# LTU6000 Series Bottle Leak Detectors

## Technical Manual



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EN-R11

Covers Model Numbers

LTU6001
LTU6002
LTU6003
LTU6004

LTU6001-AC
LTU6002-AC
LTU6003-AC
LTU6004-AC

## SAFETY WARNING

Electrical machinery contains hazardous voltages. Installation, servicing and adjustment is only to be performed by qualified personnel.
Do not tamper with this device.

Document Revision 11

# Contents

Document Revision 11

# 1 Overview

The LTU6000 updates the control system of our bestselling LT2 series leak detector. It is specifically designed for fitting to flat-bed indexed-conveyor deflash trimmers. It can also be used for other ``in-machine'' applications.

## 1.1 Benefits

- Improved Production Efficiency

  Eliminates incorrect bottle rejection without compromising test accuracy.

- Reliability

  - Interference Immunity
  - 50 million cycle rated valves
  - Output relays use solid state switches, for both AC and DC systems
  - Self-Diagnostics, self setting capability

- Accuracy

  - High speed 24 bit Analog to Digital converter provides ultimate pressure sensing accuracy and resolution
  - High flow rate pneumatics to quickly achieve bottle pressurization
  - Optimized for short cycle time leak tests
  - Self tuning algorithms to continuously optimize pressurization and threshold settings
  - Adjustable Test Pressure

- Safety

  - No behind-panel access required for machine setting
  - 24V DC versions available as standard. Convert to AC system with plug-in module.

- Improved Operator Interface
  - Simple, clear graphical color touchscreen
  - Multinational Language Displays available
  - Bargraph display of pressure, led indication of test results for each channel
  - Push Button, Front Panel Settings (changes can be locked out with optional key switch)
  - Correct Number Failed count for all trimmer configurations
  - Panel Mounted Pneumatic Controls
  - Alarm Output Option
- Simple Installation and Maintenance
  - Simplified machine connection
  - Simplified Internal Wiring (all electrical functions integrated onto single PCB)
  - Low operating power - reduces load on system supply
  - 110VAC or 24VDC models
  - Valves can be changed without removing pipes - all access from front of control enclosure.
  - Manual override buttons on all valves
  - Uniform design for 1,2,3 and 4 channel versions
  - LED state indication on valves


**Figure 1.1** 50 Million Cycle Valves. An LTU6000 installation typically has to do over 10 million cycles per year!

- Advanced System Architecture
  - Spare I/O For Extra Functions (Handle Flash Detection, Jam detection, vision systems, alarms), brought out to standard connection
  - Serial interface available for Data Logging or PLC connection
  - Easy upgrade of system to include extra facilities even after installation
  - Easy firmware updates to add new features, requires only a standard USB cable
  - Plug-in pressure transducers, allows easy upgrade or replacement
  - Competitive Pricing


***Lockable Steel Control Cabinet. (Internal door independently locked)***


***1-4 Channels on the same Circuit Board***

For more details contact the office, our distributors or see our web site

***www.plastech-controls.com***

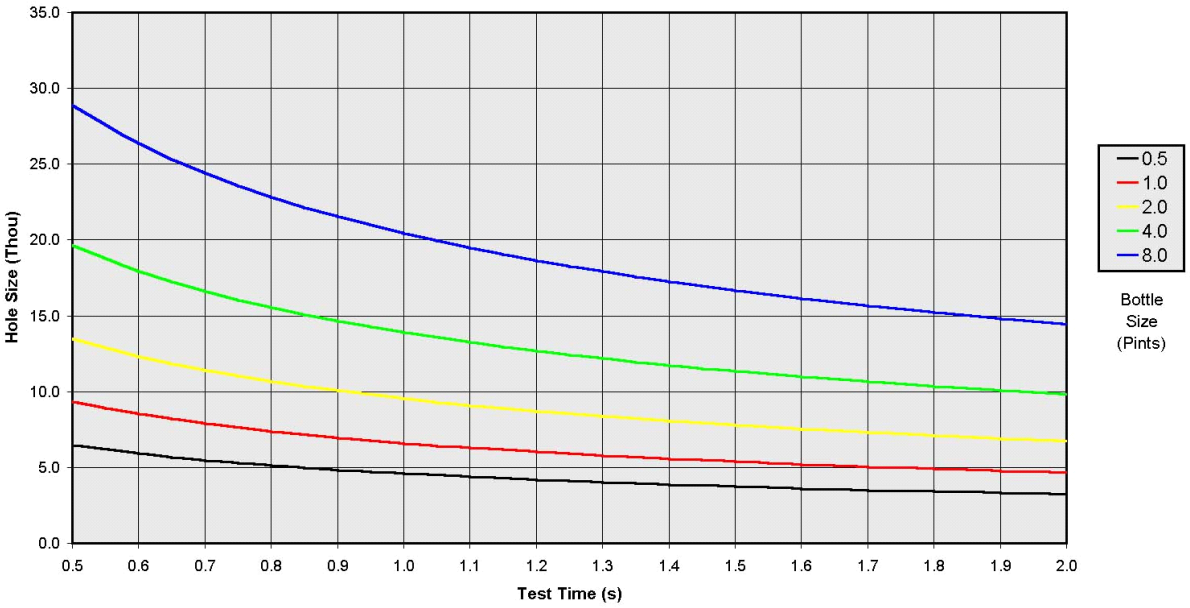
where you can obtain complete on-line sales literature, user manuals and technical documentation.

