



## LT2 Leak Detector *Technical Manual*

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# Contents

Overview	5
Benefits	5
Specification	9
Performance Graphs	10
Ordering Information	11
1 Setting Up	12
2 Operation	14
2.1 Detailed Explanation of Operating Principle	14
3 Troubleshooting	16
3.1 Faults Causing Good Bottles to be Rejected	16
3.2 Faults Causing Poor Sensitivity	17
3.3 Faults Causing Blank Display & No Response	18
3.4 Faults Causing Intermittent Valve Operation	18
4 LT2 Input / Output List	19
5 LT2 Electrical Installation	20
5.1 AC or DC?	20
5.2 AC Systems	21
5.2.1 AC Power	21
5.2.2 AC Start Signal	21
5.2.3 AC Reject	21
5.3 DC Systems	22
5.3.1 DC Power	22
5.3.2 DC Start Signal	22
5.3.3 DC Reject	22
5.4 Basic Signals	23
5.5 Optional Input Signals	23
6 Drawings	25

7	Spares	30
7.1	Notes on Spares	30
7.2	24 & 110V Operation	30
8	Special Options	32
8.1	Inbuilt Blow-off Valves	32

## Figures

2.1	Pressure Decay Leak Detection Operating Principle	14
6.1	LT2 External Wiring Diagram	26
6.2	LT2 Control Cabinet Internal Wiring	27
6.3	LT2 Control Cabinet Layout	28
6.4	LT2 Control Cabinet Pneumatics	29
8.1	LT2-R Layout Drawing	32

## Tables

4.1	Input / Output List	19
5.1	Basic Signals	23
5.2	Optional Input Signals	24

# Overview

The LT2 bottle leak detector is specifically designed for indexed-conveyor deflash trimmers. It has become an industry standard, fitted to new machines by the manufacturer. It is now also available as a retrofit package for machines in the field, allowing consistent, high performance leak testing where existing solutions are aging, unreliable or inaccurate. Customers experience dramatic production efficiency improvements after upgrading, due to the elimination of incorrect bottle rejection and machine down-time.



**3 Channel Leak Detector Model LT2-3**

## Benefits

- Improved Production Efficiency  
Eliminates incorrect bottle rejection without compromising test accuracy.
- Reliability
  - Interference Immunity
  - 50 million cycle rated valves
  - Self-Diagnostics, self setting capability

- Accuracy
  - High resolution A/D converter
  - 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
  
- Improved Operator Interface
  - Full alphanumeric display Of Settings And Results
  - 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

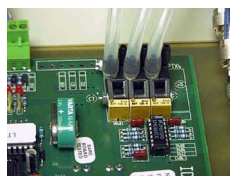


**50 Million Cycle Valves. An LT2 installation typically has to do over 10 million cycles per year!**

- 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
  - 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](http://www.plastech-controls.com), where you can obtain complete on-line sales literature, user manuals and technical documentation.



