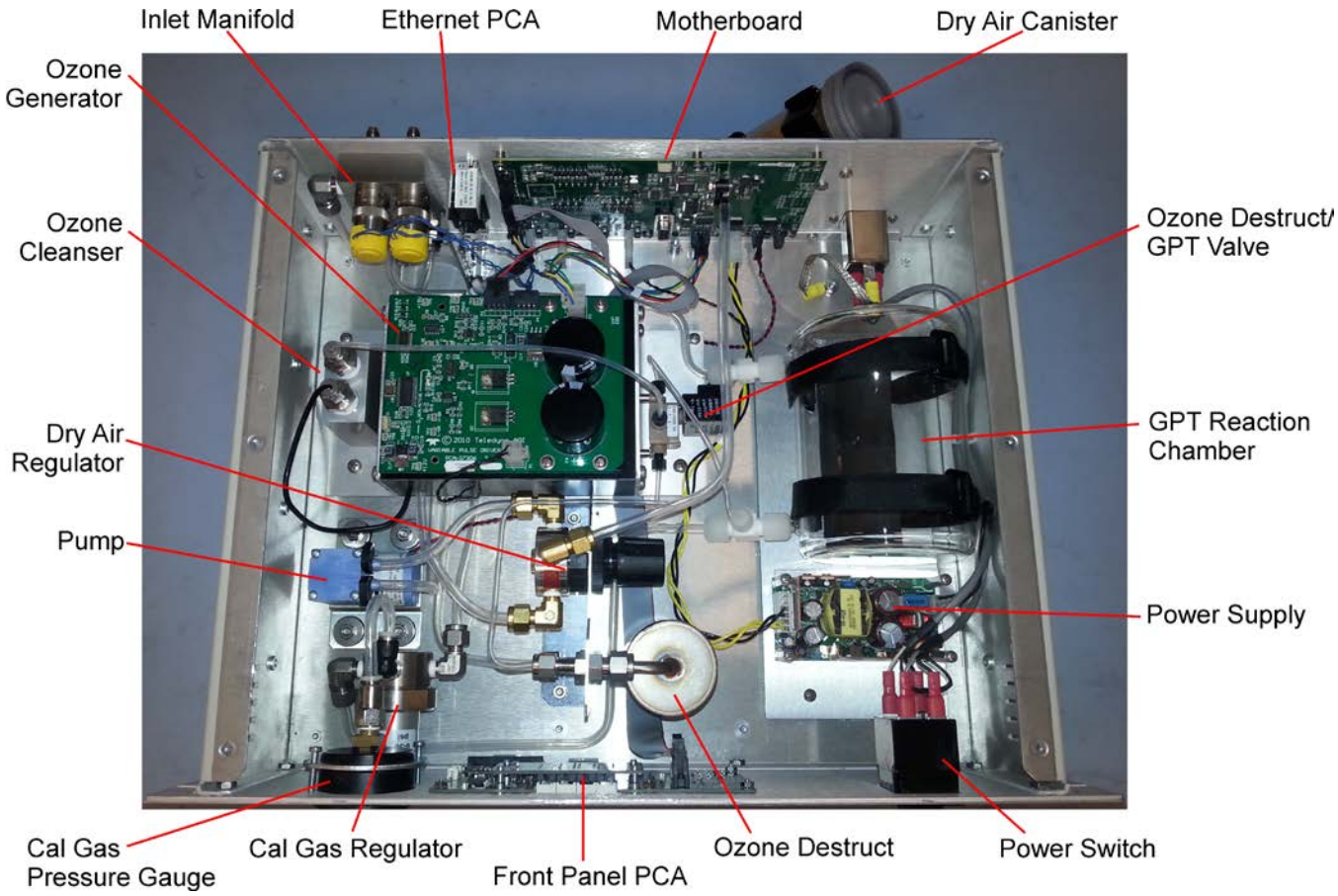


Figure 3-3: Model 702H Internal Chassis Layout

3.4 Connections and Setup

3.4.1 Electrical Connections

NOTE

To maintain compliance with EMC standards, it is required that the cable length be no greater than 3 meters for all I/O connections, which include Analog In, Analog Out, Status Out, Control In, Ethernet/LAN, USB, RS-232, and RS-485.

WARNING
ELECTRICAL SHOCK HAZARD

High Voltages are present inside the analyzer's case.

Power connection must have functioning ground connection.

Do not defeat the ground wire on power plug.

Turn off analyzer power before disconnecting or connecting electrical subassemblies.

Do not operate with cover off.

CAUTION
GENERAL SAFETY HAZARD

To avoid damage to your instrument, ensure that the AC power voltage matches the voltage indicated on the unit's model/specs label located on the rear panel before plugging it into line power.

3.4.1.1 Connecting Power

Adhering to all safety and cautionary messages, attach the power cord between the analyzer's AC power connector and a power outlet capable of carrying at least the rated current at your AC voltage range; also ensure that it is equipped with a functioning earth ground.

3.4.1.2 Connecting Control and Communications

NOTE

In this version of the unit, Ethernet and serial communications are not implemented.

Status Outputs

The schematic for Status Outputs connections are located in the appendix of this manual.

There are four modes, two cylinders, two preset values, and three errors that can be monitored through STATUS OUT.

Table 3-3. Status Outputs Contact Functions

CONTACT PAIR	FUNCTION
#1	DILUENT VALVE
#2	CYL 1 VALVE
#3	CYL 2 VALVE
#4	OZONE PRESET 1
#5	OZONE PRESET 2
#6	TEMPERATURE OK
#7	SYSTEM OK

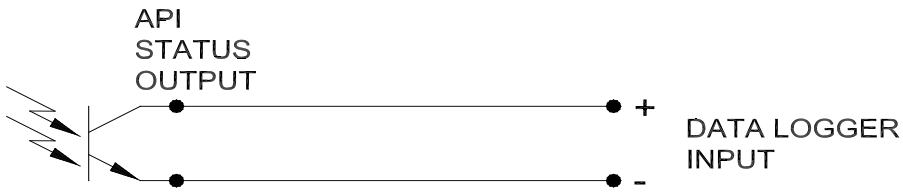
These are uncommitted emitter/collector pairs and will sink 5 mA.

