



TELEDYNE
ADVANCED POLLUTION INSTRUMENTATION
A Teledyne Technologies Company

OPERATION MANUAL

MODELS T701, T701H, 701, and 701H ***ZERO AIR GENERATORS***

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ABOUT THIS MANUAL

This T701, T701H, 701, 701H Zero Air Generators operation manual is comprised of multiple documents as listed below.

Part No.	Rev	Name/Description
078250000	C	Operation Manual
078280000	A	T701 & 701 Spare Parts List
078290000	A	T701H & 701H Spare Parts List
078270000	A	Interconnect Diagram
078270100	A	Interconnect List

NOTE

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

REVISION HISTORY

T701, T701H, 701, 701H Manual 07825

Date	Rev	DCN	Description
2014 Sep 10	C	6972	Update output conc specs per DCN6963
2014 Jul 08	B	6932	Remove "APICOM" from T701/H communications
2014 Feb 21	A	6840	Initial Release

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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.

NEVER use any gas analyzer to sample combustible gas(es)!

Note

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: sda_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



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.

NE JAMAIS utiliser un analyseur de gaz pour échantillonner des gaz combustibles!

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.

TABLE OF CONTENTS

ABOUT THIS MANUAL	I
REVISION HISTORY.....	I
SAFETY MESSAGES.....	III
1 INTRODUCTION.....	1-1
1.1 FEATURES.....	1-2
1.2 OPTIONS	1-3
2 SPECIFICATIONS AND APPROVALS.....	2-1
2.1 SPECIFICATIONS.....	2-1
2.2 APPROVALS AND CERTIFICATIONS	2-2
2.2.1 Safety	2-2
2.2.2 EMC.....	2-2
3 GETTING STARTED	3-1
3.1 UNPACKING	3-1
3.2 INSTALLATION	3-1
3.3 FRONT AND REAR PANELS	3-3
3.4 CONNECTIONS AND SETUP.....	3-4
3.4.1 Electrical Connections	3-4
3.4.2 Pneumatic Connections.....	3-5
3.5 POWER-UP.....	3-6
3.5.1 Compressor Function	3-6
3.5.2 Shut Down Procedure for Storage or Transportation	3-6
4 OPERATION.....	4-1
4.1 OVERVIEW.....	4-1
4.2 COMPONENTS.....	4-4
4.2.1 Compressor.....	4-4
4.2.2 Cooling Coil	4-4
4.2.3 Water Trap.....	4-4
4.2.4 Water Drain Valve	4-4
4.2.5 Pressure Relief Valve	4-5
4.2.6 Regenerative Dryer.....	4-5
4.2.7 Check Valve	4-5
4.2.8 Storage Tank.....	4-6
4.2.9 Pressure Sensors	4-6
4.2.10 Pressure Regulator.....	4-6
4.2.11 Pressure Gauge.....	4-7
4.2.12 Hydrocarbon Scrubber (Standard on T701H, 701H; Option on T701, 701)....	4-7
4.2.13 CO Scrubber (Standard on T701H, 701H; Option on T701, 701).....	4-7
4.2.14 NO Scrubber.....	4-8
4.2.15 Charcoal Scrubber.....	4-8
4.2.16 Final Filter.....	4-8

4.2.17	Controller	4-8
4.2.18	Dewpoint Sensor	4-10
4.2.19	Front Panel Indicator Lights.....	4-10
4.2.20	Communications Board (T-Series only)	4-10
5	COMMUNICATIONS SETUP & OPERATION (T-SERIES ONLY).....	5-1
5.1	RS232 COMMUNICATIONS	5-1
5.1.1	Data Terminal / Communication Equipment (DTE DEC)	5-1
5.1.2	RS-232 Configuration	5-2
5.2	ETHERNET	5-2
5.2.1	Configuring Ethernet Communication Manually (Static IP Address).....	5-3
5.2.2	Configuring Ethernet Communication Using Dynamic Host Configuration Protocol (DHCP).....	5-4
5.3	COMMUNICATIONS PROTOCOL: MODBUS	5-5
5.4	MODBUS REGISTERS	5-6
5.4.1	Notes on MODBUS Registers	5-7
6	MAINTENANCE.....	6-1
6.1	SCHEDULE.....	6-1
6.2	CLEANING.....	6-2
6.3	CHECKING THE TUBING	6-2
6.4	REPLACING THE CHARCOAL SCRUBBER	6-3
6.5	REPLACING THE NO - NO ₂ SCRUBBER	6-4
6.6	MAINTENANCE MODE.....	6-4
6.7	REPLACING THE CO SCRUBBER (T701, 701, OPTION ONLY)	6-5
6.8	REPLACING THE HYDROCARBON (HC) SCRUBBER (T701, 701, OPTION ONLY)	6-6
6.9	SERVICING THE REGENERATIVE DRYER	6-7
6.10	CHANGING THE REGENERATIVE DRYER'S 4-WAY VALVE	6-10
6.11	REPLACING THE REGENERATIVE DRYER'S SHUTTLE VALVE	6-10
6.12	LEAK CHECK.....	6-10
6.13	PARTICULATE FILTER ELEMENT REPLACEMENT.....	6-11
7	TROUBLESHOOTING.....	7-1
	APPENDIX A – Spare Parts.....	A-1
	APPENDIX B – Schematics.....	B-1

LIST OF FIGURES

FIGURE 3-1: INSTRUMENT LAYOUT (WITH HC AND CO SCRUBBER OPTIONS)	3-2
FIGURE 3-2: FRONT PANEL.....	3-3
FIGURE 3-3: REAR PANEL	3-3
FIGURE 4-1: PNEUMATIC DIAGRAM.....	4-3
FIGURE 4-2: CONTROL BOARD LAYOUT	4-9
FIGURE 6-1: REGENERATIVE DRYER	6-9

LIST OF TABLES

TABLE 1-1. OPTIONS 1-3
TABLE 2-1: SPECIFICATIONS 2-1
TABLE 5-1. ETHERNET STATUS INDICATORS 5-2
TABLE 5-2. T701, T701H MODBUS REGISTER MAP..... 5-6
TABLE 6-1: MAINTENANCE SCHEDULE 6-1
TABLE 7-1: TROUBLESHOOTING 7-1

1 INTRODUCTION

The Models T701, T701H, 701 and 701H Zero Air Generators are an excellent source of clean, dry air for dilution calibrators. They also may be used as a source of purge air for permeation tube ovens or burner air for FID analyzers. The T701 and the T701H (T-Series) include Serial and Ethernet connectivity for remote monitoring through MODBUS[®] protocol.

The regenerative, heatless dryer removes water and produces gas with a Dewpoint of less than -40°C independent of the inlet Dewpoint and assists in the removal of other gases, greatly increasing the life of the chemical scrubbers.

The units include an oil-free and diaphragm-free pump plus scrubbers to remove SO_2 , NO, NO_2 , O_3 , H_2S , CO (T701 and 701 option), and Hydrocarbons (T701 and 701 option).

Inlet air is pulled into the pump and routed through a pre-cooler and water trap to remove moisture. The air then passes through the Regenerative Dryer for final drying and then to the storage tank.

Tank pressure is monitored and maintained at a preset level by cycling the pump automatically as needed, thereby extending both the pump and scrubber life. Outlet air then passes through a filter to assure a clean, dry, analytical zero air supply.

These models are an ideal accessory to the Model T700 family of calibrators as a zero air source for analyzers.

All four models operate the same way, except that the Models 701 and 701H do not include communication connectivity. Throughout this manual, the zero air generators will be referred to as the 701X or Model 701X unless specified otherwise.

1.1 Features


- Regenerative, heatless dryer for maintenance-free water removal independent of inlet dewpoint
- Long life scrubbers for SO₂, NO, NO₂, O₃, H₂S, CO¹, and Hydrocarbons (HC)¹
- Automatic water drain
- Automatic pump control based on flow demand
- May be used to provide combustion air for FID
- Source of purge air for permeation tube ovens
- Source of Zero air for Ozone Generators
- Digital Communication through MODBUS® (T-Series only)
- Remote Stand-by Operation (T-Series only)

¹ Carbon (CO) and HC/CO scrubbers are options for the T701 and 701 (Table 1-1).

1.2 Options

Table 1-1 presents options available for the 701X.

Table 1-1. Options

OPTION	OPTION #	DESCRIPTION/NOTES								
Flow Restrictor		Restricts air flow.								
	72B	Flow rate: 13 LPM								
Scrubbers, CO and HC		(Options on T701 and 701 only). Remove carbon (CO), hydrocarbon (HC) impurities.								
	1B	CO scrubber								
	2B	High Purity HC/CO Scrubber (includes Option 1B)								
Rack Mount Kits		Options for mounting the instrument in racks. (Note that rack mount brackets require support structure in the rack to manage the weight of the instrument; the brackets cannot carry the full weight of the instrument and are meant only to fix the instrument to the front of a rack, preventing it from sliding out of the rack accidentally)								
	20A	Rack mount brackets with 26 in. chassis slides								
	20B	Rack mount brackets with 24 in. chassis slides								
	21	Rack mount brackets only (compatible with carrying strap, Option 29)								
Carrying Strap/Handle		Side-mounted strap for hand-carrying analyzer								
	29	Extends from "flat" position to "open" position to accommodate hand for carrying. Recesses to 9mm (3/8") dimension for storage. Can be used with rack mount brackets, Option 21. Cannot be used with rack mount slides.								
	CAUTION - GENERAL SAFETY HAZARD A FULLY LOADED T701/701H IS VERY HEAVY.									
	To avoid personal injury we recommend that two persons lift and carry the calibrator. Disconnect all cables and tubing from the unit before moving it.									
Parts Kits		Spare parts and expendables								
	42A	Expendables Kit includes a recommended set of expendables and spare parts for one year of operation of this instrument.								
Communication Cables (T-Series only)		For remote serial, network and Internet communication with the analyzer.								
		<table border="1"> <thead> <tr> <th>Type</th> <th>Description</th> </tr> </thead> <tbody> <tr> <td>60A</td> <td>Shielded, straight-through DB-9F to DB-25M cable, about 1.8 m long. Used to interface with older computers or code activated switches with DB-25 serial connectors.</td> </tr> <tr> <td>60B</td> <td>Shielded, straight-through DB-9F to DB-9F cable about 1.8 m long.</td> </tr> <tr> <td>60C</td> <td>Patch cable, 2 meters long, used for Internet and LAN communications.</td> </tr> </tbody> </table>	Type	Description	60A	Shielded, straight-through DB-9F to DB-25M cable, about 1.8 m long. Used to interface with older computers or code activated switches with DB-25 serial connectors.	60B	Shielded, straight-through DB-9F to DB-9F cable about 1.8 m long.	60C	Patch cable, 2 meters long, used for Internet and LAN communications.
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60C	Patch cable, 2 meters long, used for Internet and LAN communications.									

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2 SPECIFICATIONS AND APPROVALS

2.1 Specifications

Table 2-1: Specifications

Parameter	Specification	
	T701, 701	T701H, 701H
Output	20 SLPM at 30 psig	30 SLPM at 35 psig
Max delivery pressure	35 psig (50 psig for calibrators with special features that include restricted output).	35 psig
Dewpoint	-20°C up to 15 SLPM -10°C above 15 SLPM	-40°C
Dryer	Regenerative heatless dryer with lifetime of greater than 5 years	
Output Concentration	SO ₂ and H ₂ S < 0.1 ppb	SO ₂ and H ₂ S < 0.025 ppb
	NO < 0.1 ppb	NO < 0.025 ppb
	NO ₂ < 0.1 ppb	NO ₂ < 0.025 ppb
	O ₃ < 0.4 ppb	O ₃ < 0.3 ppb
	CO < 0.20 ppb ¹	CO < 10 ppb
	HC < 0.5 ppb ¹	HC < 0.25 ppb
Compressor	Internal long-life, oil-less piston pump	
Power ²	115 V~ 60 Hz, 7.0 A 220 – 240 V~ 50 Hz, 5.0 A	T701, 701 Typical Power Consumption ²
		T701H, 701H Typical Power Consumption ²
		230W (309 W) ¹
		427 W
		324W (357 W) ¹
		402 W
Weight	56 lbs. (25.4kg) (64 lbs. (29kg)) ¹	69 lbs. (31.3kg)
Mounting	Bench type (standard), Rack mount (optional)	
Dimensions	8.75" H x 17"W x 28"D (22.2 cm x 43.2 cm x 71.12 cm)	
Operating Temp	5-40°C	
Environmental Conditions	Installation Category (Over Voltage Category) II Pollution Degree 2 Intended for Indoor Use Only at Altitudes ≤ 2000m Maximum Relative Humidity: 95%	

¹ with HC Scrubber or HC/CO option

² Power Consumption measured at 10LPM for T701 and 20LPM for T701H. Individual results may differ due to flow demand, altitude and temperature.