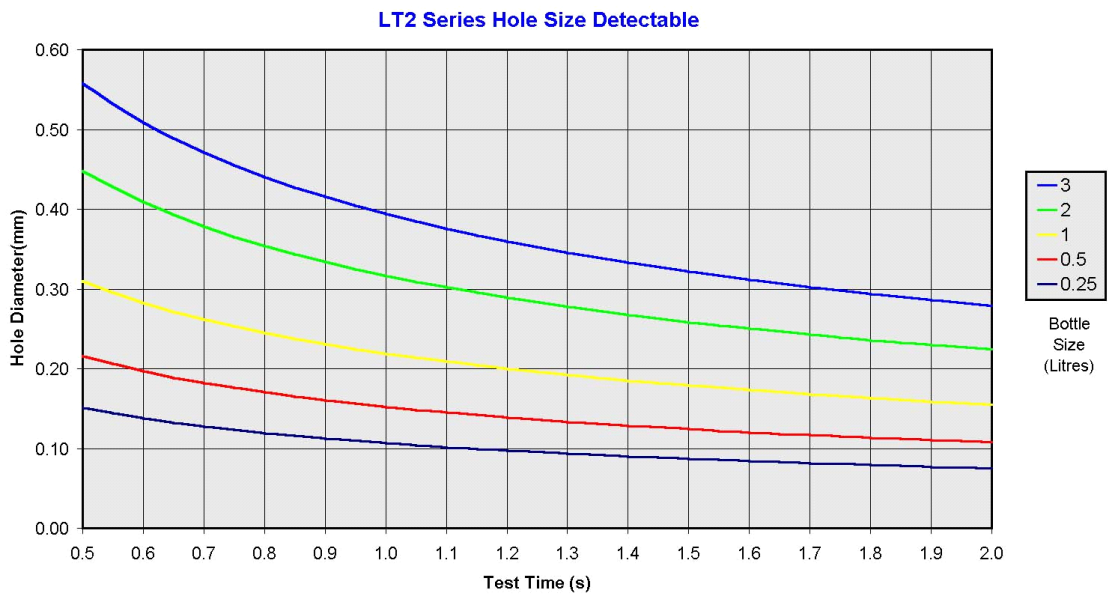
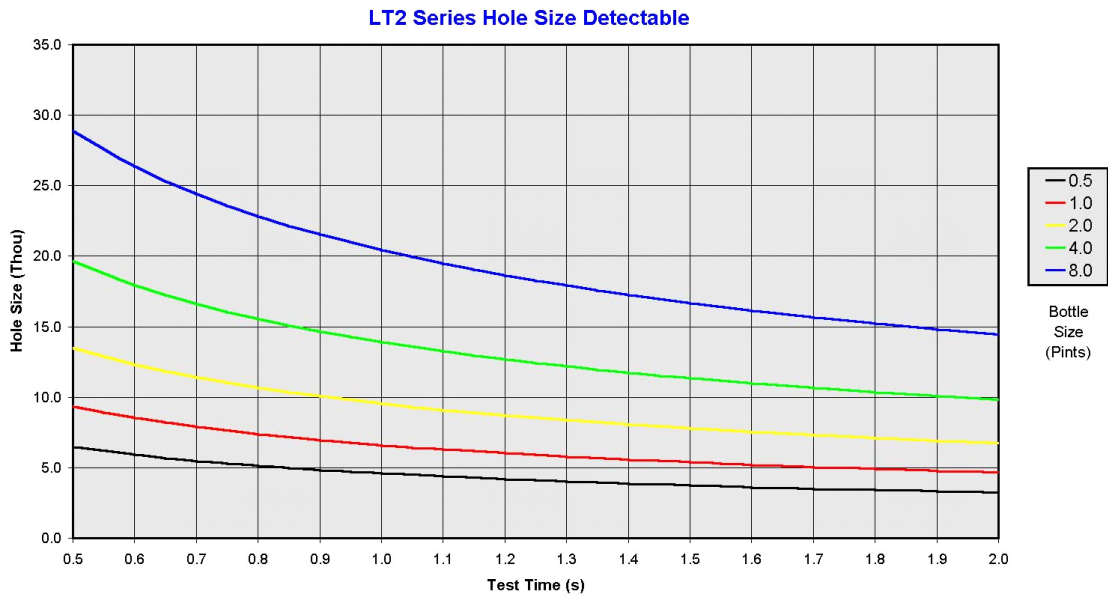


# Specification

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, 5-50 mB
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 - 65.00 mB, 0.02% resolution, x20 Over-pressure Protection.

## Performance Graphs

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



## Ordering Information

The product code is specified as :

LT2-X-YY

e.g. LT2-4-DC

X = Number of heads = 1-4, YY = supply = AC or DC

# 1 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 change page button until the “ADJUSTMENTS” page is displayed.
3. Use the “SELECT” buttons to inspect the leak tester settings.
4. Cycle the trimmer. Use the “ADJUST” buttons 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.
6. View the “Test Pressure” setting. This sets the pressure used during the test. The pressure display bargraph is scaled to this value, so that full scale is equal to the set test pressure. A value of 30mB can be set at this time.
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 up the scale. This setting is not critical. If the restrictors are wound fully anti-clockwise and