See Figure 3-4 for examples.

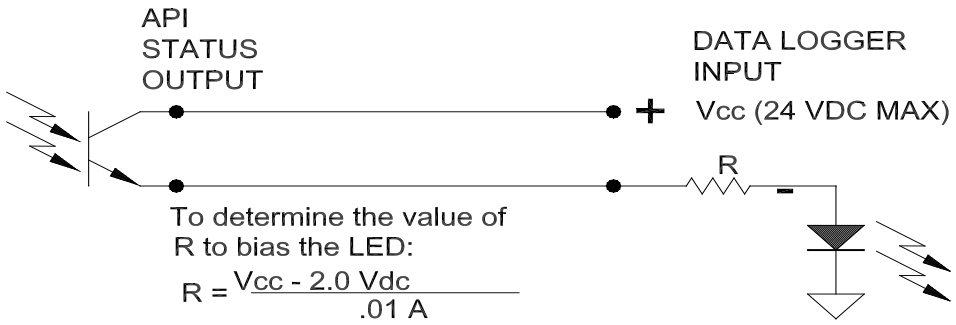
Table 3-4. Status Outputs Mode Truth Table

Status Outputs								
Pin #1	Pin #2	Pin #3	Pin #4	Pin #5	Pin #6	Pin #7	Pin #8	
GPTZ	GPT	CYL1	CLY2	Preset	O3 GEN ON	Pressure Error	Comm Error	Function
0	0	0	0	X	0	X	X	Standby
0	0	0	1	X	0	X	X	Cal Gas Cyl2
0	0	1	0	X	0	X	X	Cal Gas Cyl1
0	0	1	1	X	X	X	X	N/A
0	1	0	0	X	X	X	X	N/A
0	1	0	1	X	0	X	X	GPT Cyl2
0	1	1	0	X	0	X	X	GPT Cyl1
0	1	1	1	X	X	X	X	N/A
1	0	0	0	X	X	X	X	N/A
1	0	0	1	X	1	X	X	GPTZ Cyl2
1	0	1	0	X	1	X	X	GPTZ Cyl1
1	0	1	1	X	X	X	X	N/A
1	1	0	0	X	X	X	X	N/A
1	1	0	1	X	X	X	X	N/A
1	1	1	0	X	X	X	X	N/A
1	1	1	1	X	X	X	X	N/A
X	X	X	X	1	X	X	X	Preset 2
X	X	X	X	X	1	X	X	O3 Gen ON
X	X	X	X	X	X	1	X	Pressure Error
X	X	X	X	X	X	X	1	Comm Error

1. If the datalogger inputs are "TTL", then the configuration of the status output should be:-



2. If the datalogger inputs are driven by current (eg., input LED of an optocoupler), then the configuration of the status output should be:-



3. If the datalogger supplies a voltage (eg., 24 Vdc) and expects to see the voltage during a closure, then the configuration of the status output should be:-

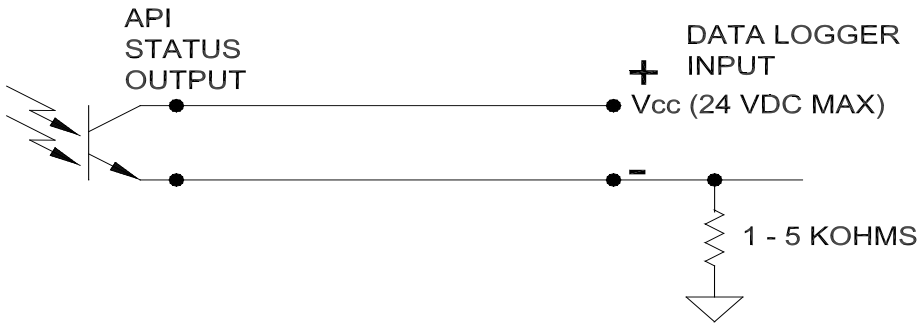


Figure 3-4: Status Output Configuration Examples

Control Inputs

The schematic for Control Inputs connections are shown in the appendix of this manual.

There are four modes, two cylinders, and two presets that can be accessed through the CONTROL IN connector.

CONTACT PAIR	FUNCTION
#1	DILUENT VALVE
#2	CYL 1 VALVE
#3	CYL 2 VALVE
#4	OZONE PRESET 1
#5	OZONE PRESET 2

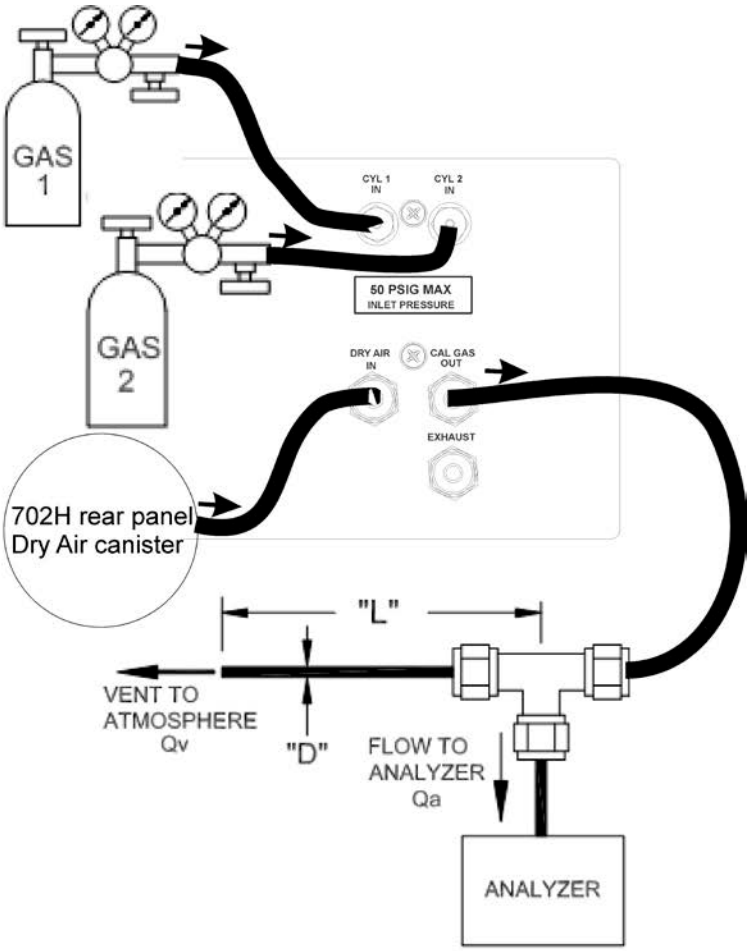
These require a contact closure. Current is 30 mA.