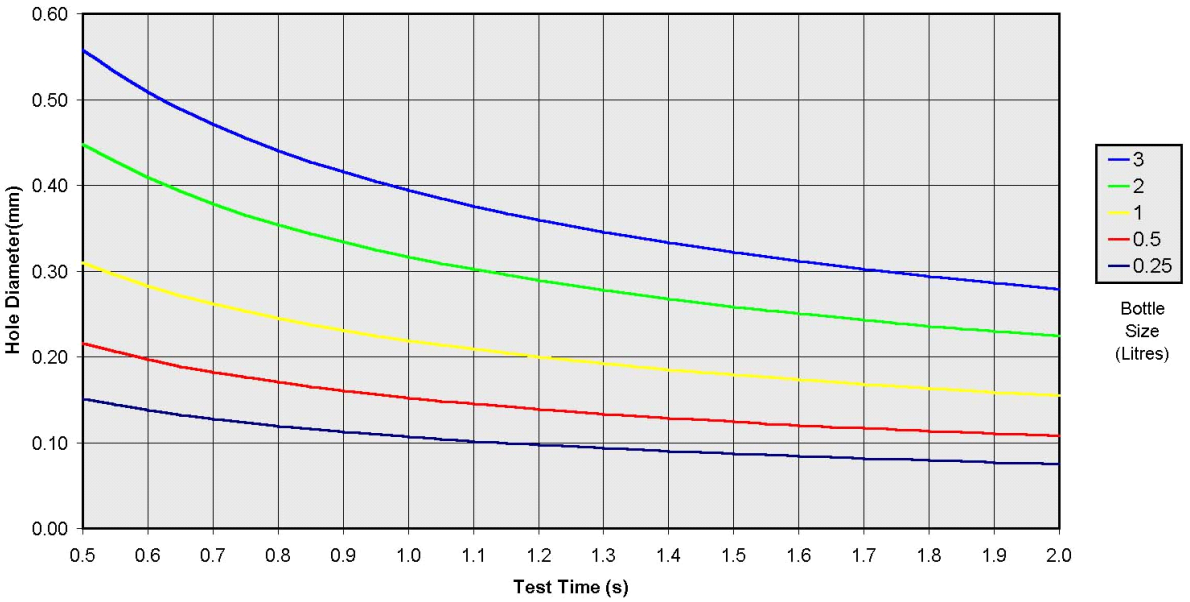
# 2 Specification

| | |
|---|---|
| Hole Size Detected | 0.1mm (for a 500ml/16oz) bottle and a 2 second test time). See Performance Data for other sizes. |
| Number of Test Channels | 1,2,3 or 4 (Specify when ordering) |
| Cycle Time | 0.5 - 20.0 seconds, adjustable |
| Minimum Bottle Volume | 250ml / 8 oz |
| Maximum Bottle Volume | 25 liters / 6 gallons |
| Test Pressure | Adjustable, 5-100mB |
| Power Supply | 100-125VAC single phase or 23-26VDC@750mA (specify when ordering) |
| Power Consumption | 30 VA maximum |
| Air Supply | 60-150 psi (4-10 bar) |
| Air Consumption | 1 liter per minute typical |
| Dimensions | Control system enclosure 470x300x180mm for all models (1,2,3,4 channel) |
| Leak Test Method | Ratiometric Pressure Decay, Auto-zero, Auto-Scale. Adaptive pressurization algorithm. |
| Transducer | Semiconductor strain gauge diaphragm, 0.00 - 100.00 mB, 0.000007% resolution, x20 Over-pressure Protection. |

## 2.1 Performance Graphs

These graphs show the hole size detectable for various bottle sizes and test times.



## 2.2 Ordering Information

The product code is specified as :

LTU600X-YY

e.g. LTU6004

X = Number of heads = 1-4

YY = ``AC'' if AC supply adapter required, otherwise blank.

# 3 Setting Up

1. Mechanically align the test heads with the necks of the bottles. Ensure that the test heads are correctly aligned with the bottles. It is critical that a reliable seal is achieved between the bottle necks and the test head cones. The test head cylinders will generally go to end of stroke during the test. In this state, the bottles should be slightly compressed so as to achieve a good seal, but not so compressed that there is danger of collapse.

2. Press the PAGE button until the ``SETTINGS'' page is displayed.

3. The settings are all displayed.

4. Cycle the trimmer. Highlight the ``Test Time'' setting by touching it. Use the ``UP'' and ``DOWN'' arrows to alter the "Test Time" setting. This sets the operation time for the test head cylinders. Adjust the Test Time with the machine cycling. Observe the test head movement. Set the Test Time to the largest value possible, which does not cause bottles to be dragged out of alignment at the end of the test. It is important that the test is as long as possible. A small increase in time can make a large increase in sensitivity.

5. View the ``Max Deviation'' setting. This setting controls the sensitivity of the test. If a bottle under test deviates from a good bottle, by more than this amount, it will be rejected. The lower the value, the more sensitive. Set it to an initial value of 25%. The value can be reduced from 25% when the machine is in production and the leak tester is working consistently. Values of 1-5% are typical for normal operation.

6. View the ``Test Pressure'' setting. This sets the pressure used during the test. The pressure display bargraph is scaled to this value, to that full scale is equal to the set test pressure. A value of 30mB is typical and can be set at this time. Use lower values for large containers and higher values for small.

7. Set the external pneumatic pressure regulator FR40 to 3 bar. This sets the working pressure of the test head cylinders. It also acts as a pre-regulator to control the bottle pressurization.

8. Run bottles through the trimmer. Adjust the flow control restrictors RS1, 2,3,4 on the leak tester front panel. These control the initial bottle pressurization level. Adjust for each channel so that the pressure display bargraph goes about 2/3 of the way across the scale. This setting is not critical. If the restrictors are wound fully anti-clockwise and the pressurization level is not high enough, increase the external filter-regulator FR40 to 5 bar. The leak tester should now be testing bottles and rejecting those with holes.

9. Press the ``PAGE'' button until the ``DISPLAYS'' page is shown. The test results and bottle counts are shown. The ``Passed'' and `` Failed'' counts can be individually set to zero using the ``RESET'' button.

10. The "Leakage %" is displayed for each channel (test head). Start up bottle production and monitor the Leakage values. For each test cycle, a number is shown for each channel. The number is the percentage of the initial air pressure that has been lost, during the test. The higher the number, the higher the leakage. A value of 99.9% indicates that all of the air has escaped. Typically, the numbers will be around 5% for good bottles. This is primarily due to cooling of the air within the bottle, during the test. The numbers should be the same from cycle to cycle, within about 2% (except where a bottle is leaking). If this is so, the "Max Deviation" setting can be reduced from 25% down to a lower value, and hence improve the sensitivity of the test. The minimum value that can be used is determined by the test-to-test variation in the test results, for good bottles. This value must be established for a particular bottle type, however a value of 1% is typical. Note: Intermittent leakage around the test head will show up as larger variations in the test result.