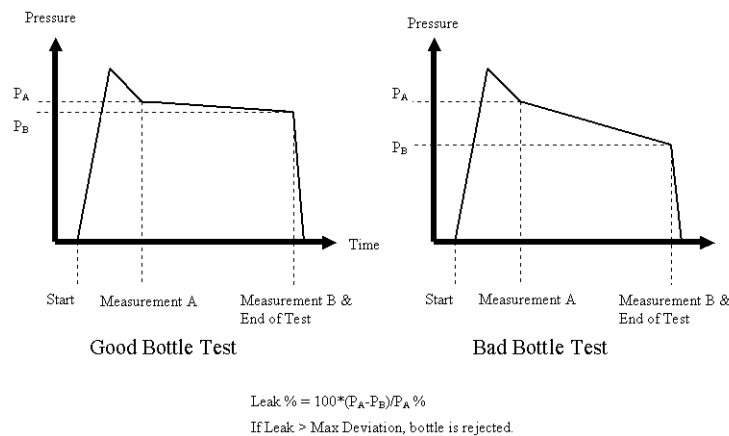
the pressurization level is not high enough, increase the external filter-regulator FR40 to 5 bar. The leak tester should now be testing bottles and rejecting those with holes.

9. Press the "PAGE" button until the "DISPLAYS" page is shown. Use the "SELECT" buttons to view the displays. The "Total Passed" and "Total Failed" counts can be individually set to zero using the "RESET" button.
10. Use the "SELECT" buttons to display "Leakage %". 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 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.

## 2 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.

### 2.1 Detailed Explanation of Operating Principle



**Figure 2.1 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 pressurisation valves are turned on, allowing the bottles to pressurise. When the pressure in a bottle rises past a threshold, the pressurisation 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.<sup>1</sup>

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 rather complicated 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.

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<sup>1</sup> 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.

# 3 Troubleshooting

In the unlikely event of a fault...

The LT2 series of leak testers have proven 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.

## 3.1 Faults Causing Good Bottles to be Rejected

Symptom	Fault & - Remedy
“Fail” indicators illuminated	Worn test head seals - <i>Replace</i> Test head alignment incorrect - <i>Align</i> “Max Deviation” setting too low - <i>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.</i>
“Fail” indicators illuminated, Bottles are loose under test head.	Insufficient Sealing Force - <i>Move test head forward.</i>
“Fail” indicators illuminated, Bottles collapse or deform during test.	Excessive sealing force - <i>Move test head back.</i>
Difficulty adjusting pressurization flow controls. Over pressurization of one channel when bottle missing from another channel.	Pressurization pipes swapped between channels - <i>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</i>



*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  
 Test head alignment  
 Excessive sealing force - *Move test head back.*  
 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.*  
*If there is a leak, check manifold fittings, valve gasket, and the internal manifold blanking plugs. Check manifold segments aligned correctly.*  
*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.*

### 3.2 Faults Causing Poor Sensitivity

<b>Symptom</b>	<b>Fault &amp; - Remedy</b>
Bottles with large holes rejected correctly, very small holes passed.	Pressurization flow control restrictor set too slow - <i>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 sys-</i>

tem pressure regulator to a maximum of 4 bar. If still not possible, start reducing the set test pressure down to a minimum of 10mB.

"Test Time" setting too low - Adjust setting as high as possible.

"Max Deviation" setting too high - Reduce (see setting up guide).

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### 3.3 Faults Causing Blank Display & No Response

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<b>Symptom</b>	<b>Fault &amp; - Remedy</b>
Display backlight illuminated	Circuit board fault - <i>repair</i>
No display backlight	Check unit switched on and has power. Check circuit board fuses Check circuit board power connector.

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### 3.4 Faults Causing Intermittent Valve Operation

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<b>Symptom</b>	<b>Fault &amp; - Remedy</b>
Intermittent valve operation	Faulty valve connector - <i>Replace or repair connector</i>

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## 4 LT2 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 4.1 Input / Output List**

## 5 LT2 Electrical Installation

### 5.1 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 LT2 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
  - LT2 reject relays set to “normally closed” position.
  - Relays open for reject, inhibiting blow-off.
  - LT2 requires power supply module fitted.
- “DC”
  - New trimmers
  - 24V DC supply and control signals
  - PLC control system
  - Rejection signals go to machine PLC

- LT2 reject relays set to “normally open” position.
- PLC expects contact closure for “reject”.

The LT2 external signals are “universal” in that they can operate with either 110VAC or 24VDC. The exception to this is the power input.

## 5.2 AC Systems

### 5.2.1 AC Power

AC systems require the power supply module (PCB-ID3-PSU) in order to convert the basic “DC” leak tester to use “AC” machine power. This is a small circuit board containing a transformer, which is mounted off the main LT2 circuit board. LT2 leak testers are normally stocked and shipped as basic “DC” machines. The power supply module is then typically fitted during installation (using the mounting pillars supplied with it).

