QT210F.3

Trimmer Mount Leak Tester

Technical Manual

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QT210F.3 Technical Guide.

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1. Outline Description of System

1.1 General Description

The QT210F leak detector uses a pressure decay technique to test moldings for leaks. It was specially designed for use with Uniloy Deflashing Trimmers, but can be used on other high speed blow molding machines. It will test moldings at rates of up to 2,400 per hour on a single cavity trimmer, or up to 4,800 per hour on a dual cavity trimmer.

Hole sizes down to 0.01 inch diameter can be detected, with even better performance possible for longer cycle times or small moldings.

The QT210F is microprocessor based, and is self calibrating. The unit will keep and display a count of the number of moldings passed and the number rejected.

The standard unit comes complete with all parts fitted to enable twin head leak testing. Upgrading from a single head to a twin head requires only a different test head assembly, and can be done at any time. Each molding is still individually tested, and full accuracy is maintained.

1.2 Method of Operation

The text below describes the operation of a QT210F installed as a single head system, testing one molding at a time. A twin head system operates in a very similar way, testing two moldings at a time. With a twin head system, there are separate transducers and valves for each test head.

The test cycle is initiated by a momentary contact closure from the trimmer control cabinet, or from a cam operated limit switch.

The test head is immediately extended to seal on the molding under test. The molding is quickly inflated to the test pressure, within ¼ second. The pressure within the molding is then accurately measured using an electronic pressure transducer. After a short time, (about ½ second), the pressure is again measured. The ratio of the two pressure readings are then used to calculate the result of the leak test. If the result is a reject, the blow off solenoid is inhibited during the next trimmer cycle. The rejected molding then falls off the end of the trimmer into a reject bin. If the result was a pass, the molding is allowed to be blown off the trimmer as usual.

The number passed and number failed counts are adjusted accordingly.

The leak test is independent of the test pressure achieved, since only pressure ratios are used, not absolute values. Pressure values are handled in digital form, making the system immune to electronic drift. The system is self calibrating, eliminating

requirement of periodic adjustments and compensating for changes in the molding characteristics.

1.3 Front Panel Description

The front panel layout is shown in figure 1.3.

The various controls and displays on the front panel are used only for monitoring the leak tester and trimmer operation. The leak test is not affected by these controls.

1.3.1 Test Status Indicators

These show the status of the current test, or the last test if no test is currently being performed.

1.3.1.1 Fault.

The indicator comes on if the program detects a fault condition of some kind.

For example, if the molding under test is crushed by excessive test pad force, or does not have adequate top load strength, the pressure can rise during the test. The fault light indicates this and other abnormal effects.

1.3.1.2 Reject.

This comes on as soon as the molding under test is determined to be a reject.

1.3.1.3 Overfill.

If the internal fill rate regulator is set too high for the size of the molding under pressure, it is possible for the molding to become over-pressurized. If this is the case, the overfill indicator comes on and the molding is rejected.

1.3.1.4 Underfill.

This function is not implemented when used on Uniloy type trimmers. This is because not all trimming cycles contain moldings. The QT210F would not be able to distinguish between underfilling due to a fault and underfilling due to the absence of a molding under the test head.