2.2 Approvals and Certifications

2.2.1 Safety

IEC/EN 61010-1:2010 (3rd Edition), Safety requirements for electrical equipment for measurement, control and laboratory use.

CE: 2006/95/EC, Low-Voltage Directive

2.2.2 EMC

IEC/EN 61326-1, Class A Emissions/Industrial Immunity

EN55011 (CISPR 11), Group 1, Class A Emissions

FCC 47 CFR Part 15B, Class A Emissions

CE: 2004/108/EC, Electromagnetic Compatibility Directive

3 GETTING STARTED

This section provides instructions on the proper installation and power up of the 701X.

3.1 Unpacking



CAUTION

TO AVOID PERSONAL INJURY, ALWAYS USE TWO PERSONS TO LIFT AND CARRY THE 701X.

1. Verify that there is no shipping damage. If there are signs of damage, immediately advise the shipper, then Teledyne API.
2. Remove the 701X from its shipping carton.
3. Remove the cover and check for damage inside.
4. Ensure electrical cables and pneumatic tubing did not come loose during shipment.
5. Check the line voltage and frequency label on the rear panel to ensure that it matches the local power source.

3.2 Installation

The basic 701X has rubber feet for counter-top use. If the rack mount option was included in the order, the 701X is supplied with slides and angles for mounting in a standard 19" RETMA rack.

In order to ensure safe operation of the 701X, the following steps must be taken prior to installation for proper venting, access, weight support, and operation:

1. At least 6" (150 mm) clearance at the rear of the instrument.
2. At least 3" (75 mm) at each side.
3. Adequate support for the weight (Table 2-1).
4. Access at the rear for making the pneumatic and electrical connections.
5. Access at the front.
6. Operate the 701X with the cover on.

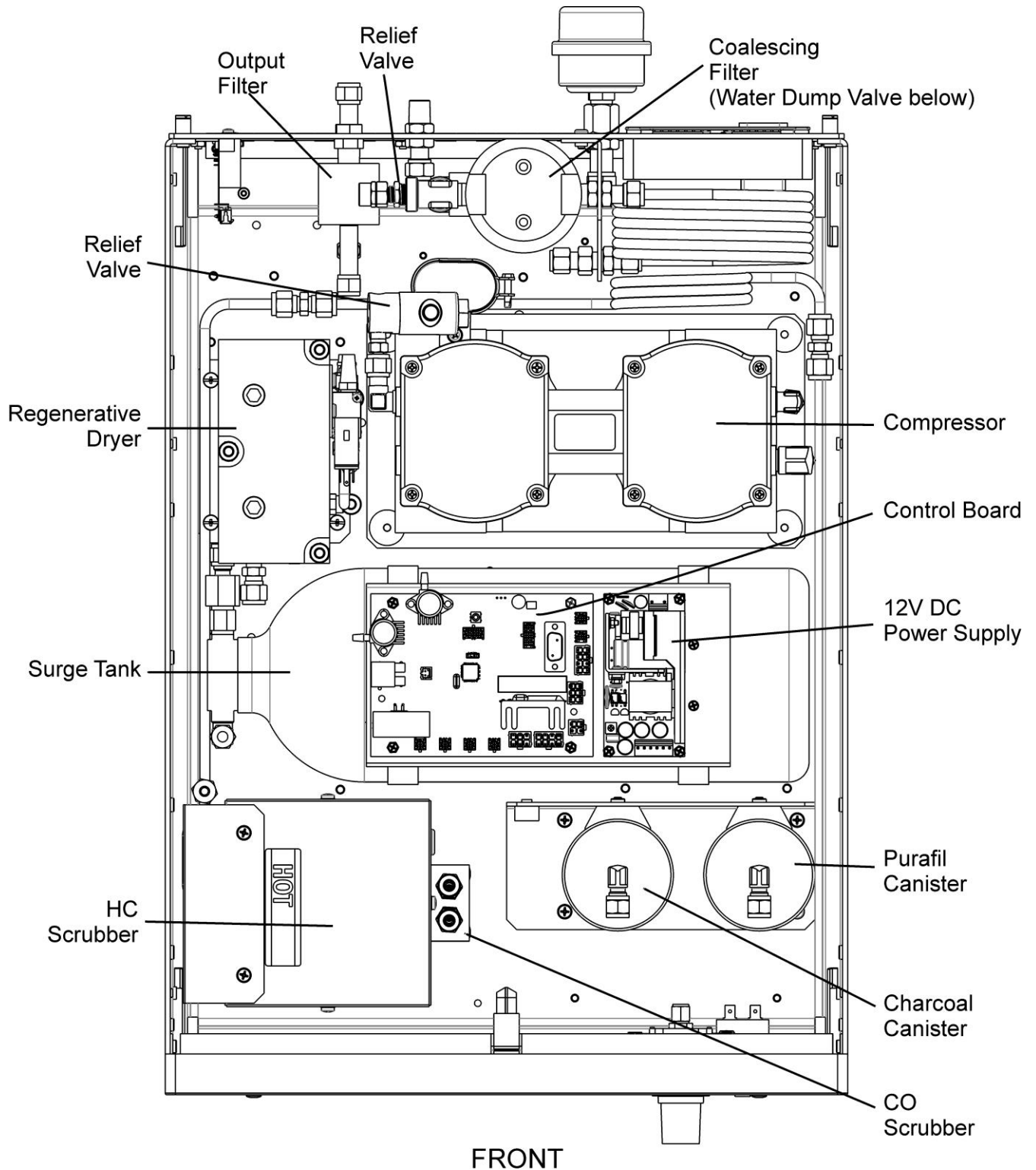


Figure 3-1: Instrument Layout (with HC and CO scrubber options)

3.3 Front and Rear Panels

Figure 3-2 and Figure 3-3 illustrate the Model T701H front and rear panels.

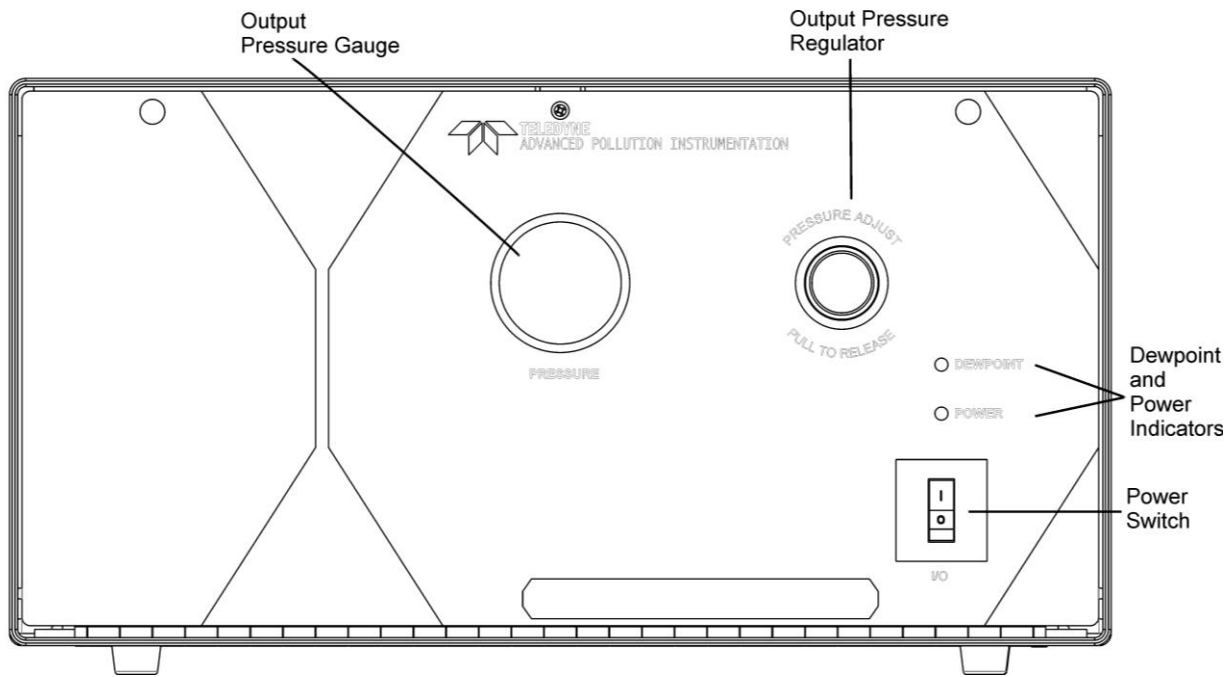


Figure 3-2: Front Panel

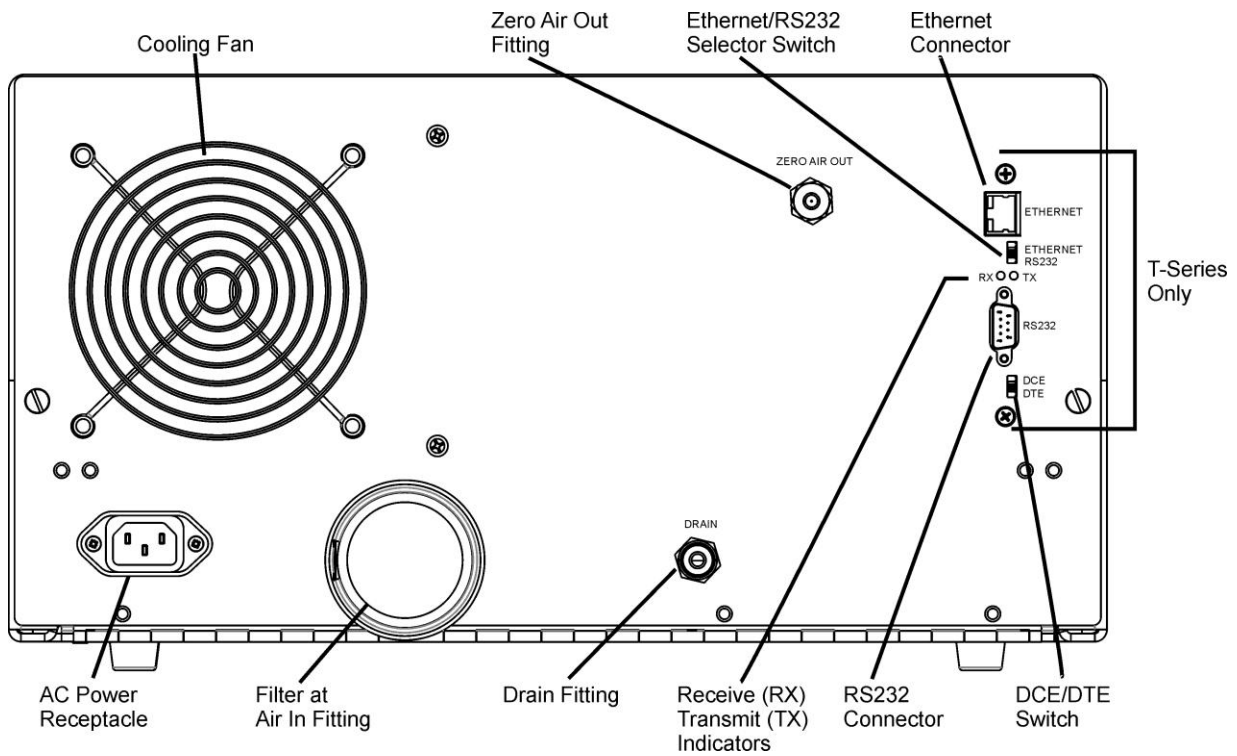


Figure 3-3: Rear Panel

3.4 Connections and Setup

All connections, electric and pneumatic, are made at the rear panel (Figure 3-3).

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 the power cord and communications cables.

WARNING

ELECTRICAL SHOCK HAZARD



- High Voltages are present inside the instrument.
- Ensure that the power cord being used is capable of carrying the power rating of the instrument (see Specifications Table 2-1)
- Power connection must have functioning ground connection.
- Ensure that installation provides access to disconnect power from the instrument.
- Do not defeat the ground wire on power plug.
- Turn off power before disconnecting or connecting electrical subassemblies.
- Do not operate with cover off.