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.*

### 5.2.2 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.

### 5.2.3 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.

The reject output relays can be changed from normally open to normally closed using jumper links on the leak tester PCB.

## 5.3 DC Systems

### 5.3.1 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.*

### 5.3.2 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.

### 5.3.3 DC Reject

For DC systems the reject outputs are normally connected to inputs on the trimmer PLC. Alternatively they could be used to interrupt the blow-off valve signals directly as on AC systems (in which case set relays to Normally Open).

The reject output relays can be changed from normally open to normally closed using jumper links on the leak tester PCB.

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 5.1 Basic Signals**

## 5.4 Basic Signals

Refer to [Figure 6.1](#) for the external wiring diagram.

## 5.5 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.

<b>Connection</b>	<b>Wire Color</b>	<b>Comment</b>
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

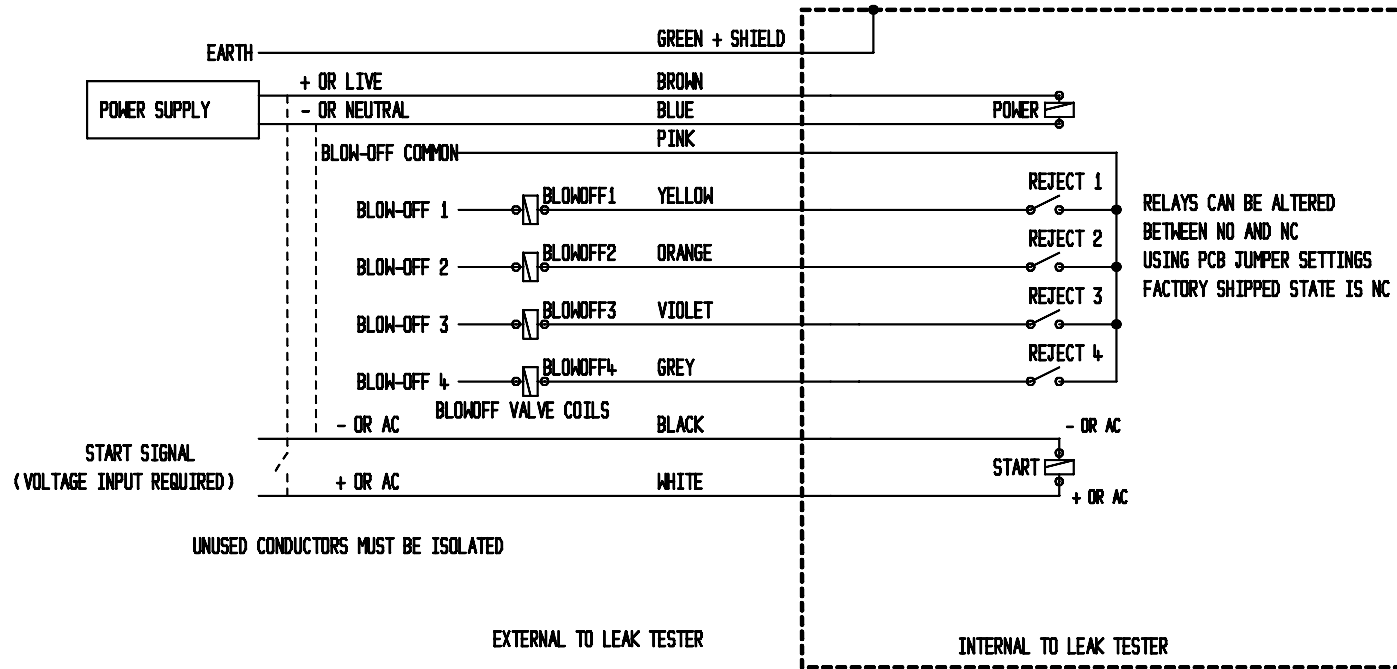
**Table 5.2 Optional Input Signals**



## 6 Drawings

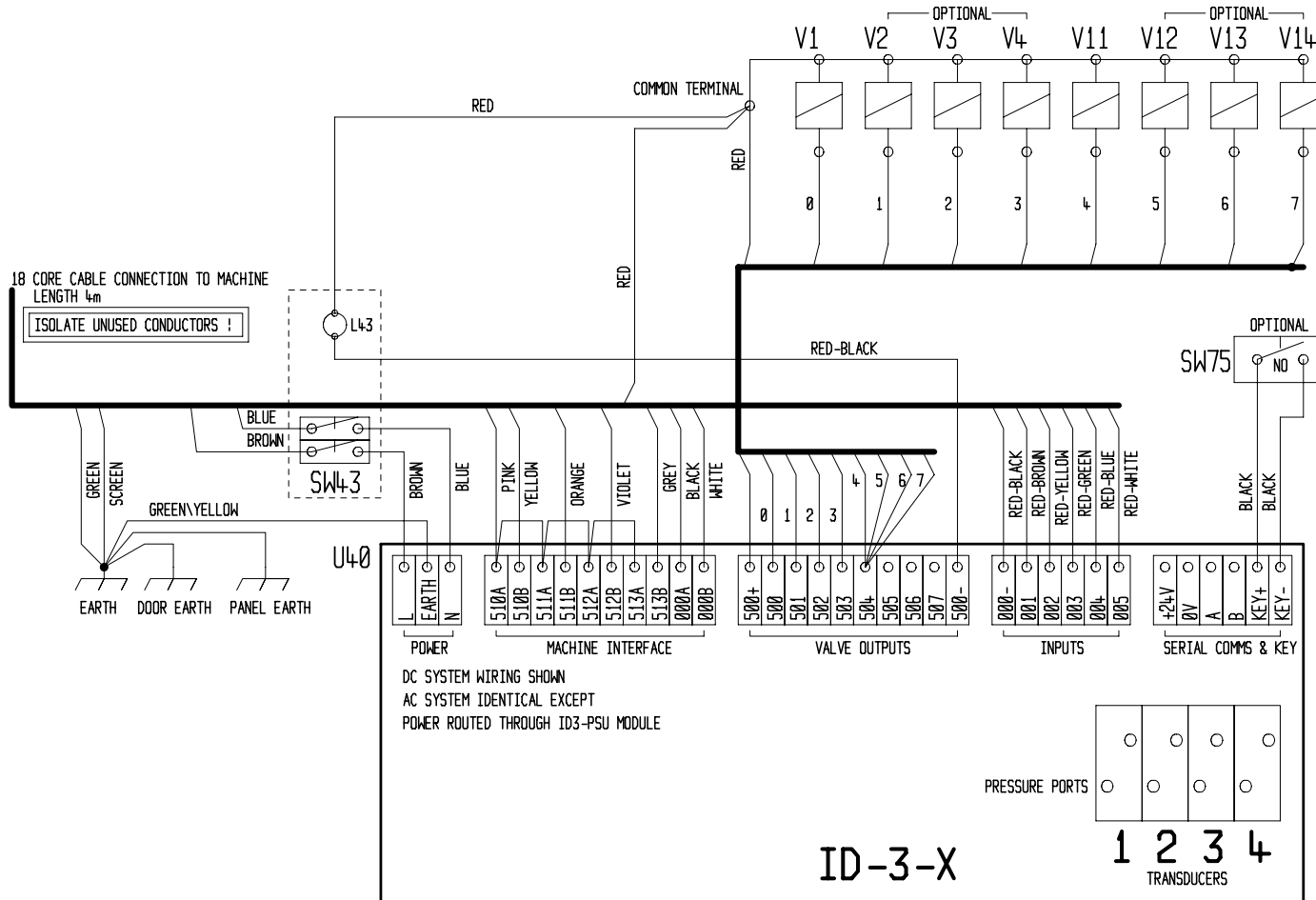
The system shown in the following drawings is a 4-channel system. Single, twin and triple channel follow the same general layout; the parts for the extra channels are simply omitted.