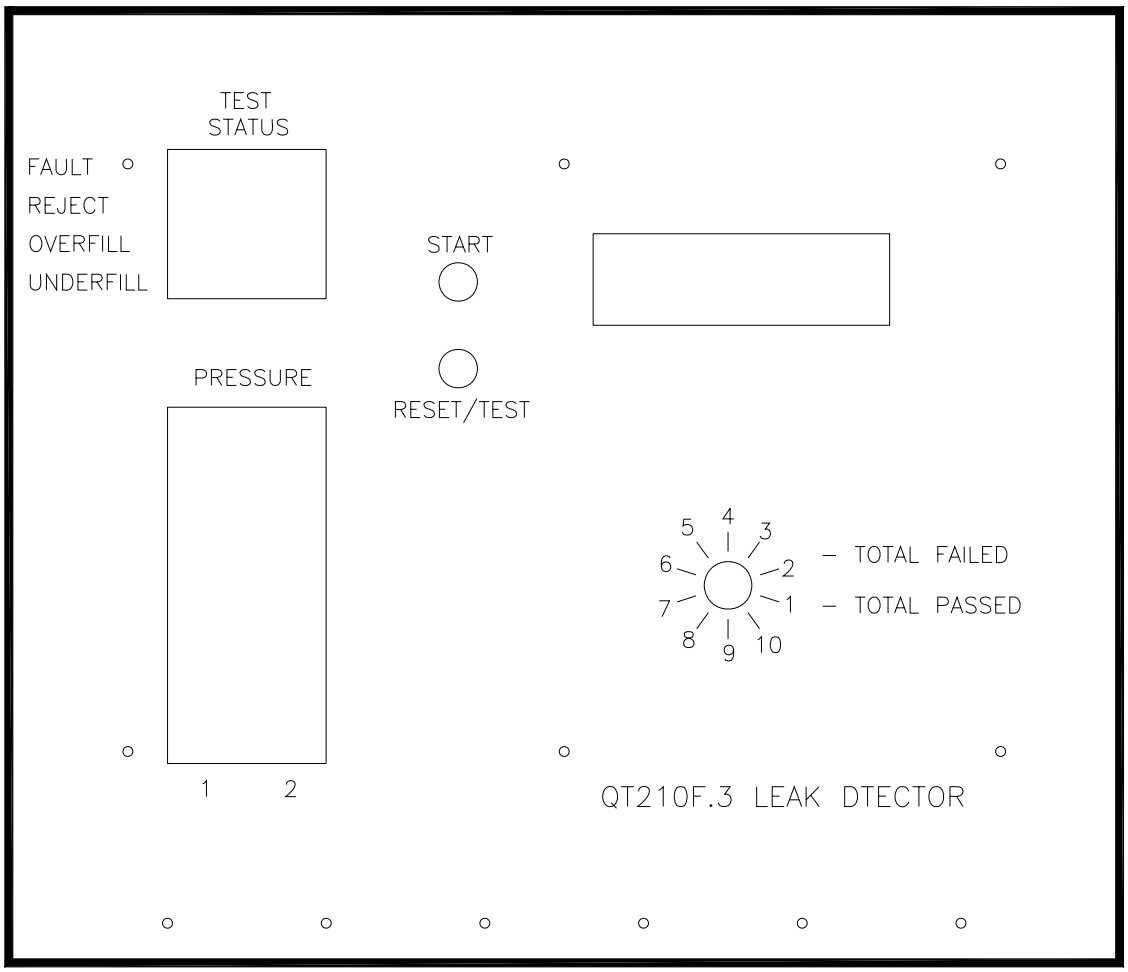

FIG. 1.3 FRONT PANEL LAYOUT

1.3.2 Pressure Bar Graphs.

The bar graph displays show the instantaneous value of the pressure within the molding under test. A green section within the display show the optimum pressurization level, although this is not critical and the system will still work over a wide range of fill pressures.

1.3.3 Start Indicator.

The start indicator shows the state of the start signal. It should come on at the start of the test, before the test heads are extended. It should go off again before the start of the next test.

1.3.4 Reset/Test Button.

This button is mainly used to zero the total passed and total failed counts. When it is pressed, the current test is aborted and the system is reset. If it is again pressed and released with ½ second, a test mode is entered. In this mode, the test heads remain extended indefinitely and any molding is pressurized. Clearly, this should not be done while the trimmer is running, otherwise a jam up may occur. The purpose of the test mode is to enable the leak tester system as a whole to be tested for leaks. Any leakage can be seen as a gradual decay in the pressure value shown on the bar graphs, over a period of several seconds. This enables the sealing of the test heads on the moldings to be checked, for example. The test mode can be stopped by pressing the reset/test button again. A start signal from the trimmer will also terminate the test mode, but a normal leak test cycle will be run first.

1.3.5 LCD Display.

The liquid crystal display in the center of the panel shows one of several numbers, depending on the position of the rotary selector switch below it. The positions are numbered and labeled as follows:

1. Total Passed. This displays the count of the total number of moldings which pass the leak test.
2. Total Failed. This displays the count of the total number of tests done in which a good molding was not detected. On many systems some of the conveyor trays do not contain moldings, i.e. redundant trimmer cycles are performed. These cycles will also be included, since there is no way for the system to distinguish between a very deformed molding and no molding at all (without the addition of extra sensors.)
3. This position is used for fault finding. Its function is explained in section 4.
4. This position is used for fault finding. Its function is explained in section 4.
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7. This position is used for fault finding. Its function is explained in section 4.
8. This position is used for fault finding. Its function is explained in section 4.
9. This position is used for fault finding. Its function is explained in section 4.

1.4 Description of Pneumatics.

The pneumatic circuit is shown in figure 1.4

1.4.1 Air Supply.

The air supply should be clean, dry air, although a water separator is fitted within the unit. The pressure should be 5-10 bar (70 – 140 psi). The supply is internally regulated.

1.4.2 Fill Circuit.

The two solenoid valves S1 and S2 are energized to fill the moldings with air to the test pressure. To give stable control of filling, a pressure regulator PR1 is used to reduce the air line pressure to about 2 bar (28 psi).

The pressure is fed to two throttle restrictors TR1 & TR2. These have been factory set to reduce the filling air flow rate to the optimal amount. The amount of air needed to pressurize a molding depends on the molding's capacity. By adjusting the pressure regulator PR1 the air flow can be adjusted to test any size molding that is normally encountered. A typical setting for this regulator is 1 bar for every liter of molding capacity (7 psi per pint).

Please note that the "test pressure" is actually controlled electronically. When the sensing transducers detect that the test pressure has been reached, the microprocessor turns off the solenoid valves S1 and S2. As separate sensors are used, each solenoid is controlled separately.