Attach power cord to AC receptacle of instrument, and plug it into 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.

3.4.1.1 Communications Connections (T-Series only)

Ethernet and RS-232 communications are available in the T701 and T701H, but only one or the other may be used at one time. Both use the standardized MODBUS® protocol. (For details on the MODBUS TCP/IP specification, please see <http://www.modbus.org>). A rear panel slide switch, located between the two connectors must be set to select either Ethernet or RS-232 for the intended mode of communication (See Ethernet/RS232 Selector Switch in Figure 3-3).

RS-232

For RS-232 of communication connect an RS-232 cable (see Communication Cables in Table 1-1) from the rear panel to the device to be used. Section 5.1 provides configuration instructions.

Ethernet

For Ethernet communication connect an Ethernet cable (see Communication Cables in Table 1-1) from the analyzer's Ethernet port to a Local Area Network (LAN) or Internet port. Section 5.2 provides configuration instructions.

3.4.2 Pneumatic Connections

Make the following pneumatic connections (refer to Figure 3-3):

AIR IN
(1/4" female
pipe thread)

Screw the inlet filter into the "AIR IN" port. Hand tight is OK.

NOTE: Operation without the filter will cause premature pump wear.

DRAIN
(1/4" swage-type
bulkhead union)

Connect a 1/4" diameter tubing to the DRAIN fitting to avoid the occasional spurts of water on the instrument rack.

Connect the other end of the tubing to a drain or, alternatively, the water can be collected in a tray or bucket and dispersed by normal evaporation.

ZERO AIR OUT
(1/4" swage type
bulkhead union)

Connect the AIR OUT port of the 701X to the INLET fitting of the Model 700 Calibrator with *clean* 1/4" TFE tubing

Keep this line as short as possible to minimize pressure drops.

3.5 Power-Up

Turn on the front panel POWER SWITCH (Figure 3-2).

- The front panel POWER light should come on.
- The cooling fan should start immediately.
- The compressor should start after a few seconds delay. The delay is to allow the control board to initialize and boot up.
- After 30 to 60 seconds, the front panel pressure gauge should read 30 psig.
- The 701X is now producing clean dry air.

NOTE

If the 701X has been unused for several days, it may take 30-60 minutes to achieve final purity and dryness.

NOTE

The 701X zero air has a 20 (T701, 701)/30 (T701H, 701H) liter/minute output restriction. It must be connected to a Model 700 or similar calibrator to restrict the zero air flow for lesser flow rates.

3.5.1 Compressor Function

Because the 701X supplies zero air on demand, pressure in the storage tank will build until the “cut-out” level is achieved, thus turning off the compressor. In order for the compressor to turn on, the storage tank pressure must drop below the “cut in” level.

This function maintains a steady supply of zero air.

3.5.2 Shut Down Procedure for Storage or Transportation

If the 701X will not be used for an extended period of time or will be transported, follow this procedure for proper shut down:

1. Cycle power off and back on.
2. Wait for the compressor to come back on.
3. The water drain valve will switch into the open position and vent any accumulated water through the water drain. (Standing H₂O will cause corrosion)
4. Turn the 701X off.

ATTENTION

COULD DAMAGE INSTRUMENT AND VOID WARRANTY

Prevent corrosion to the 701X by following the shut down procedure to prevent water from passing into the in the instrument event that the instrument is inverted during storage or shipment.

4 OPERATION

4.1 Overview

Refer to Figure 3-1 for internal components and to Figure 4-1 for pneumatic flow.

The 701X dries and scrubs ambient air to produce zero air.

The compressor draws air in from the rear panel bulkhead union and inlet filter. At the compressor outlet, the air is under pressure and hot from the compression. The relative humidity is high as a result of the high pressure.

The air is conducted through the cooling coil where heat is removed by transfer to the cooling fan air. With the high pressure and the temperature reduced to ambient level, the relative humidity is at its highest. At this point, the air is usually supersaturated.

From the coil, the wet air passes through a coalescing filter where the excess water is separated and settles in the bottom of the filter. The controller periodically opens the solenoid drain valve allowing the water to be expelled through a rear panel bulkhead union (drain).

The partially dried air enters the Regenerative Dryer which removes essentially all the remaining water and a portion of the other contaminants. The pressure relief valve may open occasionally and can be loud but this is a normal part of the operation for the 701X.

The dry air then passes through a check-valve to the storage tank. A pressure switch turns off the compressor when the pressure in the tank reaches a set high value, and turns the compressor on when the pressure reaches a set low value. Thus, when air demand is low, the compressor is turned off and the tank fulfills the demand. The pressure in the tank varies from approximately 45 psig to approximately 80 psig depending on the demand and the restricted output. Some special calibrators with restricted output are set to 50 psig. As the air leaves the tank, its pressure is controlled by an air pressure regulator mounted on the front panel. This maintains a constant pressure at the calibrator inlet and is displayed by the pressure gauge on the 701X front panel or, in the T701 and T701H, by a remote computer using MODBUS protocol (Section 5.3).

For a final clean-up, the dry, regulated air enters the specific scrubbers as follows:

1. The Hydrocarbon scrubber (option in the T701 and 701, which includes the CO scrubber) where Hydrocarbons and CO are catalytically converted to CO₂ and water.
2. The NO scrubber where NO is oxidized to NO₂.
3. The activated charcoal scrubber where the NO₂ is absorbed.
4. The CO scrubber (option in the T701 and 701), where CO is catalytically oxidized to CO₂.
5. The clean dry air passes through a fine particulate filter and leaves the 701X through the rear panel bulkhead union (Zero Air Out).

When air usage is high, the compressor may run continuously. When air usage is low, the pressure switch turns the compressor off until the storage tank pressure drops to 45 psig, and then turns the compressor on again.

NOTE

It is not necessary to turn off the 701X when the air usage is low.

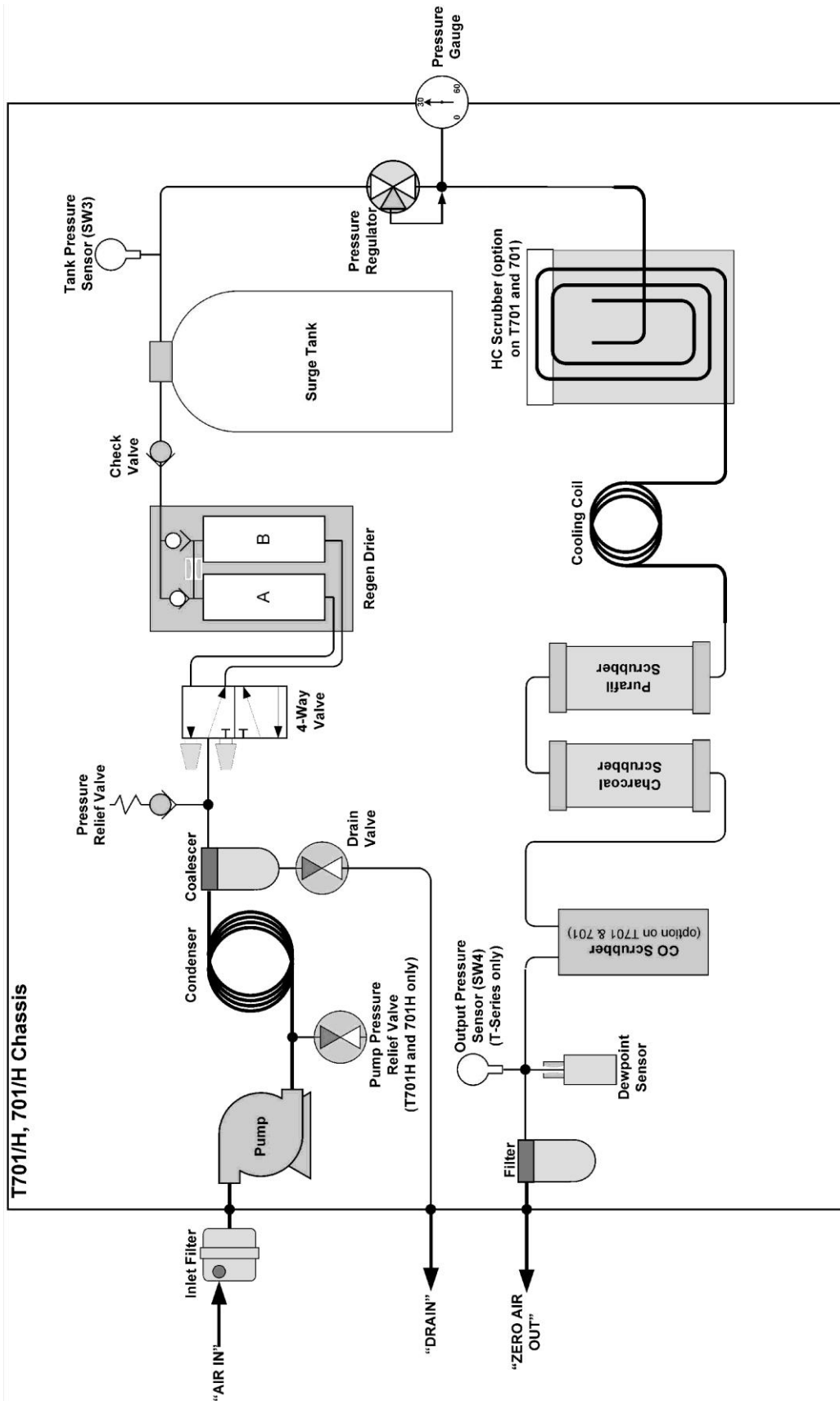


Figure 4-1: Pneumatic Diagram

4.2 Components

This section describes the main components of the instrument and their functions.

4.2.1 Compressor

The compressor is a dual-cylinder oscillating piston type driven by a split capacitor AC motor. The compressor is dry; that is, there are no lubricants which can contaminate the compressed air. The pistons are sealed by flexible TFE piston rings, and after a short run-in period to seat the rings, should last for years. There are no diaphragms.

The compressor is mounted on a sub-plate which is supported on four tuned vibration isolators.

4.2.2 Cooling Coil

The cooling coil consists of several turns of copper tubing coiled to form a cylinder through which the cooling fan blows outside air to cool the hot compressed gas, and allow the water vapor to condense.

4.2.3 Water Trap

The water trap is a coalescing type. Supersaturated air enters the trap and is rapidly swirled causing the water droplets to deposit on a membrane where the drops coalesce and gather in a puddle at the bottom of the filter bowl.

4.2.4 Water Drain Valve

Accumulated water is drained from the filter through a stainless steel solenoid-operated valve. The valve is sequenced by the controller to open and drain the accumulated water.



CAUTION

THE WATER/AIR SPRAY LEAVING THE REAR PANEL DRAIN FITTING SPURTS AT A HIGH VELOCITY AND MUST BE CONDUCTED AWAY FROM ANY SENSITIVE COMPONENTS.

The operation cycle has been preset at the factory and is not adjustable.

4.2.5 Pressure Relief Valve

The pressure relief valve is a safety device designed to limit the maximum pressure to which the 701X can be subjected. It is set to open at approximately 100 psig. This can be quite loud when the valve opens and sounds like steam escaping.



CAUTION – SAFETY HAZARD

DO NOT ADJUST THE RELIEF VALVE!

(Contact TAPI Technical Support if there is any concern about proper function).

4.2.6 Regenerative Dryer

The Regenerative Dryer consists primarily of two parallel columns of molecular sieve, in which alternately one column is scrubbing the air while the other is being regenerated.

The Regenerative Dryer needs no warm-up and operates at full efficiency as soon as the 701X is turned on. The molecular sieve has a typical life expectancy of greater than 5 years.

When the 701X is turned on, a four-way solenoid-operated valve directs high pressure air to one of the two columns and vents the other column to atmosphere. Virtually all the water in the high-pressure air is trapped by the molecular sieve. A portion of the dried air is expanded to atmospheric pressure in the outlet shuttle valve and passes in reverse through the second column. By expanding the air, the volume increases and the relative humidity decreases, thus enabling a small amount of dry purge air to evaporate the entrained water in the second column. The wet purge air leaving the column is exhausted inside the 701X. The rapid air movement inside the 701X chassis ensures that the small amount of water involved is safely vented to the atmosphere. The majority of the dry air from the first column is conducted to the storage tank.