Figure 6.1 LT2 External Wiring Diagram

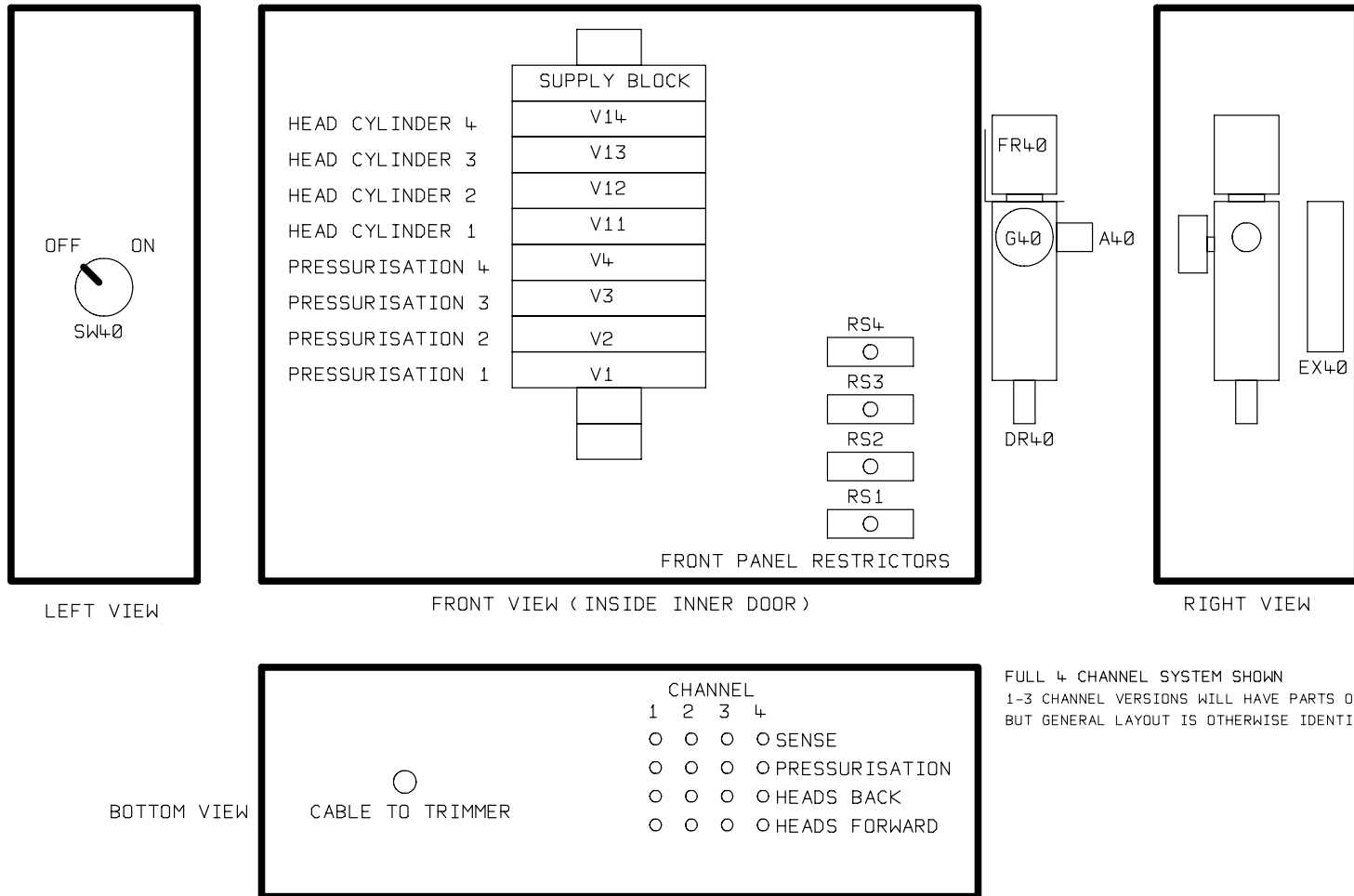


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Figure 6.2 LT2 Control Cabinet Internal Wiring