1.4.3 Test Head Clamping Circuit.

The clamp valve is a "4-2" solenoid valve used to operate the test head cylinders. The topload pressure is set by the clamp pressure regulator, and can be monitored on the clamp pressure gauge, if fitted. The clamp valve has adjustable preset restrictors on the exhausts, which can be used to limit the speed of the test head cylinders. These restrictors are not normally used, and are supplied set to wide open.

1.4.4 Pressure Transducers.

The pressure transducers are mounted on the electronic circuit board. They are connected by flexible tubing to holes in the end of the test cone. The fill and sense line remain separate all the way to the end of the test come, terminating in separate holes.

1.5 Test Head Assembly

The test head assembly consists of one or two cylinders (piped up in parallel) driving one or two test head cones. The position of the test heads is fully adjustable.

During the test, the test heads are extended to seal on the moldings under test. They are then retracted at the end of the test before the trimmer conveyor starts to move. The time for which the test heads remain extended is adjustable using preset control VR3 on the electronic pcb. This time should be as long as possible, since the test becomes more accurate for longer test times. The rest of the system auto synchronizes with the test time, no other adjustments need to be made when the test time is adjusted.

The pressure with which the test head cones seal on the necks of the moldings is adjustable using the clamp pressure regulator.

The seal can be tested using the test mode described in section 1.3.4. The conveyor should be stopped with a molding (or two) at the test station. The reset/test button should be pressed twice, within ½ second. This causes the test heads to be extended indefinitely, and the moldings to be pressurized. Any leakage in the system will be shown by a decay in the pressure indicated on the pressure bar graphs, over a period of ten seconds.

A bad seal may be caused by insufficient clamp pressure or by the test head assembly being incorrectly positioned. Check that the test head cylinders do not reach the end of their stroke during the test.

The test head assembly connects to the controller unit by six ¼" flexible pipes, in the case of a twin station system. These are:

Test heads in.
Test heads out.
Head 1 fill.
Head 1 sense.
Head 2 fill.
Head 2 sense.

These are shown on the pneumatics diagram figure 1.4.

2. Installation

This section describes the connections to be made to the trimmer unit, and the setting up and testing procedure.

2.1 Electrical Connections.

All electrical connections to unit are through a 10 pin Harting HA-10 connector on the base of the unit. The pin numbers and usual cable color codes are shown below, along with the function of each signal.

1.	Brown	Start signal input (110 VAC).
2.	Red	Reject 1 relay contact. Closes when pass.
3.	Orange	Power input (live) 110 VAC.
4.	Yellow	Reject 2 relay contact. Closes when pass.
5.	Green	Not connected.
6.	Blue	Start signal input (110 VAC).
7.	Violet	Reject 1 relay contact. Closes when pass.
8.	Grey	Power input (neutral) 110 VAC.
9.	White	Reject 2 relay contact. Closes when pass.
10.	Black	Not connected.
Screen	Green-Yellow	Earth.

The power input is 110 VAC and should remain on when the trimmer gates are open. This is because the unit runs a setting up cycle each time power is applied, and the first molding to be tested after power on is always rejected.

The start signal is 110 VAC and is applied across a relay coil internal to the QT210F. It should come on as soon as the conveyor stops, and go off again as soon as possible, although the unit will still work if the start signal remains on until just before the next test cycle.

The reject relays are normally closed contacts internal to the QT210F. They are wired in series with the blow-off solenoids. When a molding fails the test, the contacts open and the blow-off is inhibited. The moldings then fall off the end of the trimmer into the reject bin on the next trimmer cycle.

When a molding passes the test, the relay contacts are allowed to close, and the molding is blown off the trimmer. The contacts also close when the QT210F is switched off, allowing production to continue with the leak tester switched off.

2.2 Pneumatic Connections

Air input to the unit is by a single ¼" BSP fitting. Air used to pressurize the moldings passes through an internal water separator and filter. The unit also incorporates internal pressure regulators for all functions.

The test head assembly connects to the controller unit by six ¼" flexible pipes, in the case of a twin station system. These are:

Test heads in.
Test heads out.
Head 1 fill.
Head 1 sense.
Head 2 fill.
Head 2 sense.

These are shown on the pneumatics diagram figure 1.4.

For a single station system, the head 2 fill rate restrictor should be closed off, to stop air bowing from unused fill line.

2.3 Setting up and Testing

The unit should be wired and piped up as described previously.

Open the front panel of the unit to obtain access to the pneumatics. The correct reading on the fill rate pressure gauge is approximately 1 Bar (15 psi) for every liter (2

pints) of molding volume. The fill rate pressure regulator should be adjusted until this is achieved.

The trimmer should then be dry-cycled and the QT210F unit switched on. Electronic preset VR3 should be adjusted until the test heads remain extended for the entire time that the conveyor is stationary. VR3 is shown on the electronic card layout drawing fig 8.1.1. VR3 is a 20 turn trimmer. The test time is adjustable from zero (fully clockwise) to 2.5 seconds (fully anticlockwise).