The controller toggles the four-way valve at a predetermined interval and the columns alternate their function. This cycling rate has been selected to provide the optimum balance of scrubbing efficiency and air usage and is not adjustable.

4.2.7 Check Valve

The purpose of the check valve is to isolate the air in the storage tank from the components upstream. Thus when the compressor turns off, the air in the storage tank will be retained and not lost through the drier purge air path or back through the compressor.

4.2.8 Storage Tank

The storage tank serves two functions. As its name implies, it stores air so that when the demand is low, the compressor can be turned off to conserve energy, allowing the storage tank to supply the air requirements. The tank also serves as “filter capacitor”, preventing pulses generated by the drier cycles or water drain valve from reaching the output port on the rear panel.

The air in the tank has been dried so there is no need for a tank drain and no concern about internal corrosion.

The tank is a commercial gas storage cylinder, rated at 1800 psi, and is not modified or altered in any way that can harm its integrity.

4.2.9 Pressure Sensors

The Tank Pressure sensor senses the pressure in the storage tank and controls the compressor through the control board.

It is set at the factory to turn off (cut out) the compressor and turn on (cut in) the compressor at predetermined pressures for optimal performance.

The Output Pressure (T-Series only) sensor monitors the output pressure of the T701/T701H and displays its value through a MODBUS register (Section 5.4).

4.2.10 Pressure Regulator

The 701X pressure regulator serves as a stabilizer to minimize compressor-induced pressure surges or pressure variations with flow to a calibrator, such as the Teledyne API Model T700. The pressure regulator is set at 30 psig at the factory except for specially modified units. Should adjustment be desired, the regulator is accessible on the front panel. The adjustment knob has a push-pull locking ring which should be reengaged after making an adjustment to prevent the knob from turning under vibration.

When the 701X is used with the Teledyne API Model T700 Calibrator, the pressure should be between 28 and 32 psig.

WARNING



THE 701X NOMINAL DELIVERY PRESSURE IS 30 PSIG. ONLY SPECIALLY MODIFIED UNITS WILL REQUIRE THAT THE DELIVERY PRESSURE BE SET HIGHER.

ON THESE SPECIALLY MODIFIED UNITS NEVER SET THE DELIVERY PRESSURE HIGHER THAN 50 PSIG. TO DO SO MAY CAUSE DAMAGE TO THE 701X AND INJURY TO THE OPERATOR.

4.2.11 Pressure Gauge

The front panel-mounted pressure gauge shows approximately the regulated air pressure available to a calibrator. The gauge will usually indicate 30 psig. If the flow is very low, as in a standby condition, the gauge may read slightly higher. It will move to the correct reading when the air flow is increased. When the demand on air increases dramatically, the pressure may drop below 30 psig. At maximum air flow, 30 SLPM, you may notice that the pressure drops to 29 psig for a standard operation.

4.2.12 Hydrocarbon Scrubber (Standard on T701H, 701H; Option on T701, 701)

The High Purity Hydrocarbon Scrubber option (which includes the CO Scrubber) catalytically converts hydrocarbons to carbon dioxide and water. The scrubber consists of a cylindrical cartridge which contains a preheat chamber and the pelletized precious-metal catalyst. The canister is heated by a band heater with an integral type-K thermocouple and is housed in a stainless steel casing with appropriate thermal insulation. The cartridge temperature is controlled by the instrument's controller. The controller reads the thermocouple voltage, compensates for cold-junction temperature and modulates the heater to maintain a constant cartridge temperature.

The operating temperature of the cartridge is 300°C. The temperature can be verified by measuring the thermocouple voltage at the two terminal blocks of J12 (labeled "Thermal Couple" in Figure 4-2). At 300°C, the thermocouple voltage is 11.2 mV in an ambient temperature of 25°C (11.4 mV at 20° and 11.0 mV at 30°). While the controller compensates for cold-junction temperature in controlling the heater, the thermocouple voltage at the terminal block is not compensated, so allowance must be made for ambient temperature when converting the voltage to cartridge temperature.



CAUTION

**THE AIR LEAVING THE SCRUBBER IS AT 300°C (575°F).
THIS COPPER COIL AND THE CASING CAN BE VERY HOT.**

The catalyst is proprietary. It theoretically should never need changing. However, if contamination is suspected, we recommend that the scrubber be replaced (Section 6.8).

4.2.13 CO Scrubber (Standard on T701H, 701H; Option on T701, 701)

The CO scrubber catalytically oxidizes CO to CO₂. The catalyst is proprietary and operates at a slightly elevated temperature; theoretically, it should never need changing. However, it may become contaminated or poisoned over time so we recommend that it be replaced (Section 6.7) if contamination is suspected or sooner if the level of CO in the air is high.

4.2.14 NO Scrubber

The NO scrubber uses Purafil[®] to oxidize NO to NO₂. Purafil[®] has a finite life and we recommend that it be replaced (Section 6.5) annually or sooner if the level of NO in the air is high.

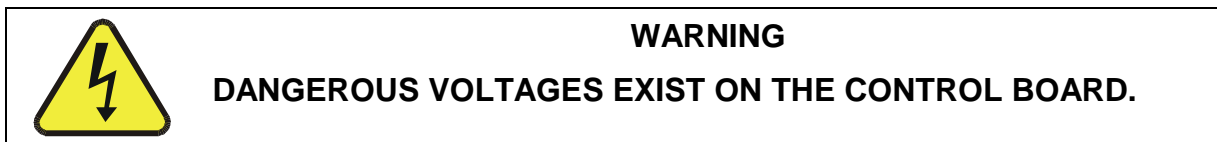
4.2.15 Charcoal Scrubber

Activated charcoal removes NO₂, O₃, SO₂ and H₂S. The charcoal should be replaced (Section 6.4) annually or sooner if there are high atmospheric levels of these contaminants, or if the calibrator zero air shows signs of a positive drift.

4.2.16 Final Filter

The final filter, inside the rear panel retains any particulates released by the 701X. The filter rating is 10 microns. If the filter becomes restricted, it should be disassembled and cleaned, or the element be replaced.

4.2.17 Controller



All functions of the 701X are managed by the Control board (Figure 4-2). The Control board provides connections for all switched and non-switched AC and DC components, AC/DC input, front panel indicators, communications board (T-Series only) and the front panel power switch/circuit breaker.

Switched DC components include the Regenerative Dryer valve, water drain valve, and the relief valve. **Switched AC components** include the pump and HC Scrubber. Provision for 120V/240V AC power is via a jumper plug (J5).

Non-switched components include the CO scrubber and fan.

All electrical connections are made by quick release connectors to aid in servicing. Additionally, the tank pressure, output pressure and Dewpoint connections are made to the control board with flexible tubing. Refer to Figure 4-2 for the layout and to Appendix B for the interconnect drawing.

The 701X Control PCB is microcontroller based, and provides the following functions:

- Cycles the four-way valve of the Regenerative Dryer.
- Cycles the water drain solenoid valve.
- Starts and stops the compressor in response to the pressure sensor. This function includes cycling the Regenerative Dryer four-way valve and momentarily opening the water drain solenoid valve before starting the compressor. This momentarily reduces the pressure at the compressor outlet to facilitate compressor starting.
- MODBUS® communication (T-Series only) via the Rear Panel Connectors to remotely display instrument's parameters.
- Monitors and regulates the HC Scrubber Temperature.

LED D13 (Figure 4-2) flashes at 1 second intervals as an indication that the controller is functioning, and a watchdog timer is enabled to prevent any power line disturbances from halting the processor.

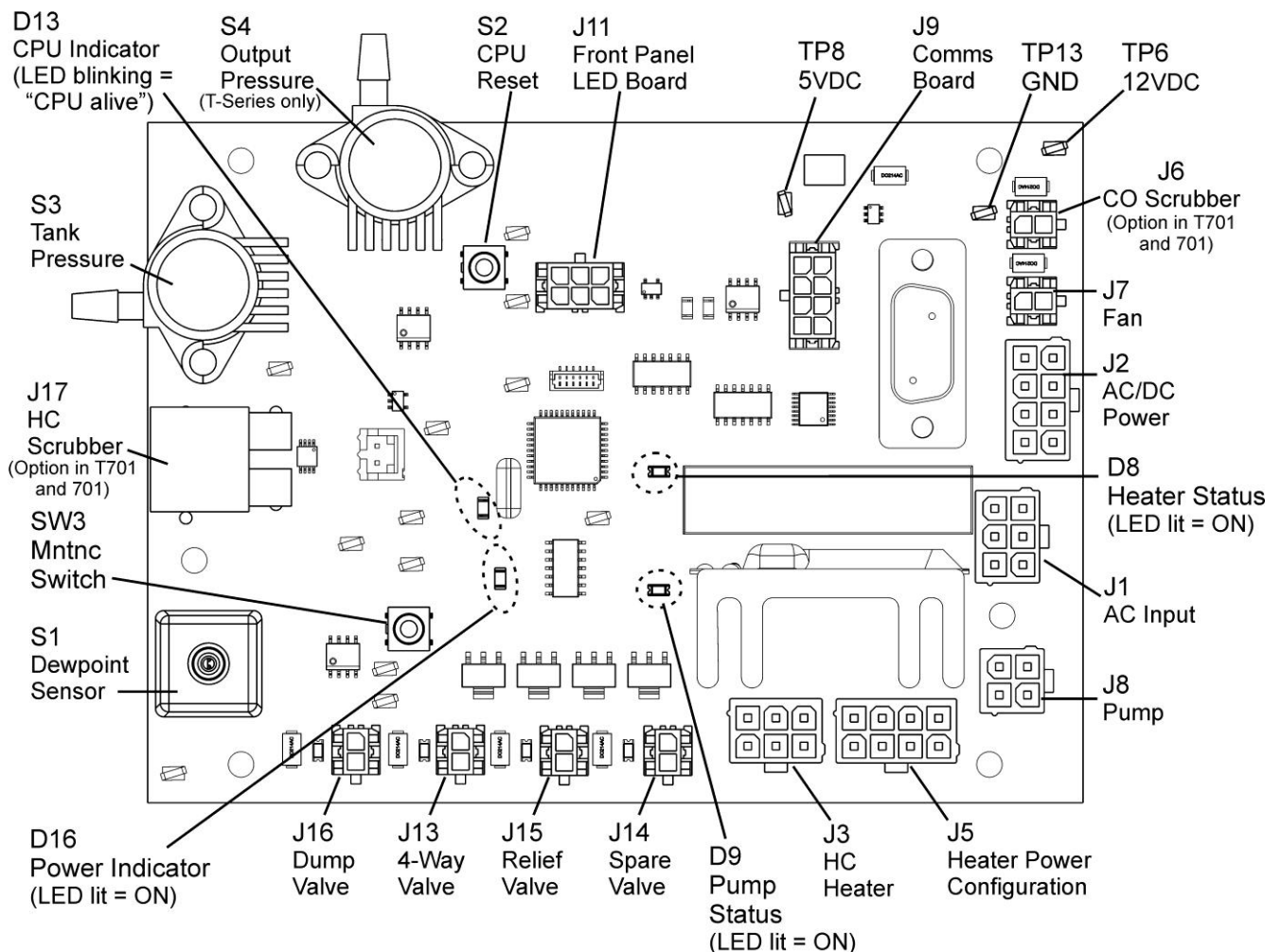


Figure 4-2: Control Board Layout

4.2.18 Dewpoint Sensor

The dewpoint sensor ensures that the Regenerative Dryer maintains an acceptable dewpoint. This will increase the life of the chemical scrubbers. When the dewpoint rises above -20°C , the green LED (dewpoint indicator) on the front panel will light.

4.2.19 Front Panel Indicator Lights

Multicolor indicator lights for both the power state and Dewpoint state relay diagnostic information and instrument mode to the user.

Power Indicator	Dewpoint Indicator	Description
Green	Green	Power ON, Dewpoint GOOD $< -20.0^{\circ}\text{C}$
Green	Yellow	Power ON, Dewpoint CAUTION
Green	Red-Flashing	Power ON, Dewpoint BAD $> -16.0^{\circ}\text{C}$
Green	Red	Power ON, Dewpoint FAULT
Alternating Yellow-Green	Any Color	Maintenance Mode. 24hr Dewpoint Fault Override.
Alternating Yellow-Green	Off	User Enabled Pump Standby Mode
Red-Flashing	Yellow	Box Temperature Fault. Pump and Hydrocarbon heater shutdown.
Red-Flashing	Red	Dewpoint Fault. Dewpoint has exceeded critical set point. Pump shutdown.