# 4 Operation

The unit is fully automatic in operation. When switched off, bottle testing does not occur and the bottles are blown off the trimmer as normal. When switched on, leak testing commences with each trimmer cycle. The leak tester signals the trimmer with the results of the tests, delayed by one trimmer cycle. The trimmer controller then either blows the good bottles into the conveying system, or allows the rejected bottles to fall off the end of the trimmer.

## 4.1 Detailed Explanation of Operating Principle

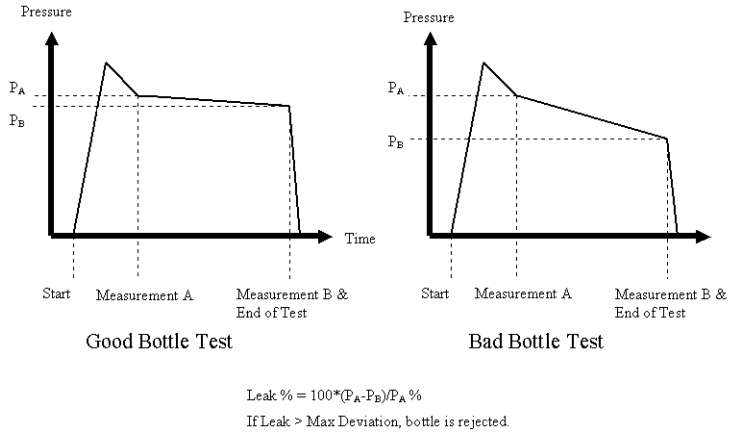



**Figure 4.1** Pressure Decay Leak Detection Operating Principle

The test cycle is initiated by a signal from the trimmer. The test head cylinder valves are turned on, bringing the test heads in to seal on the bottles. At the same time, the pressurization valves are turned on, allowing the bottles to pressurize. When the pressure in a bottle rises past a threshold, the pressurization valve associated with that channel is turned off. After a short delay, the pressure in each bottle is measured (Pressure A). The bottles remain sealed for the remainder of the test time. At the end of the test, the pressures in the bottles are again measured (Pressure B). The test heads are then retracted.

The percentage of pressure decay is then calculated from the two pressure measurements. This is the result of the test.[1]

The decision of pass or fail is made as follows:

For each channel, an average is maintained of the test results (leak %) for bottles that have passed the test. When a test is performed, the result is compared with this average. If the difference (deviation) is greater than the set "Max Deviation", the bottle is rejected. If the deviation is less than the maximum, then the bottle is passed and the result is incorporated into the average.

The advantage of this technique is that slow drifts over time of airline pressure, air temperature, pneumatic settings and bottle characteristics are compensated for. If a simple fixed limit was set on the amount of "leakage" (pressure drop) allowed, then the sensitivity of the system would be limited by long term variations in the test characteristics, and the channel-to-channel mismatches.

[1] There are several other checks required in order to catch exceptional conditions. For example, we reject the bottle if there is insufficient initial pressurization, or if the bottle collapses during the test, creating a pressure rise.

# 5 Troubleshooting

In the unlikely event of a fault...

The LTU6000 series of leak testers have been designed to be extremely reliable. However we have prepared this section in case of trouble. This table has been compiled from both reported and hypothetical fault conditions. For more detailed advice and assistance please contact us directly, especially where the suggested remedy is not straightforward.

Please do not start swapping circuit boards or (especially) taking apart manifolds, unless you are sure that there is a real fault internal to the leak tester. Historically this is very unlikely.

## 5.1 Faults Causing Good Bottles to be Rejected

| ***Symptom*** | ***Fault & - Remedy*** |
|---|---|
| ``Fail'' indicators illuminated | Worn test head seals - *Replace*<br>Test head alignment incorrect - *Align*<br>``Max Deviation'' setting too low - *Adjust setting. Normal range is 0.5 to 2.0%. If you have to set it outside this range this indicates a problem with test head sealing or some other fault. Start off with a high setting, for example 20%. Check the test results (the displayed deviation values) are consistent from test to test. If so, reduce the set Max Deviation down until it is just above the maximum observed deviation for good bottles.* |
| ``Fail'' indicators illuminated, Bottles are loose under test head. | Insufficient Sealing Force - *Move test head forward.* |
| ``Fail'' indicators illuminated, Bottles collapse or deform during test. | Excessive sealing force - *Move test head back.* |

| | |
|---|---|
| Difficulty adjusting pressurization flow controls. Over pressurization of one channel when bottle missing from another channel. | Pressurization pipes swapped between channels - *Systematically establish the correct piping by forcing each I/O in turn and checking for correct operation. (Refer to the manual for the I/O list). WARNING: do not force on the pressurization valves with the test head down on a bottle; the transducer may be damaged.* |
| ``Fail'' indicators illuminated & Over-pressurization Warning displayed | Pressurization flow control restrictor set too fast - *Turn clockwise.* |
| ``Fail'' indicator illuminated only on one channel of a multi channel machine. | Worn test head seals<br>Test head alignment<br>Excessive sealing force - *Move test head back.*<br>Internal leakage inside leak tester - *Establish this by connecting a temporary short length of pipe to the pressurization outlet and blowing down it (with the unit switched off). The leak tester should not allow airflow into it. Repeat for each pressurization outlet and each transducer sense fitting.*<br>*If there is a leak, check manifold fittings, valve gasket, and the internal manifold blanking plugs. Check manifold segments aligned correctly.*<br>*Manifold possibly split apart at pressurization valve OR Missing / leaking manifold internal blanking plug between pressurization valve and test head valves.* |
| Unit indicates test passed but Bottle(s) not being blown off | Test Time set too low - *Bottle blow-off is disabled by design outside of the test cycle. Make sure the test time has been set as long as possible, and that the leak tester gets its start signal as early as possible. Sometimes an external timer on the trimmer sets the reject timing, (to get a staggered blow off). Make sure that it is set to blow off the bottle within the test cycle.* |
| One channel falsely indicates leakage (fails to pressurize), only when other channel is empty or has very large leak. | Leaking or missing blanking plug inside manifold, between 2 pressurization valves - *Replace blanking plug.* |