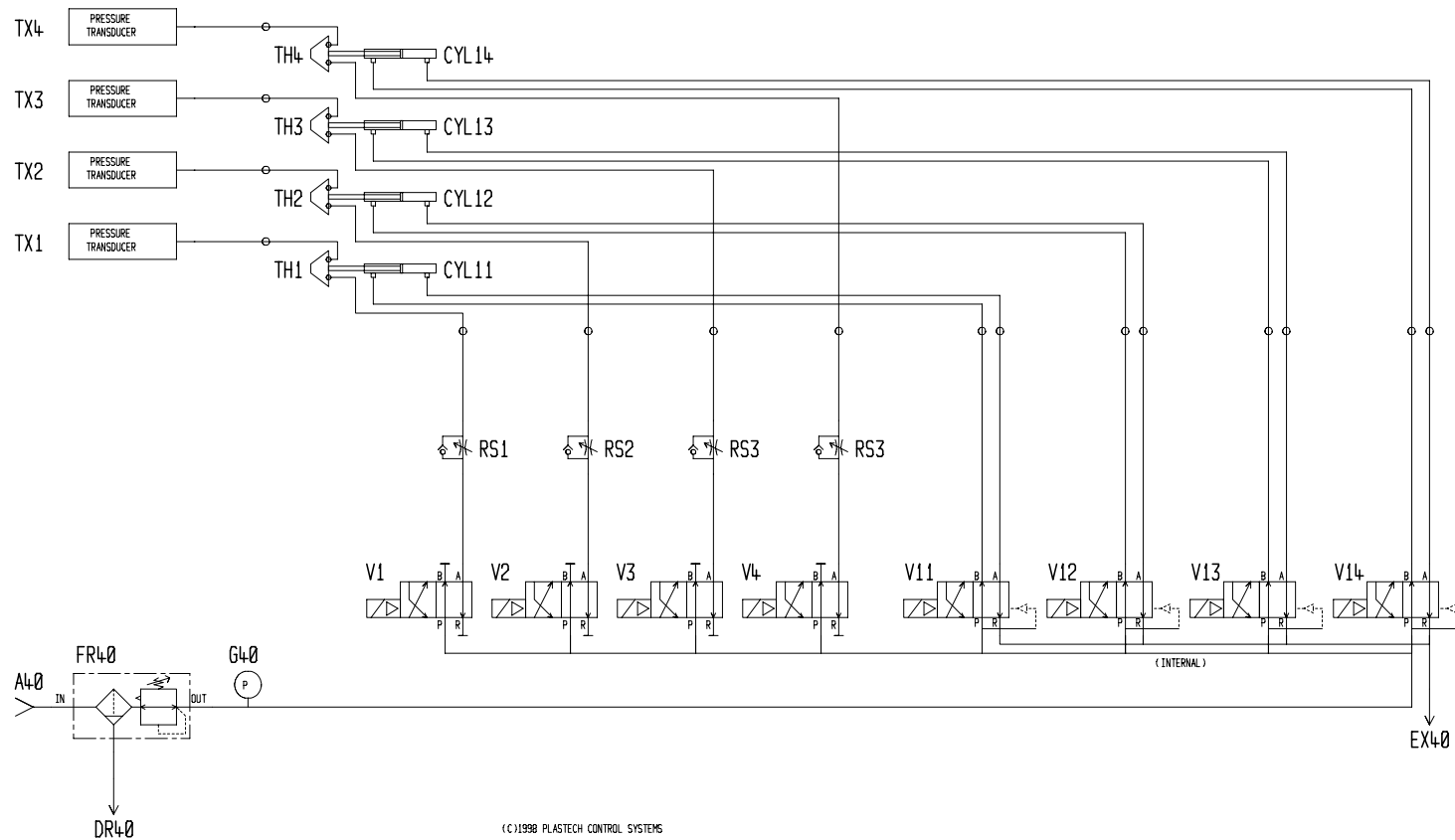


**Figure 6.3 LT2 Control Cabinet Layout**



FULL 4 CHANNEL SYSTEM SHOWN  
1-3 CHANNEL VERSIONS WILL HAVE PARTS OMITTED  
BUT GENERAL LAYOUT IS OTHERWISE IDENTICAL

Figure 6.4 LT2 Control Cabinet Pneumatics



## 7 Spares

Stock ID	Description	Ref	Function
1019	Filter Regulator, auto drain, 3/8 ported, AW3000-03-D	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	SY5140-5LOU Valve	V11-14	Test Head Cylinder Valves
812	SY5140R-5LOU Valve	V1-4	Pressurization Valves
532	TDS500#1	F201	Fuse, 1 amp
75	Bulb, 24V, for ZB2 series	L43	Illuminated Off/On Switch
1037	Bulb, BA9s, 110VAC, fits ZB2 series	L43	Illuminated Off/On Switch
1178	PCB, Complete, ID3-1 (single channel)	U40	Single channel DC card
1179	PCB, Complete, ID3-2 (twin channel)	U40	Twin channel DC card
1180	PCB, Complete, ID3-3 (triple channel)	U40	Triple channel DC card
1181	PCB, Complete, ID3-4 (quad channel)	U40	Quad channel DC card
1129	ID3-PSU adapter board (for 110V operation only)	U40-B	Power Supply unit

### 7.1 Notes on Spares

The "Stock 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 ID3-4-DC can be used as a spare for ID3-1-DC, ID3-2-DC, ID3-3-DC, ID3-4-DC.