4.2.20 Communications Board (T-Series only)

RS232 and Ethernet connectors are located on the rear panel of the T701/T701H. A selector switch is installed between them to connect either Ethernet (10 Mbit) or RS232, but not both simultaneously. Also, when the RS232 port is used, a switch is available to select between DTC/DCE (Section 5.1.1). Connectivity LEDs will light to confirm that RS232 and/or Ethernet cables are connected; indication of activity is described in Section 5.

5 COMMUNICATIONS SETUP & OPERATION (T-SERIES ONLY)

This section provides RS232 and Ethernet communications configuration instructions.

The Models T701 and T701H are equipped with a communications board that allows connection between a computer or a digital data acquisition system. The communications port uses either MODBUS RTU for the RS232 port or MODBUS TCP/IP for the Ethernet port which allows communication between a wide variety of devices and networks.

Note that when one communications port is in use, the other is disabled. For RS232 communications (Section 5.1), set the rear panel **Ethernet RS232 Selector Switch** (Figure 3-3) to **RS232**, or for Ethernet communications (Section 5.2), set the switch to **ETHERNET**.

5.1 RS232 Communications

RS232 protocol requires that communications be set up for either Data Terminal Equipment (DTE) or Data Communication Equipment (DCE), described next.

5.1.1 Data Terminal / Communication Equipment (DTE DEC)

RS-232 was developed for allowing communications between data terminal equipment (DTE) and data communication equipment (DCE). Basic terminals always fall into the DTE category, whereas modems are always considered DCE devices. The difference between the two is the pin assignment of the Data Receive and Data Transmit functions.

- DTE devices receive data on pin 2 and transmit data on pin 3.
- DCE devices receive data on pin 3 and transmit data on pin 2.

To set the instrument for use with terminals (DTE), modems (DCE) and computers (which can be either), use the switch labeled DCE DTE mounted below the RS232 ports on the rear panel to select one of these two data devices. This switch exchanges the Receive and Transmit lines on RS-232 emulating a cross-over or null-modem cable.

5.1.2 RS-232 Configuration

1. Connect one of the RS-232 cable options (Table 1-1) from the RS232 port on the rear panel to either a computer or a modem.

NOTE

Cables that appear to be compatible because of matching connectors may incorporate internal wiring that makes the link inoperable. Check cables acquired from sources other than Teledyne API for pin assignments before using.

2. Slide the rear panel Ethernet RS-232 switch down toward the RS232 port.
3. Check the activity indicators labeled Rx and Tx above the RS232 port: both the red and the green LED should be lit.
 - If the LEDs are not lit, change the DTE DCE switch to its other mode.
 - If both LEDs are still not lit, ensure that the cable is properly constructed.

Received from the factory, the unit is set up to emulate an RS-232 DCE device as follows:

- **RS-232:** RS-232 (fixed) DB-9 male connector
- **Baud rate:** 57600 bits per second
- **Data Bits:** 8 data bits with 1 stop bit
- **Parity:** Even

5.2 Ethernet

When using the Ethernet interface, the instrument can be connected to any standard 10BaseT or 100BaseT Ethernet network via low-cost network hubs, switches or routers. The T701/T701H is DHCP-enabled by default (Section 5.2.2). This allows the instrument to be connected to a network or router with a DHCP server, which automatically assigns an IP address for the instrument. This configuration is useful for quickly getting an instrument up and running on a network. However, because DHCP can reset the IP address automatically, it is recommended that the manual method be used for Ethernet configuration (Section 5.2.1) so that the IP address remains static.

The Ethernet connector has two LEDs that are on the connector itself, indicating its current operating status.

Table 5-1. Ethernet Status Indicators

LED	FUNCTION
amber (link)	On when connection to the LAN is valid.
green (activity)	Flickers during any activity on the LAN.

5.2.1 Configuring Ethernet Communication Manually (Static IP Address)

For applications where the IP Address must remain constant, a static IP Address can be manually assigned to the instrument. The interface operates with MODBUS protocol.

1. Connect a cable from the analyzer's Ethernet port to a Local Area Network (LAN) or Internet port.
2. Slide the rear panel Ethernet RS-232 selector switch up toward the Ethernet port.
3. Install Windows software application, *DeviceInstaller*, to configure the Ethernet module. This application is available for download at: <http://www.teledyne-api.com/software/>.
4. Click **Start->Programs->Lantronix DeviceInstaller->DeviceInstaller**. If your PC has more than one network adapter, a message displays. Select an adapter and click **OK**.

Note: If the unit already has an IP address (e.g., DHCP has assigned an IP address), click the **Search** icon and select the unit from the list of Lantronix device servers on the local network.

5. Click the **Assign IP** icon.
6. If prompted, enter the hardware address (on the product label) and click **Next**.
7. Select **Assign a specific IP address** and click **Next**.
8. Enter the **IP address**. The Subnet mask displays automatically based on the IP address; if desired, you may change it. On a local network, you can leave the Default gateway blank (all zeros). Port should be 502. Click **Next**.
9. Click the **Assign** button and wait several seconds until a confirmation message displays. Click **Finish**.
10. Select the device from the main window list and click **Ping** from the **Tools** menu. The Ping Device dialog box shows the IP address of the selected device.
11. From the **Tools** menu, click the **Ping** button. The results display in the Status window. Click the **Clear Status** button to clear the window so you can ping the device again.

Note: If you do not receive "Reply" messages, make sure the unit is properly attached to the network and that the IP address assigned is valid for the particular network segment you are working with. If you are not sure, check with your systems administrator.

12. Click the **Close** button to close the dialog box and return to the main window.

5.2.2 Configuring Ethernet Communication Using Dynamic Host Configuration Protocol (DHCP)

The DeviceInstaller software application (downloadable from <http://www.teledyne-api.com/software/>) can be used to search a network for instruments and determine the IP Address assigned by a DHCP server.

1. Click **Start->Programs->Lantronix DeviceInstaller->DeviceInstaller**. If your PC has more than one network adapter, a message displays. Select an adapter and click **OK**.
2. Click the **Search** icon. After a moment a list of instruments on the network will be displayed. The instrument should be listed as an **XPORT-IAP** type device.
3. Double-click on the device in the right-hand section of the DeviceInstaller window; a list of configuration parameters will be shown, including the IP Address. If multiple devices are shown, the correct one can be determined by matching the Hardware Address shown with the address printed on the label of the Ethernet module in the instrument. Remove the instrument cover or lower the rear panel to find this address.

5.3 Communications Protocol: MODBUS

The following set of instructions assumes that the user is familiar with MODBUS communications, and provides minimal information to get started. For additional instruction, please refer to the Teledyne API MODBUS manual, PN 06276 (available on TAPI website). Also refer to www.modbus.org for MODBUS communication protocols. Section 5.4 provides MODBUS registers for this instrument.

Minimum Requirements

- MODBUS-compatible software (TAPI uses MODBUS Poll for testing; see www.modbustools.com)
- Personal computer
- Communications cable (Ethernet or RS232)

Read/Write Definition window:

Example Connection Setup window:

5.4 MODBUS Registers

Table 5-2. T701, T701H MODBUS Register Map

MODBUS Register Addr. (dec, 0-based)	Description	Data Type	Units
MODBUS Coil Registers			
0	System Reset Warning	single-bit; read/write	
1	Remote Pump Disable	single-bit; read/write	
2	Pump Service Timer Reset	single-bit; read/write	
3	Latch System Reset Warning	single-bit; read/write	
4	CPU Restart	single-bit; read/write	
MODBUS Discrete Inputs			
0	Pump Service Reminder Warning	single-bit; read-only	
1	Dewpoint Warning	single-bit; read-only	
2	HC Scrubber Temp Warning	single-bit; read-only	
3	Low Output Pressure Warning	single-bit; read-only	
4	Dewpoint Shut Down Warning	single-bit; read-only	
5	Box Temperature Shut Down Warning	single-bit; read-only	
6	Maintenance Mode Warning	single-bit; read-only	
MODBUS Holding Registers			
0	MODBUS Slave Address	Unsigned Int; read/write	1-247
MODBUS Input Registers			
0	Tank Pressure	32-bit IEEE 754 Format; read-only	PSI
2	Output Pressure	32-bit IEEE 754 Format; read-only	PSI
4	HC Scrubber Temperature	32-bit IEEE 754 Format; read-only	°C
6	Box Temperature	32-bit IEEE 754 Format; read-only	°C
8	Pump Duty Cycle	32-bit IEEE 754 Format; read-only	Fraction (1.0 = 100%)
10	HC Heater Duty Cycle	32-bit IEEE 754 Format; read-only	Fraction (1.0 = 100%)
12	Pump Service Interval Remaining Timer	32-bit IEEE 754 Format; read-only	Hrs.
14	4096 mV Reference Voltage	32-bit IEEE 754 Format; read-only	mV
30	Model Number	Inverse Long; read-only	
32	Serial Number	Inverse Long; read-only	
34	Software Part Number	Inverse Long; read-only	
36	Software Version	32-bit IEEE 754 Format; read-only	

5.4.1 Notes on MODBUS Registers

5.4.1.1 System Reset Warning

The System Reset Warning register notifies the user of an intentional or unintentional CPU reset condition. When the instrument restarts, the register will read 1; to clear the register, write 0 to it or allow it to reset to 0 automatically after the warm-up period. However, if the Latch System Reset Warning register value reads 1, then the software will not clear the warning automatically, and the System Reset Warning will require manual reset (write 0 to the register).

5.4.1.2 Remote Pump Disable

The Remote Pump Disable register allows the instrument to enter standby mode when a 1 is written into the register. In this mode the pump is disabled but the Hydrocarbon heater or CO Scrubber heater remains operational to decrease the time needed for operational warm-up. To exit standby mode and resume operation, write a 0 into the register.

5.4.1.3 Pump Service Timer Reset

The Pump Service Timer Reset register operates together with two other registers, the Pump Service Interval Remaining Timer (in Holding Register) and the Pump Service Reminder Warning (in Discrete Input Register), in order to ensure the pump is serviced according to maintenance requirements. The Pump Service Interval Remaining Timer counts down the number of operational hours remaining before the next service is due. The Pump Service Reminder Warning is activated when the time runs out, showing a value of 1 in the register. To reset the warning and timer, write a 1 to the Pump Service Timer Reset register. The software will rewrite the warning register to a 0, which clears the warning and restarts the timer.


5.4.1.4 MODBUS Slave Address

The MODBUS Slave Address register assigns an address to the instrument (default 1), and is used when multiple instruments are connected to the same serial line. It accepts an address of 1 to 247. The instrument does not need to be reset after changing this address value; the change is immediate. If the instrument is connected through the Ethernet, connection it is recommended that this address register be set to 1.

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6 MAINTENANCE

6.1 Schedule

	CAUTION
The operations outlined in this section are to be performed by qualified maintenance personnel only.	

Before any maintenance cycle the power on/off and drain any water that may be present (refer to instructions for “Shut Down Procedure for Storage or Transportation ” in Section 3.5.2). Table 6-1 presents the maintenance schedule.

Table 6-1: Maintenance Schedule

Date Instrument was received: _____						
Item	Charcoal Scrubber	NO-NO ₂ Scrubber (Purafil)	CO Scrubber (T701 & 701, option only)	HC Scrubber (T701 & 701, option only)	Regenerative Dryer	Particulate Filter (“Air In” on Rear Panel)
Frequency	Annually	Annually	When Contaminated	When Contaminated	When Contaminated	Annually
Refer to Section	6.4	6.5	6.7	6.8	6.9	6.13
Month	January					
	February					
	March					
	April					
	May					
	June					
	July					
	August					
	September					
	October					
	November					
	December					

6.2 Cleaning

1. Occasionally, depending upon the local conditions, check the inside of the 701X for excessive dirt or dust.
2. Particularly, check the cooling fan, cooling coil and compressor fan inlet.
3. Remove any dirt or dust with a vacuum cleaner.
Do not use an air jet. This will only redistribute the dirt and will not remove it.



WARNING

THERE ARE HIGH VOLTAGES PRESENT WHILE THE 701X IS PLUGGED IN.

6.3 Checking The Tubing

1. Under the vibration of the compressor, it is possible for some parts of the TFE tubing to abrade against nearby objects. This is most likely to occur with the tubing directly attached to the compressor.
2. Check to see if any signs of abrasion are present, and, if so, re-dress the tubing.
3. If any section of tubing appears to be heavily abraded, remove and replace it.