## 5.2 Faults Causing Poor Sensitivity

| *Symptom* | *Fault & - Remedy* |
|---|---|
| Bottles with large holes rejected correctly, very small holes passed. | Pressurization flow control restrictor set too slow - - *Adjust (Turn anticlockwise). Aim to get about 2/3 pressurization on the bar graphs. If this is not possible, leave at maximum and start increasing the system pressure regulator to a maximum of 4 bar. If still not possible, start reducing the set test pressure down to a minimum of 10mB.*<br>"Test Time" setting too low - *Adjust setting as high as possible.*<br>"Max Deviation" setting too high - *Reduce (see setting up guide).* |

## 5.3 Faults Causing Blank Display & No Response

| *Symptom* | *Fault & - Remedy* |
|---|---|
| Display backlight illuminated | Circuit board fault - *repair* |
| No display backlight | Check unit switched on and has power.<br>Check circuit board fuses<br>Check circuit board power connector. |

## 5.4 Faults Causing Intermittent Valve Operation

| *Symptom* | *Fault & - Remedy* |
|---|---|
| Intermittent valve operation | Faulty valve connector - *Replace or repair connector* |

# 6 Input / Output List

This list is the same for single, twin, triple and quad models. Unused functions are simply not connected.

| *IO* | *Function* | *Description* | *Comment* |
|---|---|---|---|
| 0000 | 70 | Cycle Start | Input, isolated, 24-110V, AC/DC |
| 0001 | 35 | Flash Detection | Input, PNP, 24VDC |
| 0002 | 35 | Flash Detection | Input, PNP, 24VDC |
| 0003 | 35 | Flash Detection | Input, PNP, 24VDC |
| 0004 | 35 | Flash Detection | Input, PNP, 24VDC |
| 0005 | 59 | Leak Test Downstream Backup | Input, PNP, 24VDC |
| | | | |
| 0500 | 1 | Pressurization Leak Test Channel 1 | Output, NPN, 24VDC |
| 0501 | 2 | Pressurization Leak Test Channel 2 | Output, NPN, 24VDC |
| 0502 | 3 | Pressurization Leak Test Channel 3 | Output, NPN, 24VDC |
| 0503 | 4 | Pressurization Leak Test Channel 4 | Output, NPN, 24VDC |
| 0504 | 10 | Test Heads Down | Output, NPN, 24VDC |
| 0505 | 53 | Unused I/O | Output, NPN, 24VDC |
| 0506 | 53 | Unused I/O | Output, NPN, 24VDC |
| 0507 | 46 | Alarm | Output, NPN, 24VDC |
| 0510 | 54 | Reject Channel 1 | Output, Voltage Free Contact |
| 0511 | 55 | Reject Channel 2 | Output, Voltage Free Contact |
| 0512 | 56 | Reject Channel 3 | Output, Voltage Free Contact |
| 0513 | 57 | Reject Channel 4 | Output, Voltage Free Contact |

**Table 6.1** Input / Output List

# 7 Electrical Installation

## 7.1 AC or DC?

Important:

- The leak tester *must* be configured for the correct voltage; either 24VDC or 110VAC. If 110V is connected to a 24V leak tester, it will be destroyed!
- The Leak Tester *must* be earthed! On DC systems, the externally supplied - DC rail will be internally connected to the leak tester Earth.
- All unused conductors *must* be isolated! In particular you must ensure that the external red +24V signal wire, if unused, cannot short to chassis or to other signals (see below).

The bottle trimmers for which the LTU6000 was designed for fall into two categories as far as their control system is concerned:

- ``AC''
  - Old trimmers
  - 110V AC supply and control systems
  - Cam-switch and relay logic
  - Rejection by direct interruption of blow-off valve solenoid signals
  - LTU6000 requires power supply module fitted.
  - LTU6000 uses normally closed reject relays (on the power supply module).
  - Relays open for reject, inhibiting blow-off.
- ``DC''
  - New trimmers
  - 24V DC supply and control signals
  - PLC control system
  - Rejection signals go to machine PLC

- Normally Open LTU6000 reject relays integrated into main circuit board.
- PLC expects contact closure for ``reject''.

The standard LTU6000 circuit board external signals are all 24VDC. The optional ID6-PSU power supply module plugs in to the main circuit board, converting the system to use 110VAC signals

## 7.2 AC Systems

### 7.2.1 AC Power

AC systems require the power supply module (ID6-PSU) in order to convert the basic ``DC'' leak tester to use ``AC'' machine power. This is a small circuit board containing a power supply and solid state relays to interface to the AC machine. It plugs directly into the main LTU6000 circuit board.

The 110VAC power is then connected between the brown (live, "hot") and blue (neutral, "common") wires. *The green Earth wire and the cable shield must be securely connected to the machine frame or other designated earthing point.*

### 7.2.2 AC Start Signal

A ``start signal'' is required that comes on at the point in the machine cycle where the bottles come to a halt at the test station. The signal is usually obtained from a platen limit switch or cam switch on the trimmer. It is extremely important that the start signal occurs immediately, so that the bottles are not waiting to be tested. This may require adjustment of the source of the signal.

The start signal should be connected so that 110VAC is put across the black and white wires, when the bottles come to a halt on the trimmer.

### 7.2.3 AC Reject

The reject signals are connected to normally closed relays inside the leak tester. When the leak tester is switched off, these are closed. The signals to the trimmer

bottle blow-off valves are wired through these relays, so that the relays can interrupt the blow-off valves and cause the bottles to fall off of the end of the trimmer. In effect, the wire from the blow-off valve is cut during installation and fed through the leak tester. The leak tester can then link the two ends together when the bottle passes the test, allowing the trimmer to blow the bottle up the takeout chute.