The SY5140R-5LOU (pressurization) Valves can be used as spares for the SY5140-5LOU (test head cylinder) Valves with no problems (but not the other way around). This means that only one type of valve needs to be stocked, SY5140R-5LOU.

### 7.2 24 & 110V Operation

The LT2 Series is capable of either 24VDC or 110VAC operation. However, the correct PCB configuration must be used.

Very early models use dedicated 24V only and 110V only pcbs. A system is changed between 24V and 110V by swapping out the entire PCB. A "DC" part number ID3-x-DC

identifies the DC pcbs, where x is 1,2,3 or 4 depending on the number of test channels. Similar AC part numbers ID3-x-AC identify the AC PCBs.

We have improved the design for supply of new systems, using a "Universal" main board identified by ID3-x, (i.e. no AC or DC indication). These can be directly used in DC systems. For AC operation, a new power supply module is fitted to the back of the main board, containing a 110V to 24V converter circuit. The system power is routed through this board to power the main board. The start signal input and the reject signal outputs are now universal voltage (24VDC or 110VAC), so the main board can be used in any installation. The mountings and connector positions are directly compatible with the older design, so that spares compatibility is ensured.

- To summarize, the old ID3-x-DC board is replaced by the ID3-x.
- The old ID3-x-AC board is also replaced by the ID3-x, but needs the new ID3-PSU module.

This reduces spares and stock holding requirements.

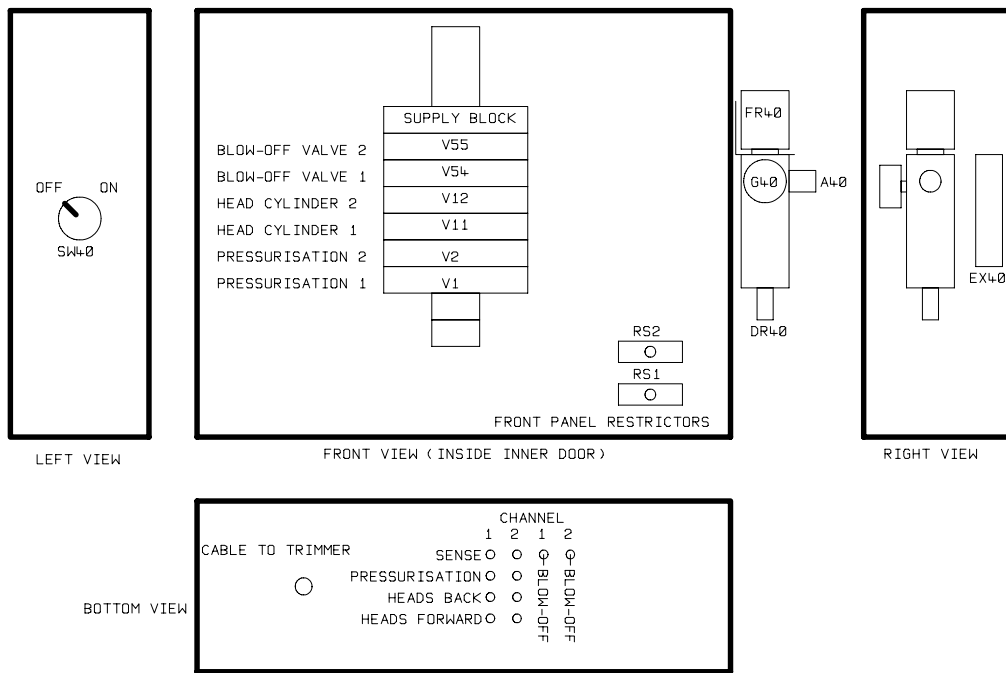
The correct type of supply must be used, i.e. 110-120VAC for an AC system, 24VDC+/- 10% for a DC system. A DC card will be destroyed if used in an AC system (an input protection diode will permanently fuse). Use of an AC card in a DC system will probably not damage the card, but in any case will not work!

An AC leak tester can be changed to a DC model, or vice versa, by adding or removing the ID3-PSU PCB, or by changing the main PCB, as discussed above. The bulb in the illuminated power switch must also be changed to the correct voltage. There are (currently) no other differences.

# 8 Special Options

## 8.1 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 8.1 LT2-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.