If the test heads are only extended when the conveyor is moving, it is possible that the cylinders are piped up backwards. Check the original start signal connections first, however. The start signal l.e.d. on the front panel should come on immediately after, or at the same time as, the conveyor stops.

If the test heads do not extend, check that the clamp pressure regulator is not set to zero.

Once the unit is cycling correctly, the test head assembly should be adjusted until the test cones are positioned so as to seal on the moldings.

A few good moldings should now be passed through the system. Adjust the fill rate pressure regulator until the moldings are pressurized into the green region of the pressure bar graphs.

The test mode should now be used to check the sealing of the test heads on the neck of the moldings. Stop the trimmer with a molding under the test head to be tested. Press the reset/test button twice, within ½ second. (Do not hold this button down). The test heads should be extended, and stay that way. Any molding under a test head should be pressurized. If a leak is present in the system, this will be shown by a fall to zero of the pressure level shown on the bar graphs. The test head assembly and the clamp pressure regulator should be adjusted until the moldings remain pressurized indefinitely (for at least 30 seconds). An initial drop in pressure is normal even for a perfect leak free system, due to cooling of the air in the molding after pressurization. The test can be stopped by pressing the reset/test button again.

This should complete the setting up procedure. Good and bad moldings should be sent through the system, making sure that both channels are tested, since they are independent.

If the system does not work properly, check the steps above, then refer to the maintenance and fault finding section 4.

Sensitivity Adjustment.

The sensitivity of the unit is adjusted using the rotary switch SW3 located on the back of the controller board.

The value set (0-9) is the percentage of pressure drop allowed before a bottle is rejected. This is normally set to 3. This means that if the pressure falls more than 3%, compared to a good bottle, the bottle under test will be rejected.

To increase sensitivity, reduce the setting to 2 or 1.

To decrease the sensitivity, increase the setting to 4 or 5, etc.

The sensitivity is normally factory set.

3. Operation.

The unit is fully automatic in operation.

The total passed and total failed counts can be zeroed by pressing the reset/test button on the front panel.

The unit can be switched off using the switch on the side of the case, allowing production to continue without leak testing. This feature can be disabled by linking out the switch.

The unit can be periodically checked for correct operation by sending a sample leaking molding through the system. If this is done, both test channels should be checked since they are independent. However, nearly all possible faults result in good moldings being rejected, no in bad moldings being passed.

4. Fault Finding.

4.0 General notes.

Please check that power is applied, the unit is switched on and there is pressure available.

The result of the leak test can be seen by looking at the status l.e.d.'s window on the front panel. This also warns of over-pressurization and timing faults.

The solenoid valves and relays are driven from the electronics board. The state of the outputs of the electronics board can be seen by looking at the output monitor l.e.d.'s on the rear of the pcb, next to the connectors. The reject relay outputs are normally on, only being tuned off when a good molding is being blown off.

If the valve operation does not match the output state, check the connectors and the valves. The clamp valve can be operated manually.

4.1 Front Panel Rotary Switch Test Functions.

Positions 3-10 of the front panel rotary switch can be useful when fault finding. The display is frozen during a test cycle. The functions are currently as follows:

3. This displays a number relating to the pressure integrity of the molding last tested. The number displayed indicates the percentage of the initial fill pressure retained during the test, for test head 1. A reading of 100.0 indicates that no pressure drop occurred. A reading of 0 indicates that no pressure remained. A typical reading is between 80.0 and 95.0.

4. This has the same function as position 3, but for test head 2.

5. This displays the current pressure at test head 1. The display can show a number between 0 and 1023, corresponding to a pressure range of 0 to 0.5 psi. This function is intended for use when factory setting the pressure transducer zero point. The display should typically read 50 for zero pressure. Any reading between 2 and 100 is acceptable.

6. This has the same function as position 5, but for test head 2.

7. This displays the sample time, in seconds, for test head 1. This is the time during which the pressure is monitored for decay. It should be greater than 0.3 seconds in order to perform a reliable leak test. The sample time is generated from the overall test time, set by preset VR3 on the controller PCB. (see figure 8.8.1.)

   If a number greater than 2 seconds is displayed, this indicates a fault condition where there is no time left at all in the cycle for monitoring of the pressure. The cycle time should be extended by using an earlier start signal and by increasing the test time control VR3 on the controller PCB.