Table 3-5. Control Inputs Mode Truth Table

Control Inputs (Active Low)					
Pin #5	Pin #4	Pin #3	Pin #2	Pin #1	
Preset	GPTZ	GPT	CYL2	CLY1	Function
x	1	1	1	1	Standby
x	1	1	1	0	Cal Gas Cyl1
x	1	1	0	1	Cal Gas Cyl2
x	1	1	0	0	Invalid
x	1	0	1	1	Invalid
x	1	0	1	0	GPT Cyl1
x	1	0	0	1	GPT Cyl2
x	1	0	0	0	Invalid
x	0	1	1	1	Invalid
x	0	1	1	0	GPTZ Cyl1
x	0	1	0	1	GPTZ Cyl2
x	0	1	0	0	Invalid
x	0	0	1	1	Invalid
x	0	0	1	0	Invalid
x	0	0	0	1	Invalid
x	0	0	0	0	Invalid
0	X	X	X	X	Preset #2

3.4.2Pneumatic Connections

Use clean 1/8” OD Stainless Steel tubing. Refer to Figure 3-5 when following connection instructions in this section.



Note that the analyzer is connected to the "leg" of the Tee and the vent is connected to the "run" of the Tee.

For minimum back-diffusion through the vent and for minimum back-pressure in the manifold, the following relationship should be met:

$$Qv \times L / Qa \times D = 500$$

where;

Qv is the flow in the vent (cc/min)
Qa is the flow to the analyzer (cc/min)
L is the length of the vent (inches)
D is the inside diameter of the vent (inches)

Example:

Analyzer flow = 500 cc/min
Vent flow = 1000 cc/min
D = .188 inches
L = 48" approximately

Figure 3-5: Pneumatic Connections with Requirements for Minimum Back-diffusion/Back-pressure

3.4.2.1 CYL 1 IN and CYL 2 IN

CAUTION

Make sure that the area is well ventilated.

If this is the first time that the gas cylinder (e.g., new cylinder) and a regulator are being connected to the 702H:

1. Attach the cylinder regulator to the cylinder and tighten.
2. Attach the 1/8” stainless steel tubing to the regulator and tighten.
   DO NOT ATTACH THE TUBING TO THE 702H.

CAUTION

Use clean 1/8" stainless steel tubing.

Do not use plastic tubing. It may burst. With nitric oxide cylinders, atmospheric oxygen can permeate plastic tubing and oxidize NO to NO_2.

3. Close the regulator shut-off valve.
4. Open the cylinder valve.
5. Check the regulator for leaks using bubble solution.
6. Tighten if necessary.

CAUTION

If the regulator still leaks, turn off the cylinder valve immediately; find the cause of the leak. (Could be missing washer or the like).

7. To prevent ambient air from flowing through the cylinder, thoroughly flush the cylinder regulator several times, as follows:
   a) Close the regulator shut-off valve.
   b) Open the cylinder valve.
   c) Turn the cylinder regulator up to 35-50 psig.

CAUTION

Do not exceed 50 PSIG at the cylinder regulator.

d) Close the cylinder valve.

e) Open the regulator shut-off valve to vent the regulator contents.

f) Repeat this once or twice more and then leave the regulator shut-off valve closed.

g) Connect the stainless steel tubing to the Model 702H rear panel CYL 1 IN union and tighten.

CAUTION

With nitric oxide cylinders, do not allow air to enter the regulator after purging. Oxygen will form NO_2 with the NO.

The gas cylinder or other source must produce 2-5 LPM at 5 - 50 psig.

3.4.2.2 DRY AIR IN

The 702H is shipped with the dry air canister connected to the DRY AIR IN port; check that the connections are intact.

3.4.2.3 CAL GAS OUT

Use CLEAN ¼" OD Stainless Steel tubing and a T-fitting to connect the CAL GAS OUT port to the sample manifold of the analyzer being checked. Figure 3-5 illustrates the USEPA-suggested criteria for designing the sampling manifold.

CAUTION

The sample manifold must be properly vented. The Model 702H does not have a built in vent. The vent should be a part of the manifold and should be as close as possible to the analyzer sample inlet (See tee-fitting in Figure 3-5). There must be only one vent in the manifold.

When connecting the Model 702H CAL GAS OUT port to the analyzer(s) to be calibrated, it is very important that the analyzer sample inlet pressure be the same as its normal sampling pressure.

3.4.2.4 EXHAUST

Although the 702H has an ozone scrubber, ensure that no ozone is being released into the shelter by running tubing from the EXHAUST port to outside.

3.5 Pneumatic Flow

Refer to Figure 3-6 while reading the pneumatic flow descriptions.