## 7.3 DC Systems

### 7.3.1 DC Power

DC leak testers require 24V DC +/- 10% power. Consumption is less than 1A. This is connected between the brown (positive +24V) and blue (negative 0V) wires. *The green Earth wire and the cable shield should be securely connected to the machine frame or other designated earthing point.*

### 7.3.2 DC Start Signal

A start signal is required that comes on at the point in the machine cycle where the bottles come to a halt at the test station. For DC systems this is usually provided by the trimmer PLC, however it could also be obtained from a platen limit switch or cam switch. *It is extremely important that the start signal occurs immediately*, so that the bottles are not waiting to be tested. This may require adjustment of the source of the signal.

The start signal should be connected so that 24VDC is put across the black and white wires, when the bottles come to a halt on the trimmer. The black is negative and the white is positive.

### 7.3.3 DC Reject

For DC systems the reject outputs are normally connected to inputs on the trimmer PLC.

## 7.4 Basic Signals

Refer to Figure 9.1 for the external wiring diagram.

| *Connection* | *Wire Color* | *Comment* |
|---|---|---|
| Earth | Green + Shield | Connect securely to earth point |
| + DC or Live AC supply | Brown | |
| - DC or Neutral AC supply | Blue | |
| Blow Off Common | Pink | |
| Blow Off channel 1 | Yellow | |
| Blow Off channel 2 | Orange | Twin channel units and above |
| Blow Off channel 3 | Violet | Triple channel units and above |
| Blow Off channel 4 | Grey | Quad channel units only |
| Start Signal - or AC | Black | |
| Start Signal + or AC | White | |

**Table 7.1** Basic Signals

## 7.5 Optional Input Signals

These signals are used to connect optional input sensors or switches. These can be powered from the 24V supply wires shown. Unused signal wires can be tied back or cut off from the main cable.

| *Connection* | *Wire Color* | *Comment* |
|---|---|---|
| Input Common 0V | Red-black | 0V power for external sensors |
| Input common +24V | Red | +24V power for external sensors |
| Input 001 | Red-Brown | |
| Input 002 | Red-yellow | |
| Input 003 | Red-green | |
| Input 004 | Red-blue | |
| Input 005 | Red-white | Backup Detection signal |

**Table 7.2** Optional Input Signals

# 8 Firmware Updates

The LTU6000 has a particularly easy firmware update process. This updates the software to add new features, fix bugs or change the basic configuration of the machine.

The firmware update process works by emulating a standard USB memory ``stick'', i.e. a flash drive. To update the firmware you will need a laptop or desktop PC, the new firmware file and a standard USB A:B cable. No special drivers are required.

- *The firmware update process is done with the leak tester switched off*
- Either take a portable computer to the leak tester, or remove the circuit board assembly from the leak tester and take it to the computer.
- Connect the leak tester board to the computer using the USB cable. Note: Leak tester must be switched off. No separate power source is required; the board takes power via the USB cable.
- The leak tester board will be detected as a flash drive.
- The existing firmware will appear on this drive as a file. This file can be moved to a safe location in case you need to restore it later, or just deleted.
- Delete the existing file on the flash drive.
- Copy the new firmware file to the flash drive.
- You should see a light on the board turn red then green. This indicates the new file has been written.
- Unplug the USB cable and refit the circuit board / turn on the leak tester.

# 9 Drawings

The system shown in the following drawings is a 4-channel system. Single, twin and triple channel follow the same general layout; the parts for the extra channels are simply omitted.