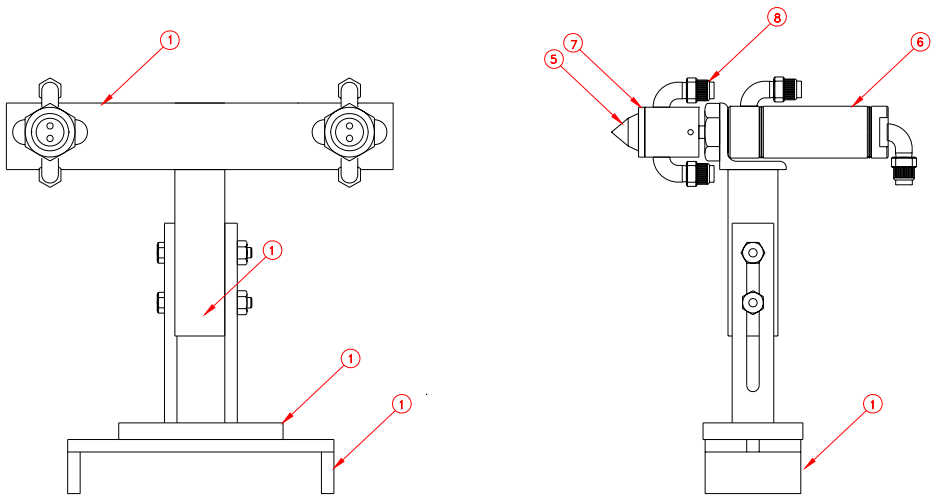
8. This has the same function as position 7, but for test head 2.

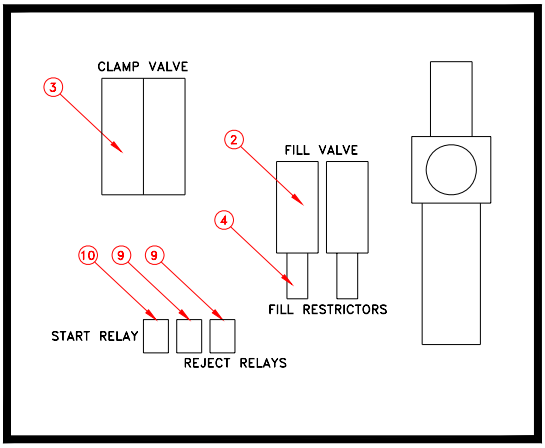
9. This displays the number (a percentage) which is the current standard for determining the result of the test. This percentage is compared with the percentage shown by position 3, to determine the result of the test. If the difference is greater then 5%, the container is rejected.

10. This has the same function as position 9, but for test head 2.

5. Parts List

Part #	Description	Qty.	Item
L100-002	Fill Valve	Ea.	2
L100-003	Clamp Valve	Ea.	3
L100-004A	Fill Restrictor	Ea.	4
E100-271	Reject Relay LY24VDC	Ea.	9
E100-080	Start Relay LY2-120VAC	Ea.	10
L100-093	PCB – ID5	Ea.	NA
	PCB Trade In	Ea.	NA
10631	Nose Cone Standard (38mm)	Ea.	5
M102-118	Nose Cone Gaskets Std. (1 ½” x ¾”)	Ea.	7
M100-980	Nose Cone Cylinder	Ea.	8
	Leak Tester Stand	Ea.	1
	90º Swivel Elbow	Ea.	8





FRONT VIEW (INSIDE INNER DOOR)

6. Detailed Description of Test Sequence.

The test starts when a start signal is received from the trimmer control cabinet.

The test heads are then immediately extended. The time for which they remain extended is preset, and is adjustable using VR3 on the PCB. Fully anti-clockwise is 2.5 seconds, fully clockwise is zero seconds. The test time selected is displayed momentarily, in seconds, when the reset button is pressed.

Each test head has a blow-off inhibit relay associated with it. If the test result for a test head is a pass, then the blow-off relay for that test head is allowed to close during the next test cycle, when the moldings have been moved to the blow-off station. This allows the moldings to be blown off as normal. If the result is a fail, the relay remains open, and the moldings fall off the end of the trimmer into a reject bin.

The blow-off inhibit relays are operated during the period that the test head is down (since this is the period when the conveyor is stopped and the molding can be blown off).

The fill valves are also turned on, immediately the start signal is received. This allows air to blow from each test head. When a test head seals on a molding, the pressure quickly rises. Just before the fill pressure is reached, the fill valve is turned off. During the delay caused by the response time of the valve, the pressure rises to the fill pressure, indicated by the green section of the pressure bar graphs. This method ensures the fastest possible filling of the molding to the fill pressure. The filling is not critical; the leak detector will still work with wide variations in achieved filling pressure.

The fill rate for both channels is controlled by a single pressure regulator. The regulator should be adjusted until the moldings are filled to the green section of the bar graphs. This regulator only needs to be adjusted when the volume of the molding is altered.

After the moldings are filled to the fill pressure, the pressure is sampled. Just before the test heads retract, the pressure is again sampled. A number measuring the pressure integrity of the molding is then obtained by dividing the second sample by the first sample. A ratio of 100% corresponds to no pressure drop at all during the test. A ratio of 10% means that 90% of the air has escaped. This makes the leak test independent of fill pressure.