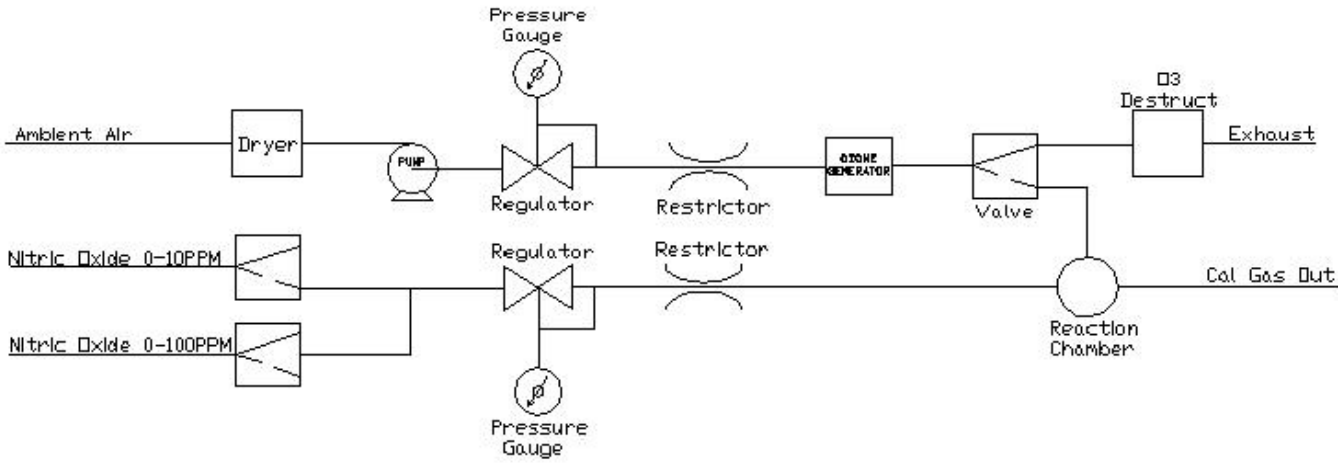


Figure 3-6: Model 702H Pneumatic Flow Diagram

3.5.1 Calibration Gas

Calibration gas from each of two certified cylinders enters the rear panel at the ports marked CYL 1 and CYL 2. Flow is controlled (ON/OFF) by manifold-mounted normally closed solenoid valves, one valve for CYL 1 and one valve for CYL 2. The two CYL valves are connected so that you may use either gas or neither (set via the Menu System), but not both at once. Control the gas flow by adjusting the gas pressure regulator with the front panel knob below the CAL GAS PRESSURE gauge and observing the gauge on the front panel.

3.5.2 Ozone/GPT/GPTZ

A low flow passes through the ozone generator (during GPTZ ozone concentration will be 0%), then mixes with the CAL GAS at the entrance to the reaction chamber.

The ozone reacts stoichiometrically with the NO (NO concentration must be at least 10% greater than O_3 concentration) in the reaction chamber to form NO_2 with some NO remaining.

NOTE

Ensure that NO production is 10% more than O_3.

The reacted product leaves through the rear panel CAL GAS OUT port.

4 OPERATION

This section begins with a description of how to use the front panel controls and displays.

4.1 Using the Controls and Displays

4.1.1 Viewing and Editing

The Menu, Navigation, and Editing control is used to access the menu system and to view and edit parameters. (Figure 4-1 shows the menu structure).

- MENU enters the menu system, backs out of a menu level, and escapes from a menu item. In Preset edit mode the MENU button toggles across decimal places.
- ▲ navigation and increment button scrolls up the menu system and, when in Preset edit mode, increases the % value of the Ozone Generator drive.
- ▼ navigation and decrement button scrolls down the menu system and decreases the value of a setting when in Preset edit mode.
- ENT accesses a submenu or initiates a function, or when in Preset edit mode accepts the displayed value.

Summary:

- Press the MENU button to access the menu system.
- Press the navigation buttons ▲ ▼ to scroll through the menu system.
- Press the ENT button to activate the menu item.
- Press the MENU button to select the decimal place in edit mode, and press the increment ▲ or decrement ▼ buttons to change the value as desired (raise or lower the % of the Ozone Generator drive) for PRESET 1 or PRESET 2, whichever is presently selected as indicated by the LED in the OZONE PRESET window.
- Press the ENT button to accept the new value.

4.1.2 Ozone Preset

Preset is used to set the upper range limit (URL) of each cylinder of Nitric Oxide. The Preset button is only active while the instrument is in GPT mode, and can be either pressed-and-released to toggle between the two preset values, PRESET 1 and PRESET 2, or pressed and held to go into edit mode to change the Preset values.

NOTE

The following capabilities are currently in development:

- **The Preset functions can also be controlled remotely via MODBUS or Ethernet, or via contact closure through the CONTROL IN terminal strip on the rear panel.**
- **The status of these functions may be read remotely through MODBUS or Ethernet, or through the STATUS OUT terminal strip on the rear panel.**

4.1.2.1PRESET 1

Set the URL of Cylinder 1. PRESET 1 is typically used to generate 20% URL of the bottle that was selected in the GPT menu.

4.1.2.2PRESET 2

Set the URL of Cylinder 2. PRESET 2 is typically used to generate 80% URL of the bottle that was selected in the GPT menu.

4.1.3 Display

The digital display serves as “power on” indicator, and on startup displays “TELEDYNE API 702H”, and then goes into Standby mode (STBY). During operation, the display shows the Menu system and settings.

4.1.4 Status Indicators

The LED that’s lit indicates either the current status of the Model 702H.

Refer to the Troubleshooting section to see causes and remedies for errors.

4.1.5 Active Gas

The Active Gas panel indicates which cylinder (CYL 1 or CYL 2) is active by the corresponding LED that is lit, or if both cylinders are inactive (neither LED is lit). The front panel menu turns on either CYL 1 or CYL 2 solenoid valve and turns off either or both. (Either one or the other can be active, or both can be inactive, but both cannot be simultaneously active).