CAUTION

DO NOT LOOSEN ANY TUBING CONNECTION WHILE THE 701X IS RUNNING.



CAUTION

BEFORE WORKING ON THE 701X PLUMBING TURN OFF THE 701X, WAIT FOR THE PRESSURE GAUGE TO READ ZERO. (THIS MAY REQUIRE THAT YOU LOOSEN THE REAR PANEL BULKHEAD UNION TO ALLOW THE AIR TO BLEED AWAY.)



WARNING

EVEN THOUGH THE FRONT PANEL POWER SWITCH IS OFF, THERE IS LINE VOLTAGE PRESENT AT THE POWER ENTRY TERMINALS AND POWER SWITCH TERMINALS FOR ADDED SAFETY, REMOVE THE POWER CORD FROM THE REAR PANEL RECEPTACLE.

6.4 Replacing the Charcoal Scrubber

Before emptying the used charcoal, wearing a dust mask is recommended as a preventive measure since it is possible that some charcoal dust may rise when emptying and refilling the canister.

1. Turn off the 701X and wait for the pressure to go to zero.
2. Open the front panel, or remove the top cover.
3. Remove the 1/4" tubing connected to the top of the scrubber canister.
4. Release the fastening strap to free the canister.
5. Remove the 1/4" tubing connected to the bottom of the canister.
6. Unscrew the cap of the canister.
7. Remove the pad from the top of the canister.
8. Pour out the charcoal and dispose of it properly.
9. Refill the canister with fresh charcoal, up to 3/8" to 1/4" from the top. Rap the sides of the canister gently to settle the charcoal and add more as necessary.
10. Replace the pad on top of the charcoal.
11. Wipe any charcoal dust from the top edge of the canister. This is the surface which seals against the gasket.
12. Check that the gasket is in place in the cap.
13. Replace the cap and tighten it "hand-tight".
14. Reconnect the lower 1/4" tube connection.
15. Reattach the canister with the fastening strap.
16. Reconnect the upper 1/4" tube.
17. Enable "maintenance mode" (Section 6.6) which will bypass the Dewpoint warnings during scrubber drying.
18. After the compressor is turned on, it may be wise to check the scrubber for leaks using a commercial soap solution leak finder.
19. Place the instrument in Maintenance Mode to dry out scrubber (Section 6.6).

6.5 Replacing The NO - NO₂ Scrubber

This procedure is identical to the charcoal scrubber replacement procedure (above) except that the canister should be refilled with Purafil[®].

NOTE

After replacing the material in these scrubbers it can take up to 48 hours for the material to dry out before the 701X is functioning optimally.

6.6 Maintenance Mode

When changing the media of the Charcoal Scrubber (Section 6.4) and the NO-NO₂ Scrubber (Section 6.5), the new media will contain some moisture due to humidity in the ambient air and will consequently trigger a Dewpoint fault condition. Placing the 701X in Maintenance Mode will override the fault for 24 hours, allowing time to thoroughly dry the new media before resuming normal operation. (In high humidity environments this may take longer).

To place the instrument in Maintenance Mode, press and briefly hold the Maintenance Switch (SW3, Figure 4-2).

6.7 Replacing The CO Scrubber (T701, 701, option only)

The CO scrubber is attached to the HC scrubber housing. This is not a heated scrubber. It is secured with four screws through the body of the scrubber into the bracket.

1. Turn off power and unplug the 701X.



CAUTION

THE SCRUBBER WILL BE HOT.

2. With a wrench, remove the inlet and outlet tubing and the two unions from the top of the scrubber cartridge.
3. Remove the four screws to remove the scrubber.
4. Pick out the retaining screens.
5. Shake out the catalyst beads and dispose. No special disposal methods required.
6. Pour in new catalyst to 1/2" from the top of the bores. Tap the cartridge sides gently to settle the beads and top up to the 1/2" level.
7. Replace the retainer screens.
8. Replace the TFE tape on the two unions and replace the unions in the cartridge.
9. Reassemble the scrubber, replace it in the chassis and reconnect the tubing and receptacle.
10. Turn on the 701X and leak check using soap solution.

6.8 Replacing the Hydrocarbon (HC) Scrubber (T701, 701, option only)

1. Turn off power and unplug the instrument's power cord.
2. Disconnect the HC scrubber power at the Controller (Figure 4-2).
3. Unplug the thermocouple from the control board.



CAUTION

WAIT FOR THE SCRUBBER TO COOL. THE SCRUBBER CASING AND THE COPPER COOLING COIL WILL BE VERY HOT.

4. Remove the heat shield from the HC scrubber.
5. Disconnect the pneumatic connections at the CHARCOAL SCRUBBER INLET AND AT THE REAR END OF THE COPPER COOLING COIL, using 1/2" and 9/16" wrenches.
6. Remove the four screws holding the scrubber, under the chassis.
7. Lift out the scrubber.
8. Install a new Teledyne API-supplied scrubber (these are purged at the factory).
9. Screw it down.
10. Attach and tighten the pneumatic connections.



CAUTION

ENSURE THAT THE COPPER COOLING COIL IS NOT TOUCHING ANY WIRE OR CABLE.

11. Plug the scrubber into the control board.



CAUTION

BE SURE THAT YOU USE A TELEDYNE API-SUPPLIED, PURGED SCRUBBER. OTHERWISE, DOWNSTREAM COMPONENTS MAY BE DAMAGED. AN UNPURGED HYDROCARBON SCRUBBER PRODUCES A LOT OF WATER WHEN FIRST TURNED ON.

12. Plug the thermocouple into the control board.
13. Turn on the 701X.

14. Connect a millivolt meter to J17 (labeled "Thermal Couple" in Figure 4-2) on the temperature controller.
Observe that the Heater Relay LED (D8) starts blinking at 11.2 mV (300°C) and that the thermocouple voltage holds steady.
15. When all traces of water have disappeared from the 701X output, the output may be reconnected to the analyzers.

6.9 Servicing The Regenerative Dryer

It is unlikely that the Regenerative Dryer should ever need service. Should the molecular sieve become contaminated by oil or other external contaminants, the scrubber will need to be cleaned and recharged. Refer to Figure 6-1.

Although the molecular sieve is not toxic, wearing a mask is recommended as a preventive measure against inhaling dust that may rise during the emptying and refilling process.

1. Turn off the 701X, and turn on again and remove any water in bowl.
2. Unplug the instrument from electrical service.
3. Allow the pressure to bleed to zero.
4. Remove the two pneumatic connections and the electrical connection from the 4-way manifold.
5. Remove the dryer from the chassis by unscrewing the four captive screws in the dryer base.
6. Remove the 4-way valve bracket from the upper manifold and let the valve hang loose attached to the lower manifold.
7. Remove the three nuts on top of the upper manifold.
8. Remove the upper manifold.
9. Remove the two columns.
10. Remove the retainer pads from the two columns and dump the molecular sieve into a suitable waste receptacle.
11. Wipe out the inside of the columns with a clean dry rag.
12. Examine the surface and ports in the upper and lower manifolds. If there is an accumulation of dirt or corrosion, disassemble the manifolds and clean them. If not, proceed with step 13.
13. Place two new clean retainer pads in each end of each column. Push the pads 1/8" into the column.
14. Pour new clean molecular sieve into each column, up to 1/4" from the top. Tap the side gently, (with a screw-driver handle, for instance) to settle the molecular sieve, and then top up to the 1/4" mark again.

15. Place two new clean retainer pads on top of the molecular sieve. Push the pad 1/8" into the column.
 16. Change the four o-rings in the circular grooves in the upper and lower manifolds.
 17. Place the bottom of the columns with two pads in the circular grooves in the lower manifold. Ensure that they are in the grooves and not caught up on the edge.
 18. Wipe the ends of the columns. These are the surfaces which seal against the o-rings.
 19. Place the upper manifold (new if replacing the shuttle valve, Section 6.11) on top of the two columns. Ensure that the columns are in the grooves. (Wiggle the columns sideways to ensure that the columns are seated in the grooves.)
 20. Replace the nuts and lock-washers on the three tie rods BUT DO NOT TIGHTEN THEM.
 21. Push down hard in the center of the upper manifold with one hand and finger-tighten the nuts until you feel a soft resistance.
 22. With a wrench, tighten each nut in turn, 1/2 turn at a time. This will ensure that all the nuts are tightened evenly. If the nuts are tightened unevenly, the column o-rings may not seal and you may cause damage to the sealing surfaces.
 23. Examine the fit of the columns in the manifold groove one more time.
 24. Re-attach the 4-way valve bracket.
 25. Replace the dryer in the 701X chassis and tighten the four captive screws.
 26. Reconnect the two pneumatic fittings and the valve power cord.
 27. Plug in and turn on the 701X.
 28. Using soap solution, check the dryer for leaks.
- If no leaks are detected, the 701X is ready for operation.

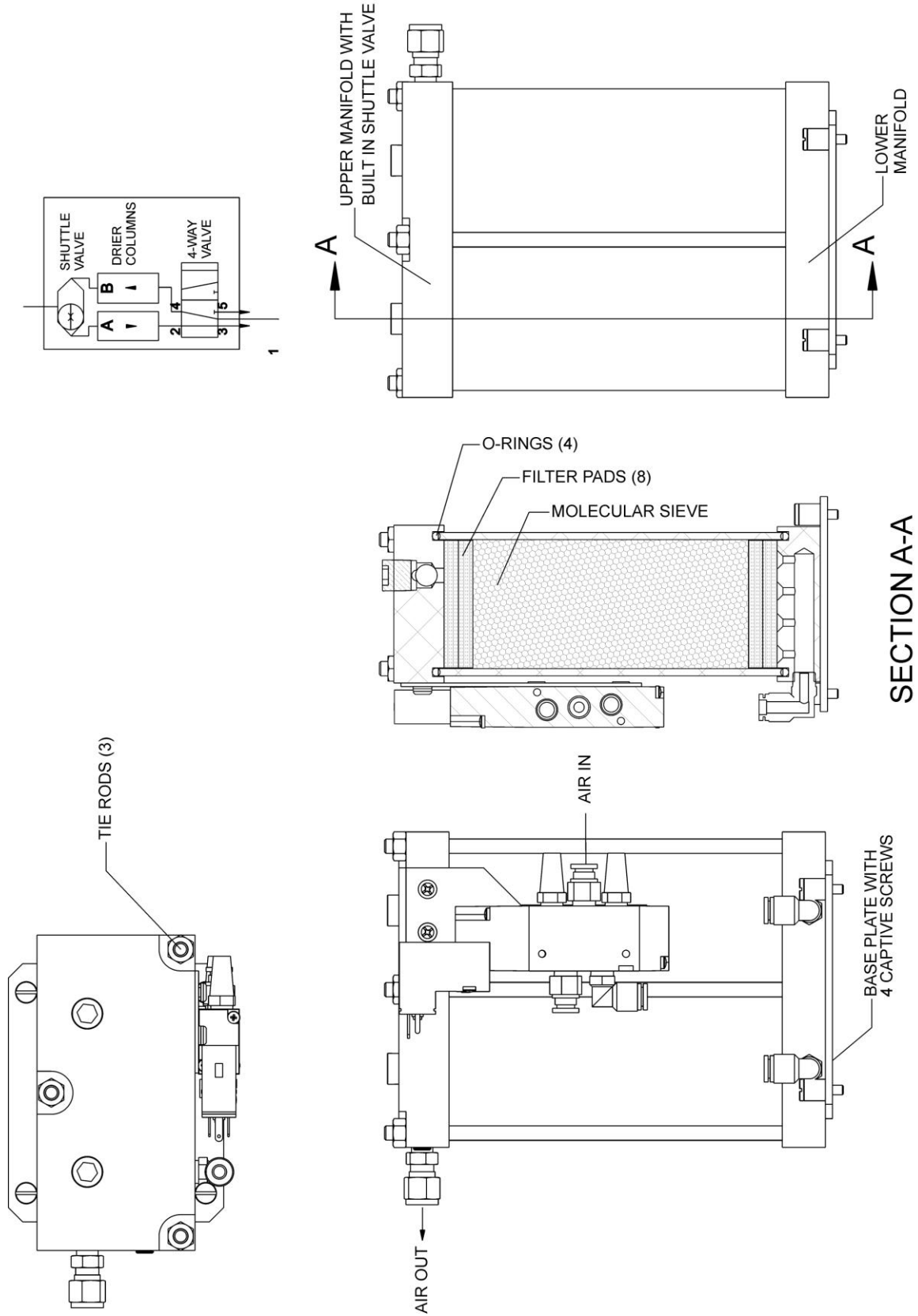


Figure 6-1: Regenerative Dryer

6.10 Changing the Regenerative Dryer's 4-Way Valve

1. Remove the Regenerative Dryer from the chassis as described in Section 6.9 above.
2. Disconnect the two tubing connections and the electrical connection to the 4-way valve.
3. Remove the 4-way valve bracket from the regenerative upper manifold.
4. Remove the 4-way valve from the bracket.
5. Attach a new valve, complete with tube fittings and muffler(s).
6. Attach the bracket to the upper manifold.
7. Connect the electric cable and two pneumatic fittings.
8. Re-install the dryer in the 701X chassis and tighten the four captive base screws.