**Figure 9.1** LTU6000 External Wiring Diagram

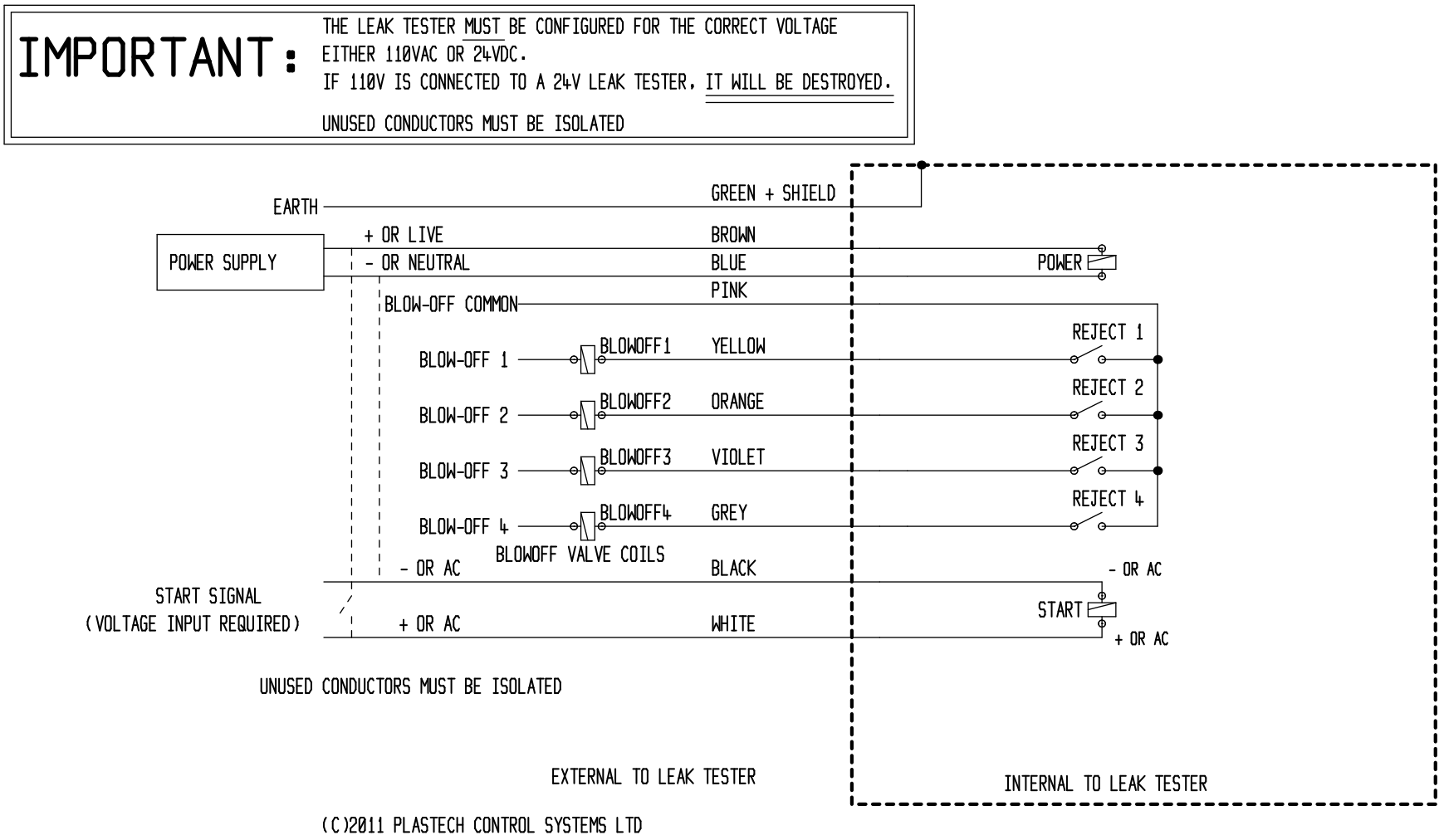


**Figure 9.2** LTU6000 Control Cabinet Internal Wiring