4.1.6 Cal Gas Pressure

The CAL GAS PRESSURE knob controls the cal gas pressure regulator; turn clockwise to increase pressure and counter-clockwise to decrease pressure. The regulator secondary pressure is displayed on the pressure gauge above the knob. The regulator pressure gauge is common to CYL 1 and CYL 2 (indicated by their respective LEDs in the Active Gas window in front panel). The pressure gauge will read zero when neither CYL 1 nor CYL 2 is selected (neither LED is lit), and the instrument is in Standby mode (indicated by STBY in the display).

CAUTION

Do not exceed 50 PSIG or the MODEL 702H pressure gauge and regulator may be damaged.

Remember to keep the pressure gauge in the upper half of its range for best resolution and control.

4.2 Menu System

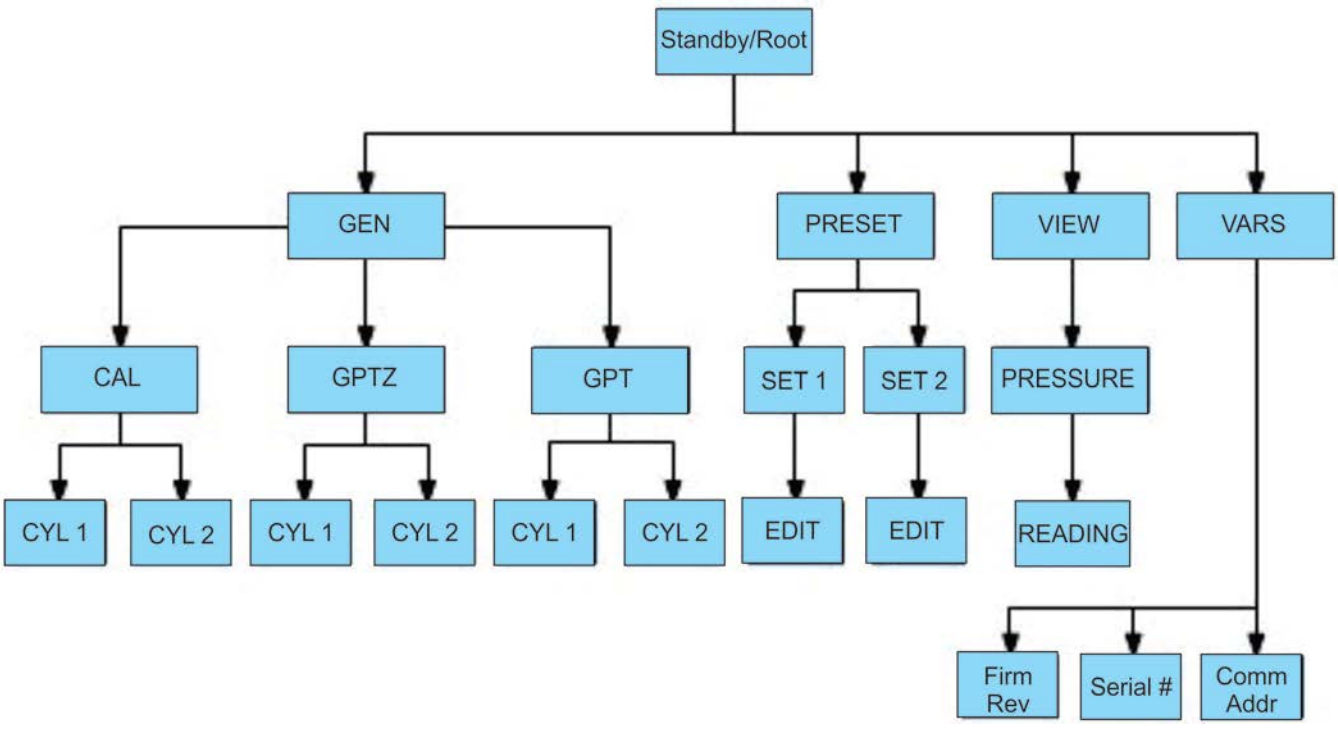


Figure 4-1: Model 702H Menu Structure

Menu Item	Description
GEN>CAL	generates a calibration of cylinder 1 or 2
GEN>GPTZ	generates a gas phase titration with ozone drive at 0% for cylinder 1 or 2
GEN>GPT	generates a gas phase titration for cylinder 1 or 2
PRESET>SET1	displays ozone % value stored in Preset 1 in Edit mode (most significant digit will start blinking)
PRESET>SET2	displays ozone % value stored in Preset 2 in Edit mode (most significant digit will start blinking)
VIEW>PRES	displays the current dry air pressure
VARS	displays the firmware version and serial number of the Model 702H (Comm Addr is under development for future use).

4.3 Verifying Flows

Before running GPT, verify and record the Cal Gas and Ozone flows.

4.3.1 Cal Gas Flow Verification:

1. Connect a regulated cylinder of dry air to one of the cylinder inputs (CYL 1 or CYL2) on the 702H (NO may be substituted for dry air depending on flow meter compatibility).
2. Connect the CAL GAS OUT and EXHAUST ports of the 702H to vent/atmosphere.
3. Generate GPTZ using the cylinder of dry air for several minutes to completely evacuate the 702H of any gas concentrations.
4. Connect a (NIST Traceable) flow meter to the CAL GAS OUT port on the rear panel.
5. Generate GPTZ using the cylinder of dry air.
6. Adjust the CAL GAS PRESSURE knob on the front panel until the desired flow rate is achieved. (Note: Clockwise increases pressure and flow. Also, generating Cal Gas will reduce the total flow by approximately 80ccm).
7. Record the pressure on the front panel gauge.
8. Put the instrument in Standby.