6.11 Replacing the Regenerative Dryer's Shuttle Valve

It is not necessary to remove the Regenerative Dryer from the 701X chassis.

The Shuttle Valve is integral to upper manifold assembly. To replace the Shuttle Valve, replace the upper manifold assembly. Refer to Section 6.9 steps 1, 2, 3, 5, 6, 7, 8 & 19 through 28.

6.12 Leak Check



WARNING

UNPLUG POWER CORD PRIOR TO PERFORMING LEAK CHECK.

1. Power off the unit and unplug the power cord.
2. Cap the exhaust on the rear panel and the regenerative dryer.
3. Disconnect the line from the T-connector threaded into the outlet filter to the Dewpoint sensor, and cap that fitting as well.
4. Plug in the power cord, power on the unit, and allow it to run until the pump shuts off on its own (now it's pressurized).
5. Turn off the power switch and wait five minutes. The reading on the front panel pressure gauge should not change.

NOTE

This procedure checks the majority of the components and fittings. If you believe that there is still a leak, please contact Technical Support.

6.13 Particulate Filter Element Replacement

Replace the particulate filter located at the “Air In” inlet on the rear panel (refer to Figure 3-3) as follows:

1. Remove the particulate filter cap by turning it counter-clockwise.
2. Remove the old filter element and replace with a new filter element (Teledyne API P/N FL16).
3. Replace the particulate filter cap and turn it clockwise to secure in place.

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7 TROUBLESHOOTING

This section presents possible problems and their causes and solutions.



CAUTION – Avoid Warranty Invalidation

Failure to comply with proper anti-Electro-Static Discharge (ESD) handling may void your warranty. For anti-ESD handling instructions please refer to the manual, Fundamentals of ESD, PN 04786, which can be downloaded from our website at <http://www.teledyne-api.com> under Help Center > Product Manuals in the Special Manuals section.

Table 7-1: Troubleshooting

Problem	Probable Cause	Corrective Action
Power light does not come on.	Unplugged power cord.	Plug in power cord at both ends.
	Failed Control Board	Check for 5 VDC at TP8 on the control board (see Figure 4-2).
	Tripped power switch/circuit breaker.	Reset the power switch/circuit breaker.
	VDC power supply failed.	Replace power supply (see Figure 3-1 for location).
Compressor does not start (after 10 seconds).	Tank pressure is above the cut-out pressure.	No action. Pressure will drop as air is used.
	AIR IN filter is plugged.	Replace the filter (Section 6.13).
	Compressor fan is jammed.	Check for any mechanical obstruction.
	Pump is not connected to controller.	Connect the pump to the controller (see Figure 4-2).
	Pump is in Stand-by Mode	Remove from Stand-by Mode (see Section 5-7)
	Pump relay (K4) is open.	Replace the controller (Section 4.2.17).
Compressor stops and does not restart.	Tank pressure has not subsided to the pressure switch cut-in setting.	No action. Wait for the pressure to subside.
Compressor does not stop when the demand is.	Internal leak.	Check for leaks. (Section 6.12).
	Pump has low output pressure.	Rebuild pump (see sticker on pump for rebuild kit PN).

Problem	Probable Cause	Corrective Action
Instrument vibrates excessively.	Compressor shock isolator screws are loose.	Tighten the screws.
	Screws securing the compressor to the base plate are loose.	Tighten the screws.
	The tubing attached to the compressor is vibrating against a component.	Adjust the placement of the tubing.
	Air demand too high. Maximum air flow is 30 SLPM (unless customized at factory).	No action. Pressure will drop as air is used.
Pressure does not increase to 30 psig.	Air Inlet impeded.	Check for impediment and remove object.
	Pressure regulator is set too low.	Adjust the pressure via the front panel control.
	Air leakage.	Check for leaks (Section 6.12).
	Air demand is too high.	Lower the flow demand.
Output pressure surges.	Scrubbers may be contaminated.	Replace the scrubbers (Sections 6.4, 6.5, 6.7, 6.8).
Output air is not "Zero".	4-way valve is jammed; only one column is being used.	Check to ensure the valve is plugged in (Figure 4-2); replace the valve (Section 6.10).
Output air is not dry.	Shuttle valve is jammed.	Replace the upper manifold assembly (Section 6.9, steps 1 thru 8, and step 19).
	Molecular sieve is contaminated.	Replace the molecular sieve (Section 6.9).

APPENDIX A - SPARE PARTS

Note Use of replacement parts other than those supplied by T-API may result in non-compliance with European standard EN 61010-1.

Note Due to the dynamic nature of part numbers, please refer to the Website at <http://www.teledyne-api.com> or call Customer Service at 800-324-5190 for more recent updates to part numbers.

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T/701 Spare Parts List

PN 07828 DCN 6846 01/24/2014

1 of 1 page(s)

Part Number	Description
5960000	AKIT, EXP, ACT CHARCOAL, (2 BTL@64 FL-OZ EA)
5970000	AKIT, EXP, PURAFIL (2 BTL@64 FL-OZ EA)
6900100	RETAINER PAD CHARCOAL, LARGE, 2-1/4"
6900000	RETAINER PAD CHARCOAL, SMALL, 1-3/4"
16910000	AKIT, EXP KIT, CO CATALYST
16920000	AKIT, EXP KIT, MOL SEIVE
18490000	GAUGE, PRESSURE, 60 PSI
36260200	ASSY, 4-WAY VALVE, PARKER
57270000	GASKET, SCRUBBER
56890000	ASSY, PUMP, 100-115V/50-60HZ, GAST
56890100	ASSY, PUMP, 200-240V/50-60HZ, GAST
73380200	ASSY, HC SCRUBBER, DUAL VOLTAGE
77830000	PCA, CONT BOARD, 2P+RH (T701 ONLY)
77830100	PCA, CONT BOARD, 1P+RH (701 ONLY)
77860000	PCA, ETHERNET BOARD (T701 ONLY)
77890000	PCA, FRONT PANEL LED BOARD
78580000	ASSY, WATER DROP VALVE
78610000	ASSY, 12VDC FAN
78670000	CONFIG PLUG, 115V
78670100	CONFIG PLUG, 230V
78820100	BARB TEE W/ .004" ORIFICE, 1/4" TUBE, KYNAR (T701 ONLY)
80470100	BARB FITTING, W/.004" ORIFICE, 1/4" TUBE, KYNAR (701 ONLY)
FL0000007	FILTER, COALESCING, .03 MICRON(KB)
FL0000015	FILTER, AIR, 150 LPM
FL0000016	FILTER ELEMENT, PAPER, FOR FL15
HW0000130	GROMMET, QUICK RELEASE
HW0000131	PLUNGER, QUICK RELEASE
HW0000190	NUT, PANEL MOUNT, REGULATOR
PS0000038	PS, 60W SWITCHING, 12V
PU0000077	KIT, PUMP REBUILD FOR PU74 & PU75
SW0000069	SWITCH/CIR BRK, VDE CE, HI INRU
VA0000016	VALVE, RELIEF
VA0000014	REGULATOR
VA0000016	VALVE, CHECK
WR0000008	POWER CORD, 10A

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T/701H Spare Parts List

PN 07829 DCN6846 01/24/2014

1 of 1 page(s)

Part Number	Description
5960000	AKIT, EXP, ACT CHARCOAL, (2 BTL@64 FL-OZ EA)
5970000	AKIT, EXP, PURAFIL (2 BTL@64 FL-OZ EA)
6900100	RETAINER PAD CHARCOAL, LARGE, 2-1/4"
16910000	AKIT, EXP KIT, CO CATALYST
16920000	AKIT, EXP KIT, MOL SEIVE
18490000	GAUGE, PRESSURE, 60 PSI
36260200	ASSY, 4-WAY VALVE, PARKER
57270000	GASKET, SCRUBBER
66800000	ASSY, GAST PUMP, 115V
66800100	ASSY, GAST PUMP, 220-240V
72270000	ASSY, WATER FILTER W/BRASS VENT
73380200	ASSY, HC SCRUBBER, DUAL VOLTAGE
77830000	PCA, CONT BOARD, 2P+RH (T701H ONLY)
77830100	PCA, CONT BOARD, 1P+RH (701H ONLY)
77860000	PCA, ETHERNET BOARD (T701H ONLY)
77890000	PCA, FRONT PANEL LED BOARD
78580000	ASSY, WATER DROP VALVE
78610000	ASSY, 12VDC FAN
78670000	CONFIG PLUG, 115V
78670100	CONFIG PLUG, 230V
78820100	BARB TEE W/ .004" ORIFICE, 1/4" TUBE, KYNAR (T701H ONLY)
80470100	BARB FITTING, W/ .004" ORIFICE, 1/4" TUBE, KYNAR (701H ONLY)
FL0000015	FILTER, AIR, 150 LPM
FL0000016	FILTER ELEMENT, PAPER, FOR FL15
HW0000130	GROMMET, QUICK RELEASE
HW0000131	PLUNGER, QUICK RELEASE
HW0000190	NUT, PANEL MOUNT, REGULATOR
PS0000038	PS, 60W SWITCHING, 12V
PU0000090	KIT, REBUILD, PU88 & PU89
SW0000069	SWITCH/CIR BRK, VDE CE, HI INRU
VA0000012	VALVE, RELIEF
VA0000014	REGULATOR
VA0000016	VALVE, CHECK
WR0000008	POWER CORD, 10A

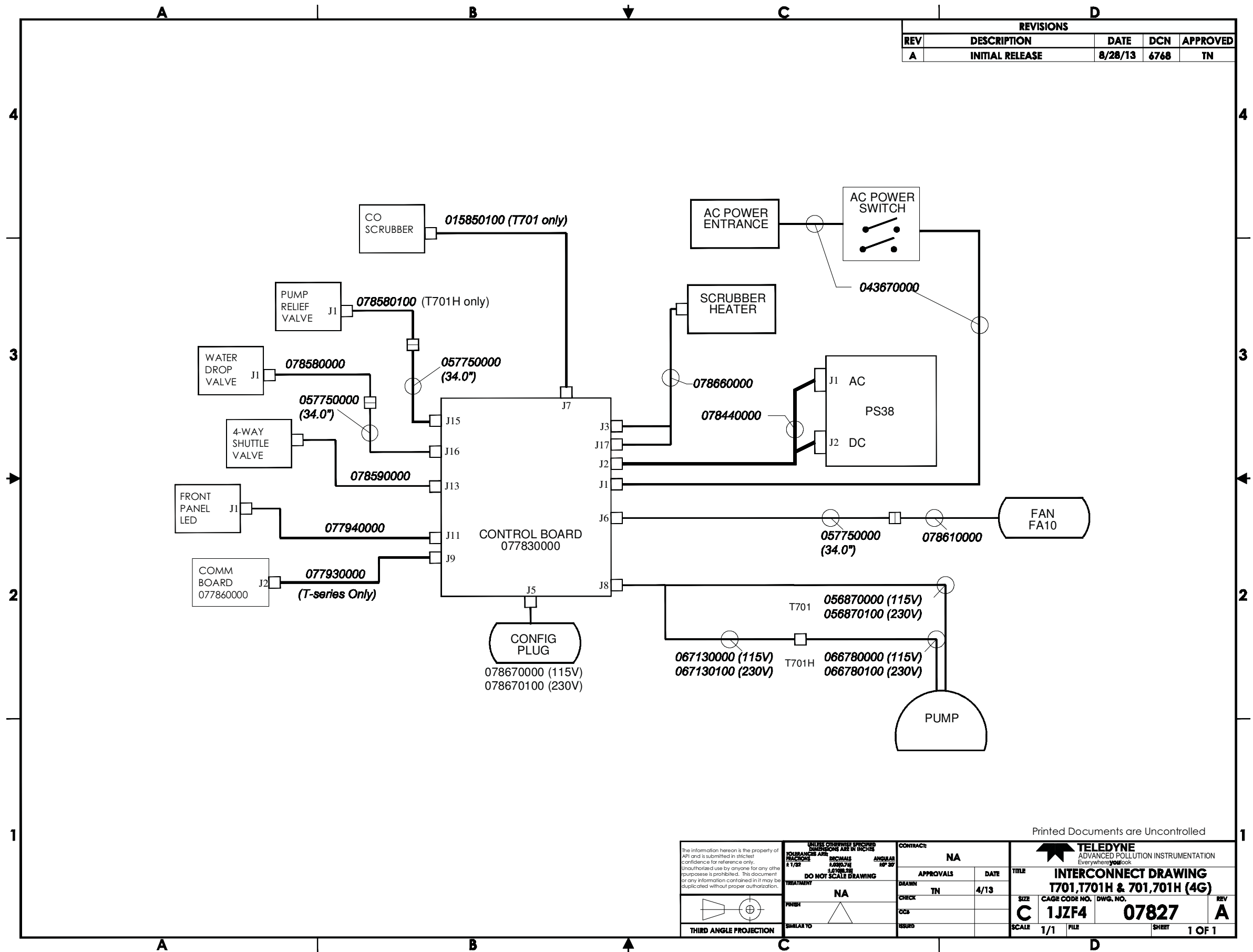
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APPENDIX B - SCHEMATICS