If this “decay fraction” is less than 80%, then the molding is rejected. This will be the case for all but the smallest holes (those below 1 mm diameter). For these small holes, a different criterion is used:

The “decay fraction” is compared with the last good “decay fraction” measured. If the new decay fraction is more than 3% below the last good measurement, the molding is

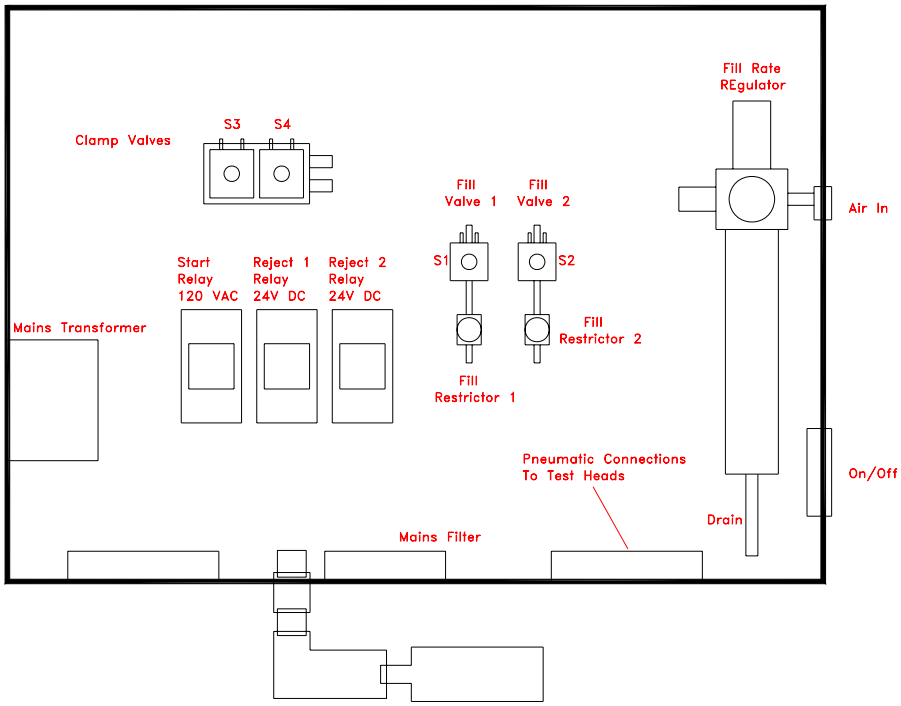
rejected. If this is not the case, then the current “decay fraction” is taken to be the next standard. In this way, the unit automatically compensates for and is immune to variations in cycle time, transducer drift and molding volume.

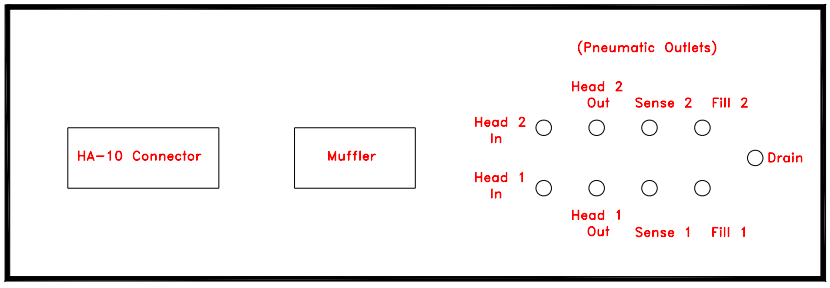
The state of the molding, (good or reject) is remembered until the next cycle, when it has been indexed to the blow-off station. It is either blown off the trimmer, or allowed to be carried to the reject bin at the end of the trimmer.