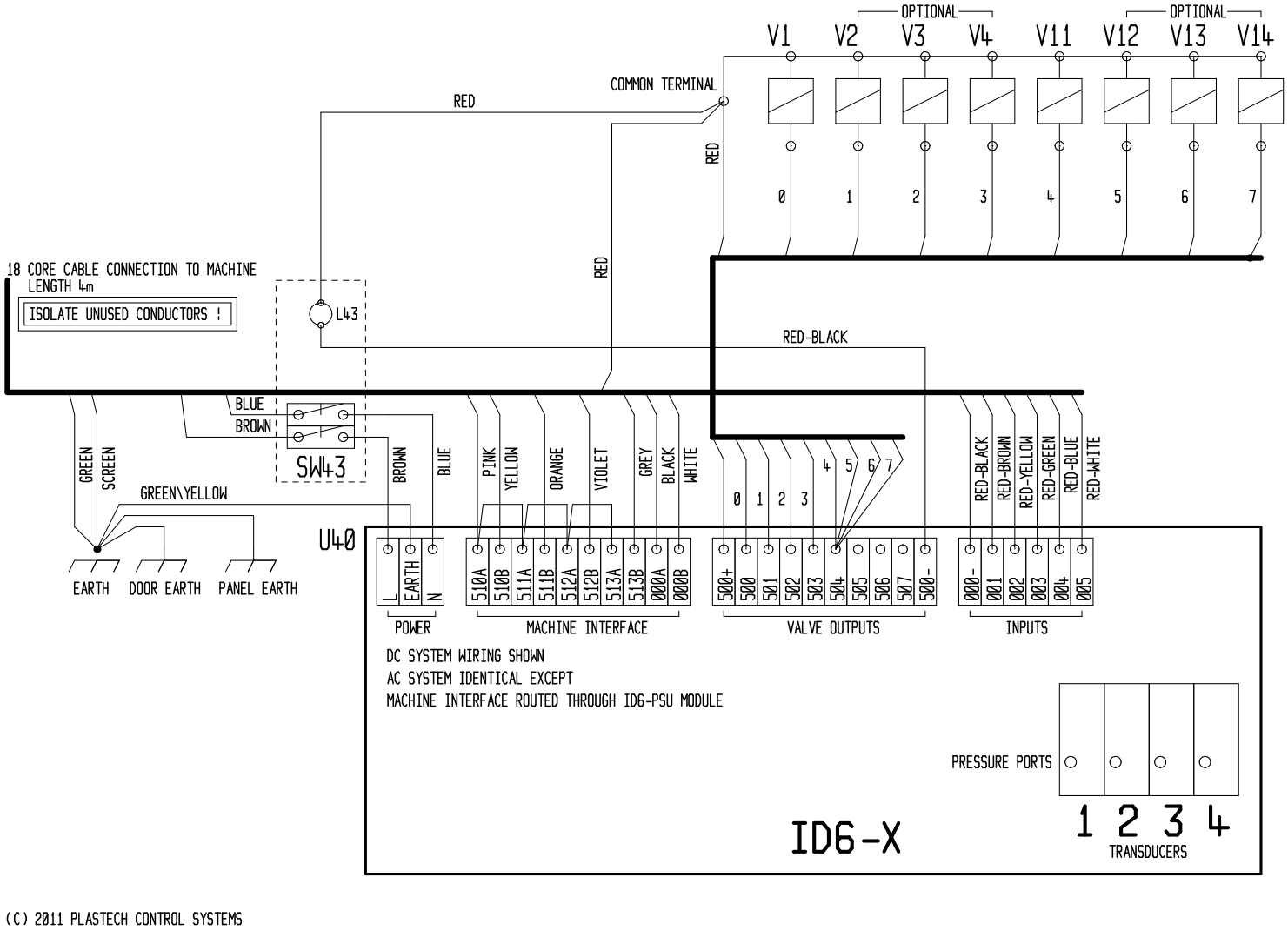


**Figure 9.3** LTU6000 Control Cabinet Layout

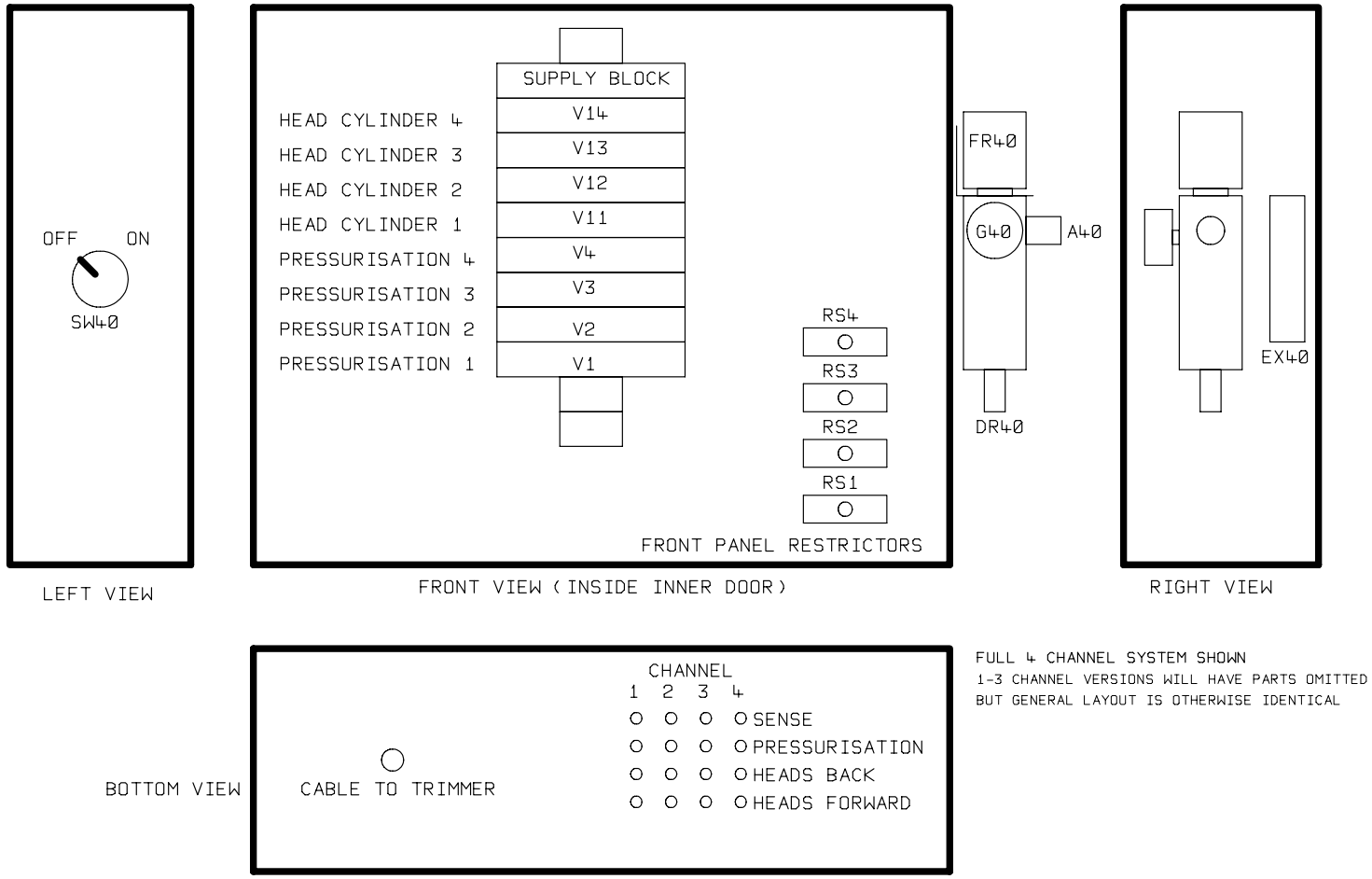
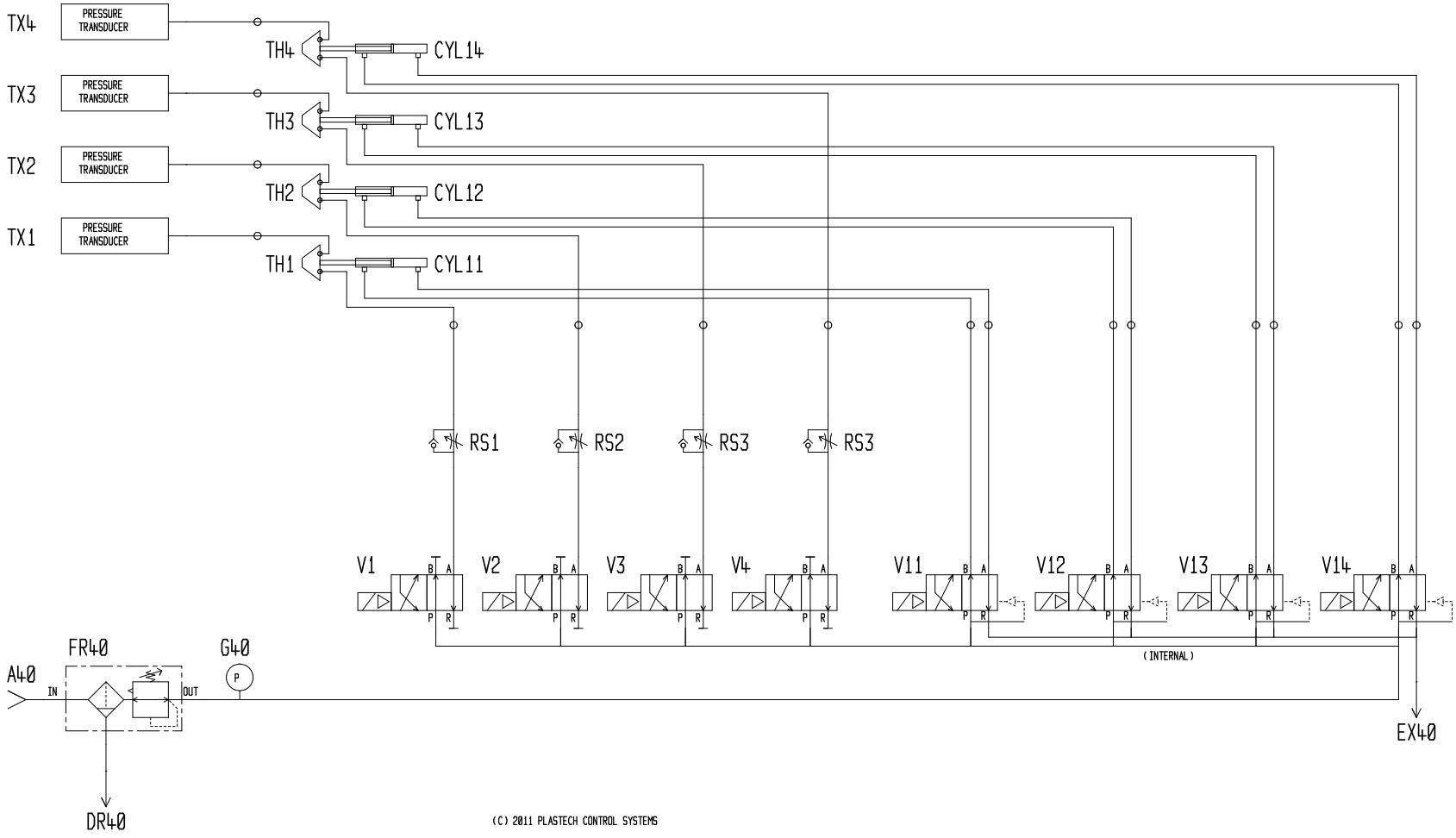