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Cable Part #	Signal	CONNECTION FROM				CONNECTION TO			
		Assembly	PN	J/P	Pin	Assembly	PN	J/P	Pin
015850100 CO Scrubber Heater (T701 & 701 only)									
	+12V	CO +12VDC Heater	077830000	P2	1	Control Board	077830000	J7	1
	+12V RET	CO +12VDC Heater	077830000	P3	2	Control Board	077830000	J7	2
043670000 Cbl Assy, AC Power, 701X/T701X									
	AC Line	Power Entry	CN0000073		L	Power Switch	SW0000069		L
	AC Neutral	Power Entry	CN0000073		N	Power Switch	SW0000069		N
	Power Gnd	Power Entry	CN0000073		G	Shield	SW0000069		
	Power Gnd	Power Entry	CN0000073		G	Chassis Gnd			
	AC Line Switched	Power Switch	SW0000069		L	Control Board	077830000	J1	3
	AC Neutral Switched	Power Switch	SW0000069		N	Control Board	077830000	J1	6
	Power Gnd	Power Entry	CN0000073		G	Control Board	077830000	J1	2
056870000 Assy, Pump, 115V~, 701/T701									
	AC Line	Assy, Pump, 115V~	058670100		L	Control Board	077830000	J8	1
	AC Neutral	Assy, Pump, 115V~	058670100		N	Control Board	077830000	J8	2
	Power Gnd	Assy, Pump, 115V~	058670100		G	Control Board	077830000	J8	3
056870100 Assy, Pump, 230V~, 701/T701									
	AC Line	Assy, Pump, 230V~	056870100		L1	Control Board	077830000	J8	1
	AC Neutral	Assy, Pump, 230V~	056870100		L2	Control Board	077830000	J8	2
	Power Gnd	Assy, Pump, 230V~	056870100		G	Control Board	077830000	J8	3
057750000 Cbl Assy, Ext Cable, T701X									
	+12V RET	Fan	078610000	Fan	1	Control Board	077830000	J6	1
	+12V	Fan	078610000	Fan	2	Control Board	077830000	J6	2
	+12V RET	Pump Relief Valve (T701H only)	078580100	Relief	1	Control Board	077830000	J15	1
	+12V	Pump Relief Valve (T701H only)	078580100	Relief	2	Control Board	077830000	J15	2
	+12V RET	Water Drop Valve	078580000	Water Drop	1	Control Board	077830000	J16	1
	+12V	Water Drop Valve	078580000	Water Drop	2	Control Board	077830000	J16	2
066780000 Assy, Pump, 115V~, 701H/T701H									
	AC Line	Assy, Pump, 115V~	066780000		L	Control Board	077830000	EXT/J8	1
	AC Neutral	Assy, Pump, 115V~	066780000		N	Control Board	077830000	EXT/J8	2
	Power Gnd	Assy, Pump, 115V~	066780000		G	Control Board	077830000	EXT/J8	3
066780100 Assy, Pump, 230V~, 701H/T701H									
	AC Line	Assy, Pump, 230V~	066780100		L1	Control Board	077830000	EXT/J8	1
	AC Neutral	Assy, Pump, 230V~	066780100		L2	Control Board	077830000	EXT/J8	2
	Power Gnd	Assy, Pump, 230V~	066780100		G	Control Board	077830000	EXT/J8	3
066780100 Assy, Pump, 230V~, 701H/T701H									
	AC Line	Assy, Pump, 230V~	066780100		L1	Control Board	077830000	EXT/J8	1
	AC Neutral	Assy, Pump, 230V~	066780100		L2	Control Board	077830000	EXT/J8	2
	Power Gnd	Assy, Pump, 230V~	066780100		G	Control Board	077830000	EXT/J8	3
067130000 Cbl, Gast Pump, 115V, 701H									
	AC Line	Assy, Pump, 230V~	066780100		L1	Control Board	077830000	J8	1
	AC Neutral	Assy, Pump, 230V~	066780100		L2	Control Board	077830000	J8	2
	Power Gnd	Assy, Pump, 230V~	066780100		G	Control Board	077830000	J8	3
067130100 Cbl, Gast Pump, 230V, 701H									
	AC Line	Assy, Pump, 230V~	066780100		L1	Control Board	077830000	J8	1
	AC Neutral	Assy, Pump, 230V~	066780100		L2	Control Board	077830000	J8	2
	Power Gnd	Assy, Pump, 230V~	066780100		G	Control Board	077830000	J8	3
077930000 Cbl Assy, Communications, T701X									
	CAN L	Comm Board	077860000	J2	1	Control Board	077830000	J9	1
	GND	Comm Board	077860000	J2	2	Control Board	077830000	J9	2
	+5V	Comm Board	077860000	J2	3	Control Board	077830000	J9	3
	GND	Comm Board	077860000	J2	4	Control Board	077830000	J9	4
	CAN H	Comm Board	077860000	J2	5	Control Board	077830000	J9	5
	RX 2	Comm Board	077860000	J2	6	Control Board	077830000	J9	6
	TX 2	Comm Board	077860000	J2	7	Control Board	077830000	J9	7
	Ethernet Reset	Comm Board	077860000	J2	8	Control Board	077830000	J9	8
077940000 Cbl Assy, Front Panel LED Indicator, T701X									
	PWR RED LED	Front Panel LED Board	077890000	J1	1	Control Board	077830000	J11	1
	PWR GREEN LED	Front Panel LED Board	077890000	J1	2	Control Board	077830000	J11	2
	RH RED LED	Front Panel LED Board	077890000	J1	7	Control Board	077830000	J11	3
	GND	Front Panel LED Board	077890000	J1	4	Control Board	077830000	J11	4
	GND	Front Panel LED Board	077890000	J1	3	Control Board	077830000	J11	5
	RH GREEN LED	Front Panel LED Board	077890000	J1	6	Control Board	077830000	J11	6
078440000 Cbl Assy, Power Supply, T701X									
	AC Line	Power Supply	PS0000038	J1-AC	1	Control Board	077830000	J2	1
	AC Neutral	Power Supply	PS0000038	J1-AC	3	Control Board	077830000	J2	5
	+12V	Power Supply	PS0000038	J2-DC	1	Control Board	077830000	J2	4
	+12V RET	Power Supply	PS0000038	J2-DC	3	Control Board	077830000	J2	8
078580000 Assy, Water Drop Valve, T701X/751X									
	+12V RET	Water Drop Valve	078580000	EXT/J16	1	Control Board	077830000	J16	1
	+12V	Water Drop Valve	078580000	EXT/J16	2	Control Board	077830000	J16	2
078580100 Assy, Pump Relief Valve (T701H only)									
	+12V RET	Pump Relief Valve	078580000	EXT/J15	1	Control Board	077830000	J15	1
	+12V	Pump Relief Valve	078580000	EXT/J15	2	Control Board	077830000	J15	2
078590000 Cbl Assy, 4-Way Shuttle Valve, T701X/751H									
	+12V RET	4-Way Shuttle Valve	078590000	P13	1	Control Board	077830000	J13	1
	+12V	4-Way Shuttle Valve	078590000	P13	2	Control Board	077830000	J13	2
078610000 Assy, 12VDC Fan, T701X/751X									
	+12V RET	12VDC Fan	078610000	EXT/J6	1	Control Board	077830000	J6	1
	+12V	12VDC Fan	078610000	EXT/J6	2	Control Board	077830000	J6	2
078660000 HC Scrubber Heater, T701X, 751H									
	Thermocouple (+)	HC Scrubber Heater	078660000	P17	+	Control Board	077830000	J17	1

Cable Part #	Signal	CONNECTION FROM				CONNECTION TO			
		Assembly	PN	J/P	Pin	Assembly	PN	J/P	Pin
	Thermocouple (-)	HC Scrubber Heater	078660000	P17	-	Control Board	077830000	J17	2
	Thermostat (pin1)	HC Scrubber Heater	078660000	P3	1	Control Board	077830000	J3	1
	Thermostat (pin2)	HC Scrubber Heater	078660000	P3	4	Control Board	077830000	J3	4
	HC Scrubber Heater (A)	HC Scrubber Heater	078660000	P3	3	Control Board	077830000	J3	3
	HC Scrubber Heater (B)	HC Scrubber Heater	078660000	P3	5	Control Board	077830000	J3	5
	HC Scrubber Heater (Com)	HC Scrubber Heater	078660000	P3	6	Control Board	077830000	J3	6
078670000	HC Heater Config Plug, 115V								
	AC Line	Control Board	077830000	J3	2	NC			
	AC Line Switched	Control Board	077830000	J3	1	Thermostat (pin1)	078660000	P3	1
	AC Neutral	Control Board	077830000	J3	3	HC Scrubber Heater (A)	078660000	P3	3
	Jumper 1-6	Thermostat (pin2)	078660000	P3	4	HC Scrubber Heater (Com)	078660000	P3	6
	Jumper 2-5	AC Neutral	077830000	J5	2	HC Scrubber Heater (B)	078660000	P3	5
	Jumper 3-8	Chassis Gnd	077830000	J5	3	Control Board	077830000	J5	8
	Jumper 4-7	Chassis Gnd	077830000	J5	4	Control Board	077830000	J5	7
078670100	HC Heater Config Plug, 230V								
	AC Line	Control Board	077830000	J3	2	NC			
	AC Line Switched	Control Board	077830000	J3	1	Thermostat (pin1)	078660000	J3	1
	AC Neutral	Control Board	077830000	J3	3	HC Scrubber Heater (A)	078660000	P3	3
	Jumper 1-5	Thermostat (pin2)	078660000	P3	4	HC Scrubber Heater (B)	078660000	P3	5
	Jumper 3-7	Chassis Gnd	077830000	J5	3	Control Board	077830000	J5	7
	NC	Control Board	077830000	J5	6	HC Scrubber Heater (Com)	078660000	J3	6



REVISIONS				
REV	DESCRIPTION	DATE	DCN	APPROVED
A	INITIAL RELEASE	8/28/13	6768	TN

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	<small>TREATMENT</small> NA	<small>APPROVALS</small> <small>DATE</small> <small>4/13</small>	<small>TITLE</small> INTERCONNECT DRAWING T701, T701H & 701, 701H (4G)
	<small>FINISH</small> 	<small>DRAWN</small> TN	<small>SIZE</small> C
	<small>SIMILAR TO</small> 	<small>CHECK</small> <small>OCS</small> <small>ISSUED</small>	<small>CAGE CODE NO.</small> 1JZF4
<small>THIRD ANGLE PROJECTION</small> 	<small>DATE</small> 4/13	<small>DWG. NO.</small> 07827	<small>REV</small> A
		<small>SCALE</small> 1/1	<small>FILE</small>
		<small>SHEET</small> 1 OF 1	