7. Controller Unit Layout and Internal Wiring

The internal layout of the controller unit is shown in figure 7.1

The internal wiring is shown in figure 7.2

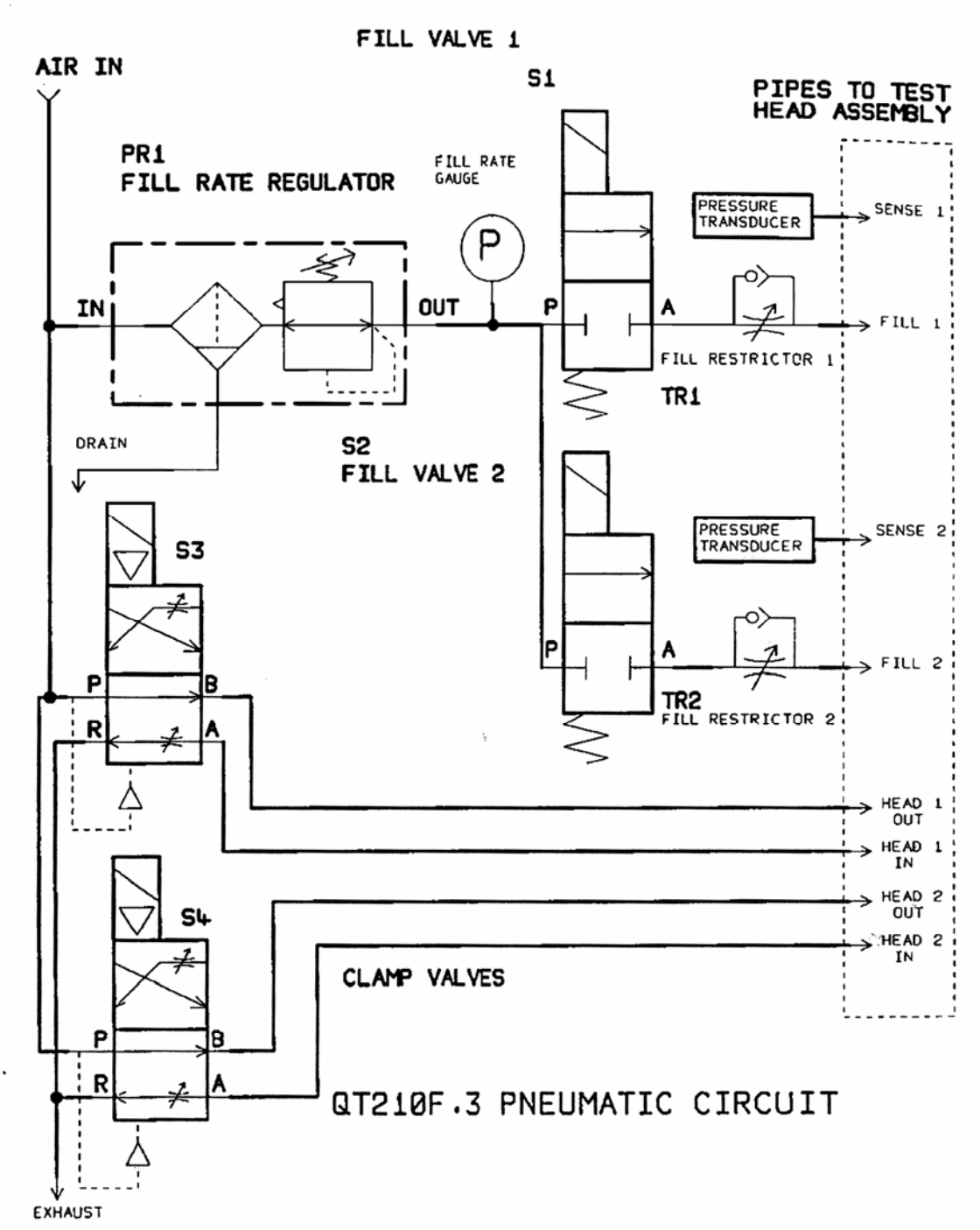




Bottom View

Leak Tester Layout Drawing

Viewed with Panel Unhinged



QT210F.3 PNEUMATIC CIRCUIT

8. Controller Card Description

The layout of the PCB is shown in figure 8.1.1

The circuit diagram is shown in figure 8.1.2.

8.1 General Description

All of the electronics are on a single controller PCB, mounted directly behind the front panel. The card has switches and displays on the front side, accessible from the front panel. Most of the other components are on the back side. These include the pressure transducers, microprocessor, solenoid valve drivers, memory and configuration switches.

8.2 Circuit Operation

8.2.1 Power supply

Power to the board is fed in through J1. Normal input is 12-0-12 VAC, although an option exists on the PCB for a PCB mounted mains transformer, in which case the input voltage is switch selectable between 110 VAC and 240 VAC (SW1).

The low voltage ac is rectified by bridge rectifier U1 and smoothed by C2, C3. The center tap of the transformer is taken to the junction of C2 and C3, so that unregulated dc voltages of 12V and 24V are available (loaded). The +24V is used to supply the solenoid valves, the reject relay coils and their drivers U4, U5.

The 12V feeds the 5V logic supply regulator U2. This device also produces a reset signal after a power up to initialize the system.

8.2.2 Microprocessor.

The microprocessor used is and 87P50 single chip microcontroller with a piggy-back 2732 EPROM used to store the program. Program changes are achieved by replacing the EPROM, or by replacing the pair of devices. The 87P50 has control over the other devices on the board. It communicates with these with an 8 bit data bus DB0-DB7, which visits all devices. Other control lines from the 87P50 are also used as required.

8.2.3 Pressure Transducers.

One transducer is used for each test head fitted. The pressure within the molding under test is piped all the way back to the pressure transducer on the PCB. This line must be leak proof and free of kinks. The pressure transducers are precision, temperature compensated types, appearing to the circuit as a strain gauge bridge configuration. The

differential outputs of the transducers are amplified at fixed gain by U9, and zeroed by VR1 and VR2. These controls are factory set and do not require field adjustment.

8.2.4 Analog to Digital Converter.

The system uses a 16 channel 10 bit a/d converter (U19) to acquire the various analog signals needed. The pressure transducer signals are connected to the first two channels AI0 and AI1. AI2 is connected to the clamp time control VR3. Other channels are not used at present, but can be connected to other preset controls, or external analog signals

8.2.5 Output Drivers.

The solenoid valves and reject relays are controlled by output latch U3 and power drivers U4, U5. U4 and U5 are open collector devices, switching their output lines to zero volts when active. Led indicators U7, U8 are connected across these outputs, showing the output state. The connected valve or relay should be on when the associated led is on.