4.3.2 Ozone Flow Verification:

1. Remove the cylinder of dry air from the input port, and cap both ports.
2. With the flow meter still installed, generate GPTZ using either of the capped inlet ports.
3. Press Menu>Exit to return to the top level menu.
4. Press View>Pressure>Enter to see the pressure value.

   The pressure on the front panel display should be close to 12 PSI, and the flow out of the Cal Gas Port shown on the flow meter should be close to 80 ccm. Record these values.
5. Return the instrument to standby mode and remove the caps and flow meter from the rear panel.

4.3.3 Ozone Pressure Verification:

The ozone pressure may be checked anytime the 702H is generating GPT or GPTZ. From the main menu, select View>Pressure>Enter. The display shows the current ozone regulator pressure.

4.4 Setting Up GPT

By setting the correct flows and concentrations of nitric oxide and ozone, the nitric oxide (NO) is stoichiometrically oxidized by ozone (O_3) to nitrogen dioxide (NO_2) using the EPA-approved Gas Phase Titration technique.

The USEPA prescribes specific rules for Gas Phase Titration of NO to NO_2. See Basic Equations, in Section 4.5.

Select the ozone-generator value (%) from the front panel by means of the Menu or by PRESET button (if GPT is already running). As implied, the PRESET button selects one of two preselected ozone lamp currents.

The usual preset ozone concentrations are:

- 0.20 of URL
- 0.80 of URL.

4.4.1 To Adjust a Preset Value

1. Press PRESET button (for Preset 1 or Preset 2).
2. Press the increment or decrement button until the desired concentration is shown in the display.
3. Press ENTR to store the new value.
4. The allowable range of ozone concentrations is 400 ppm•LPM.

4.5 Basic Equations

The addition of ozone during the GPT and GPTZ modes changes the output gas according to the following equations:

$[NOx]_{out} = [NO]_{cyl} \times (QNO / (QNO + QO_3))$

$[NO_2]_{out} = [O_3] \times (QO_3 / QNO + QO_3)$

$[NO]_{out} = [NOx] - [NO_2]$

where:

$[NOx]_{out}$ = NOx concentration at CAL GAS OUT [ppm]

$[NO]_{cyl}$ = NO concentration in the cylinder [ppm]

$[NO_2]_{out}$ = NO2 concentration at the CAL GAS OUT [ppm]

$[NO]_{out}$ = NO concentration at the CAL GAS OUT [ppm]

$[O_3]$ = Ozone concentration into the reaction chamber [ppm]

QNO = NO flow from the cylinder (LPM)

QO_3 = Ozone flow into the reaction chamber (LPM)*

QAIR = Dilution air flow into the reaction chamber (LPM)

These equations are simplified during GPTZ because the ozone concentration is zero.

$[NO]_{out} = [NOx]_{out} = [NO]_{cyl} \times (QNO / (QNO + QO_3))$

$[NO_2]_{out} = 0$

* QO_3 value should be pulled from the Final Test & Validation Data Sheet shipped with the 702H.

Converter Efficiency:

These NO_X, NO and NO_2 figures are predicated on a 100% efficient converter in the NO_X analyzer.

Refer to the Teledyne API NO_X analyzer's manual for determining converter efficiency.

5 TROUBLESHOOTING AND MAINTENANCE

5.1 Troubleshooting

Table 5-1: Model 702H Troubleshooting

Problem	Probable Cause	Corrective Action
Display does not come on.	Unplugged power cord.	Plug in power cord at both ends.
	Incorrect line voltage.	Refer to Table 2-1 for the correct line voltage.
	Tripped power switch/circuit breaker.	Untrip power switch/circuit breaker.
	15 VDC power supply failed.	Replace power supply.
	Display cable disconnected.	Reconnect or replace display cable.
Pressure regulator does not respond.	Pressure source not connected.	Enter one of the generate modes.
	Instrument is in Standby Mode.	Turn on the selector valve.
	Failed cylinder valve.	Replace the cylinder valve.
Regulated pressure is too low.	Pressure at intake too low.	Ensure that the NO bottle is delivering sufficient pressure.
	Possible leak.	Call TAPI Technical Support  **Do NOT attempt to leak check on site. The reaction chamber must NEVER be pressurized!**
No ozone output.	No Ozone flow.	Ensure proper supply of pressurized dry air/replace internal pump.
	Ozone generator lost power.	Replace ozone generator power cable.
	3-way O_3 valve failed.	Replace the O_3 valve.
	No communication to ozone generator.	Replace I^2C cable.

5.2 Maintenance

For maintenance, contact Teledyne API Technical Support.

NOTE

Maintenance must be performed by qualified maintenance personnel only.

CAUTION

Do not loosen any tubing connection while pressure is applied to the Model 702H.

WARNING

Even though the front panel power switch is off, there is line voltage present at the power entry terminals.

For added safety, remove the power cord from the rear panel receptacle.

Teledyne API, Technical Support,
9480 Carroll Park Drive
San Diego, California 92121-5201USA