**Figure 9.4** LTU6000 Control Cabinet Pneumatics




4 CHANNEL VERSION SHOWN - OTHER VERSIONS FOLLOW SAME PATTERN

# 10 Spares

| *Part ID* | *Description* | *Ref* | *Function* |
|---|---|---|---|
| 1019 | Filter Regulator, auto drain, 3/8 ported | FR40 | Air In |
| 62 | Pressure Gauge, screw in, 1/8 ported, 0-10 Bar | G40 | System Pressure |
| 598 | Restrictor, Panel Mount, 1/8 | RS1-4 | Pressurization Rate Control |
| 783 | Valve, 5-2, Common Pilot | V11-14 | Test Head Cylinder Valves |
| 812 | Valve, 5-2, Independent Pilot | V1-4 | Pressurization Valves |
| ID6-1 | PCB, Complete, (single channel) | U40 | Single channel DC card |
| ID6-2 | PCB, Complete, (twin channel) | U40 | Twin channel DC card |
| ID6-3 | PCB, Complete, (triple channel) | U40 | Triple channel DC card |
| ID6-4 | PCB, Complete, (quad channel) | U40 | Quad channel DC card |
| ID6-PSU | Adapter board (for 110V operation only) | U40-B | Power Supply unit |

## 10.1 Notes on Spares

The "Part ID" column shows the internal Plastech Controls stock number for the part. This can be used for ordering purposes.

Cards with higher numbers of channels fitted can be used, in an emergency, as spares for lower numbers, for example an ID6-4 can be used as a spare for ID6-1, ID6-2, ID6-3, ID6-4.

## 10.2 24 & 110V Operation

The LTU6000 Series is capable of either 24VDC or 110VAC operation. However, the correct PCB configuration must be used.

An AC leak tester can be changed to a DC model, or vice versa, by adding or removing the ID6-PSU PCB.

# 11 Special Options

## 11.1 Inbuilt Blow-off Valves

In most configurations, the leak tester is fitted to a trimmer machine that already has an arrangement for separating good and bad bottles. Typically, good bottles are blown up a take-out chute while bad bottles are allowed to fall off the end of the trimmer. The leak tester, when fitted, controls the signals to the existing blow-off valve(s) on the trimmer.

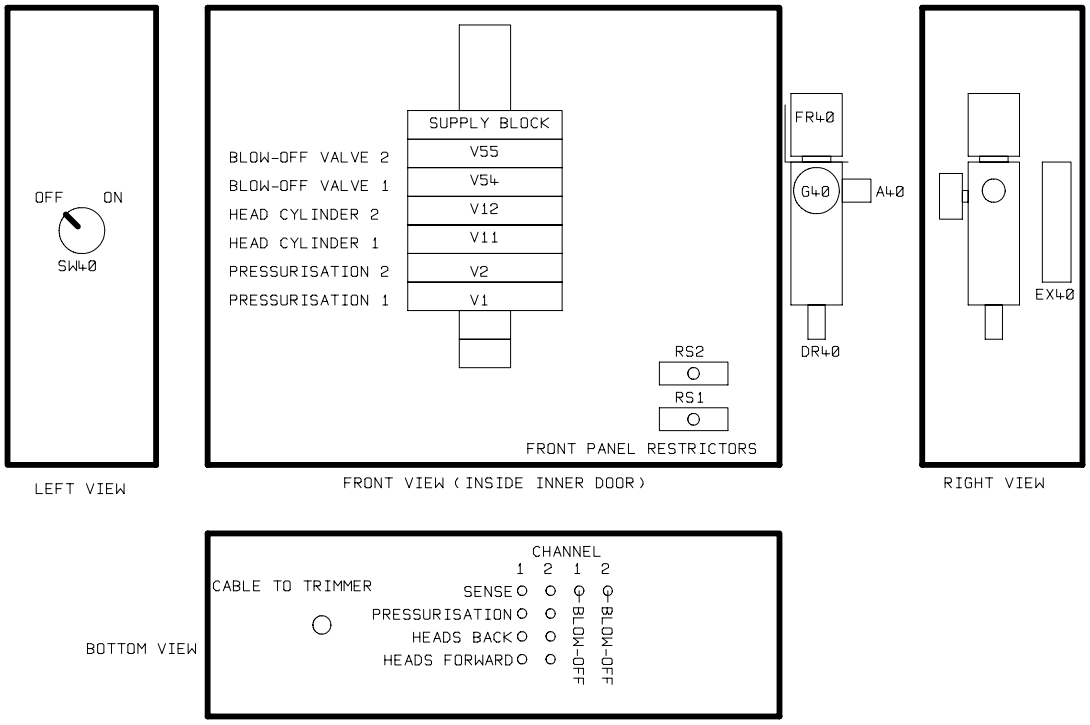



**Figure 11.1** LTU6000-R Layout Drawing

An option is available for fitting to machines without existing blow-off valves (The -R option). The blow-off valves are integrated into the leak tester itself and controlled directly. The leak tester reject outputs are wired directly to extra internal solenoid valves mounted on the top end of the standard leak tester manifold block.

Extra air fittings are provided on the leak tester to connect the external pipes to the blow-off nozzles.

***Produced by Plastech Control Systems Ltd***

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