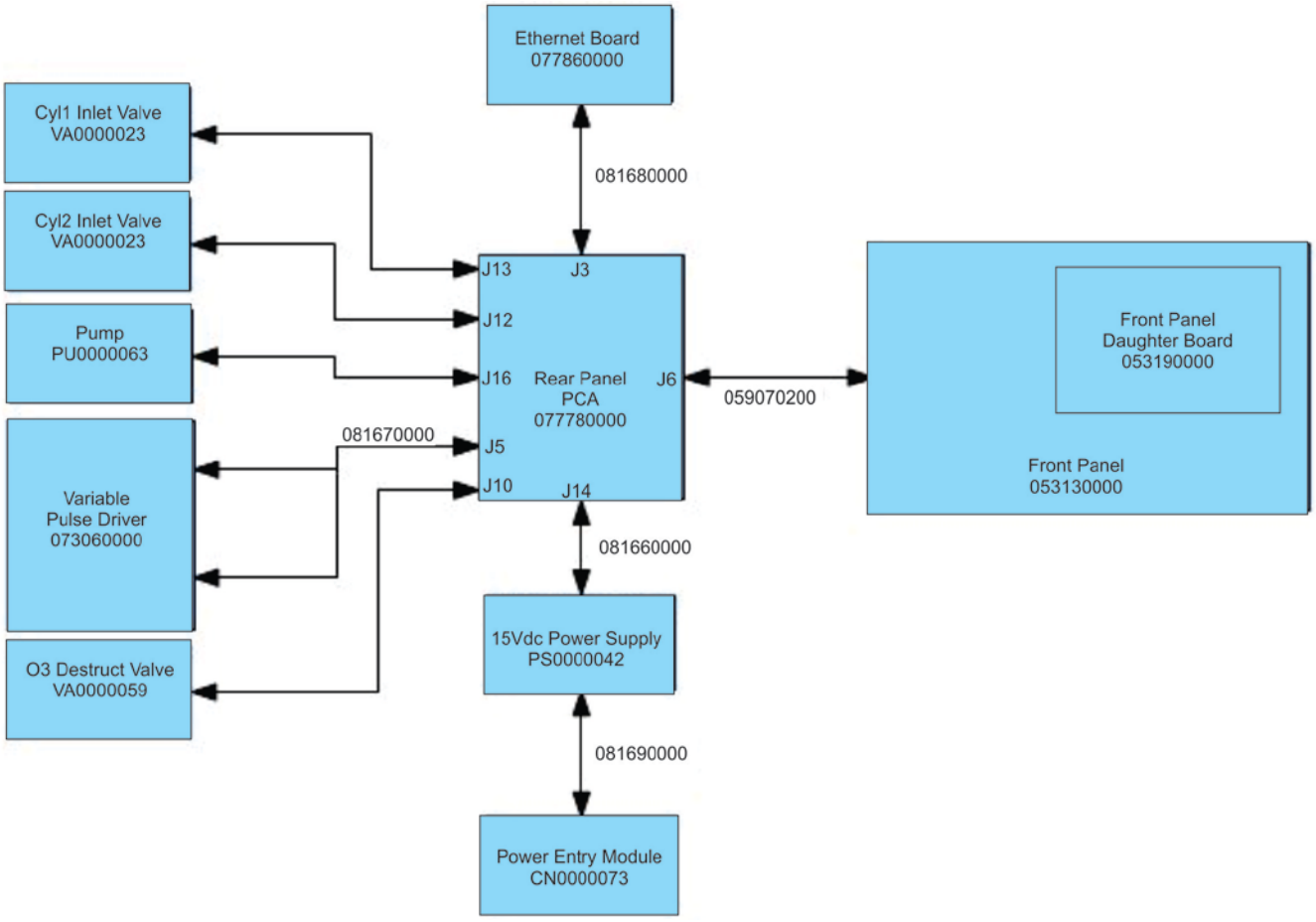
Toll-free Phone: 800-324-5190
Phone: 858-657-9800
Fax: 858-657-9816
Email: sda_techsupport@teledyne.com
Website: http://www.teledyne-api.com/

6 CHECK SHEET AND INTERCONNECTS

6.1 Check Sheet

CHECK OUT SHEET Model 702H
SERIAL NUMBER_____DATE_____BY_____
LINE POWER? _____(_____VAC/ ___ HZ)
PROM # _____
APPEARANCE _____ OK
CAL GAS (@ 15 PSIG) _____ CCM
OZONE CONCENTRATIONS
PRESET 1 (@ 15 PSIG FLOW) _____ PPM.
(PPM x FLOW LPM)_____PPM•LPM
PRESET 2 (@ 15 PSIG FLOW) _____ PPM.
(PPM x FLOW LPM)_____PPM•LPM

6.2 Interconnects



APPENDIX – Status Outputs and Control Inputs Connections

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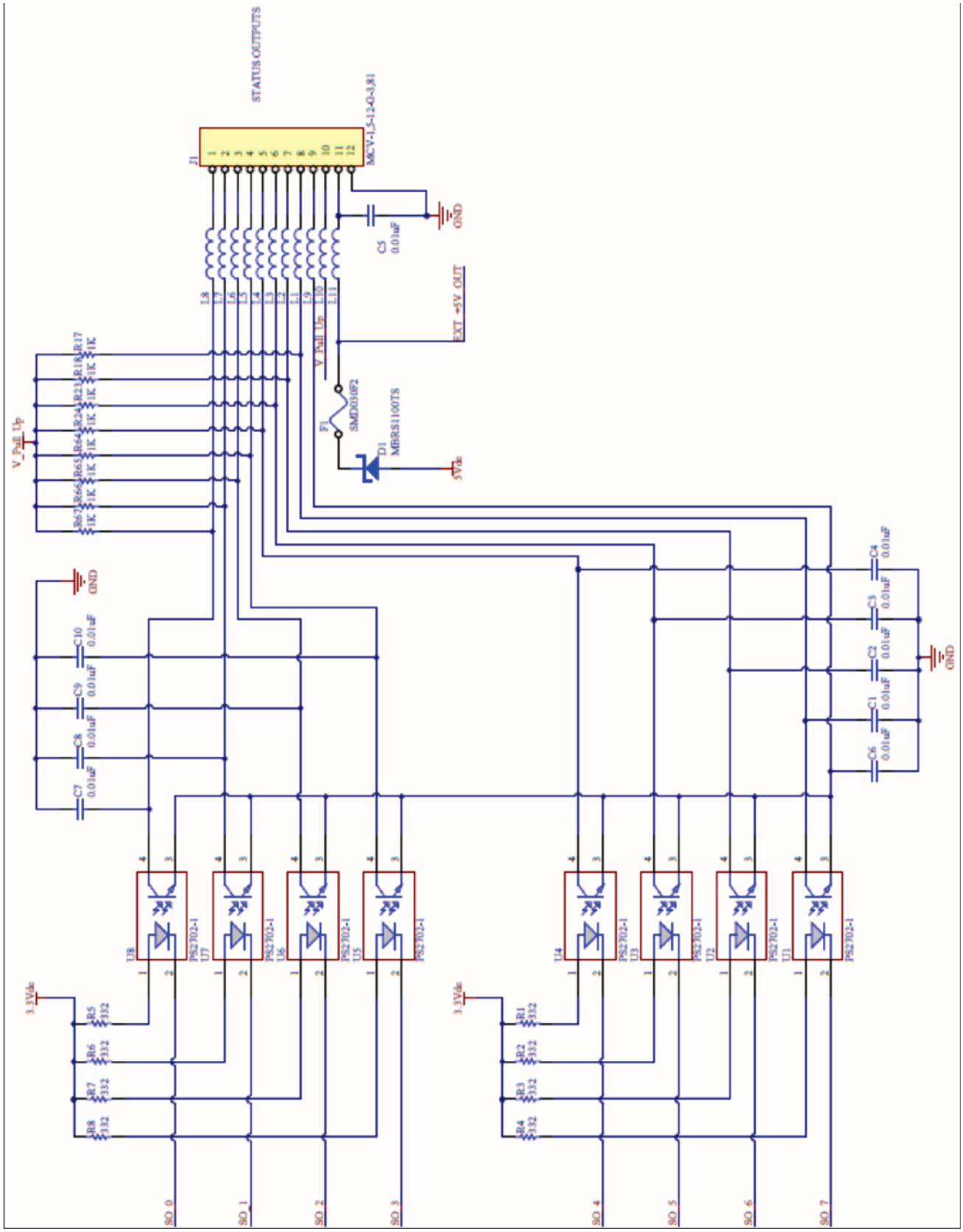
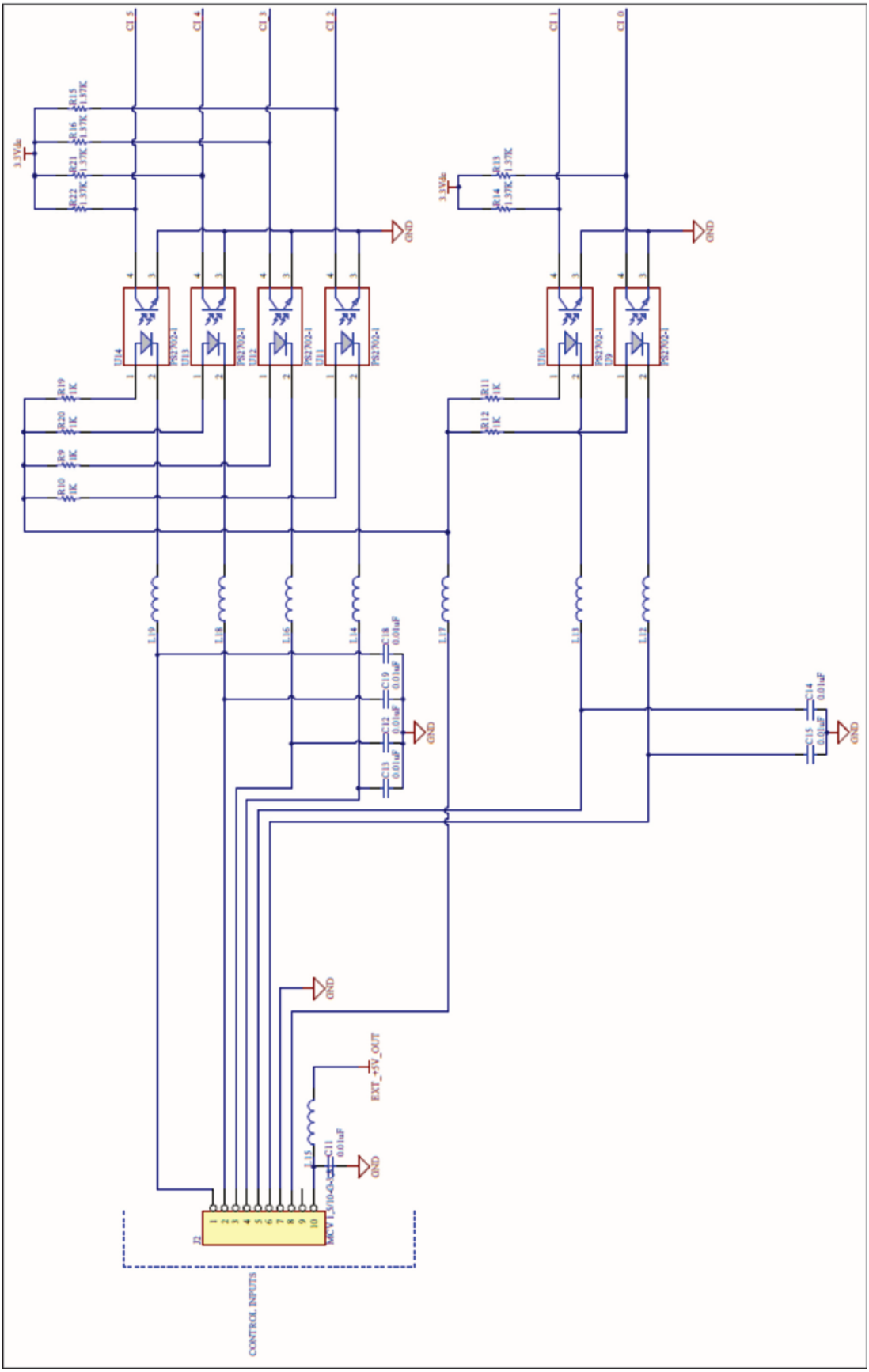


702H Status Outputs



702H Control Inputs