8.2.6 Display Drivers.

The lcd is a triply multiplexed type driven by U21, mounted on the front side of the PCB. The preset near U21 on the rear side of the PCB rotates the viewing angle. This control is factory set.

The bar graphs and test status leds are connected in a matrix and driven by multiplexed led display driver U18.

8.2.7 Memory.

The program data memory is internal to the 87P50. The count of number passed and number failed is stored in battery backed ram U27. This is kept supplied with power even when the main is off, by re-chargeable battery B1. The battery is automatically trickle charged when power is applied. The count can be stored for up to one month with no power applied.

8.2.8 Reset Circuitry.

The reset pin of the processor can be driven by three separate sources. Other pins of the processor detect which source caused the reset signal. The sources are:

(a) Start signal reset.
(b) Front panel reset.
(c) Power on reset.

The reset signal is active low.

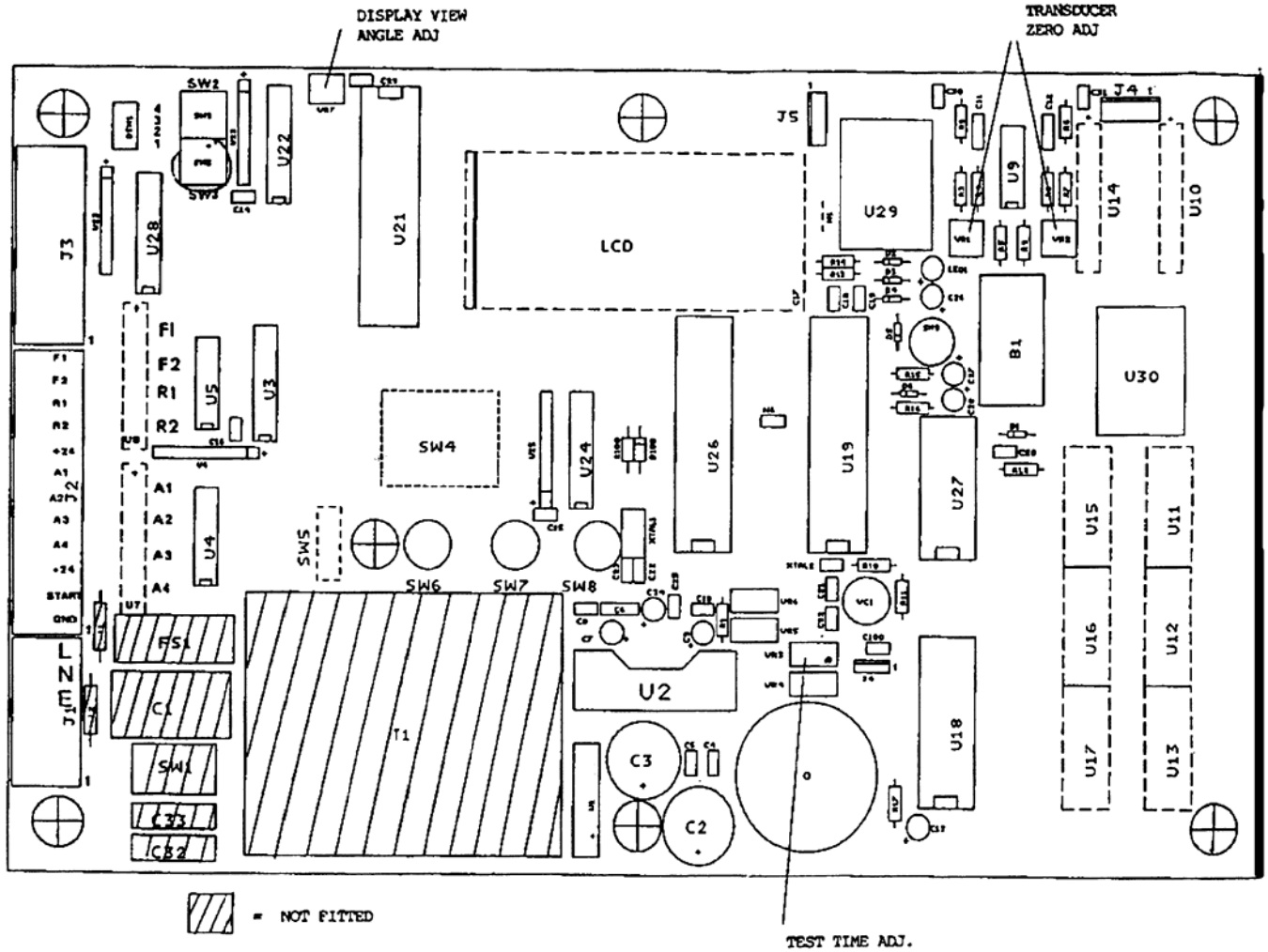
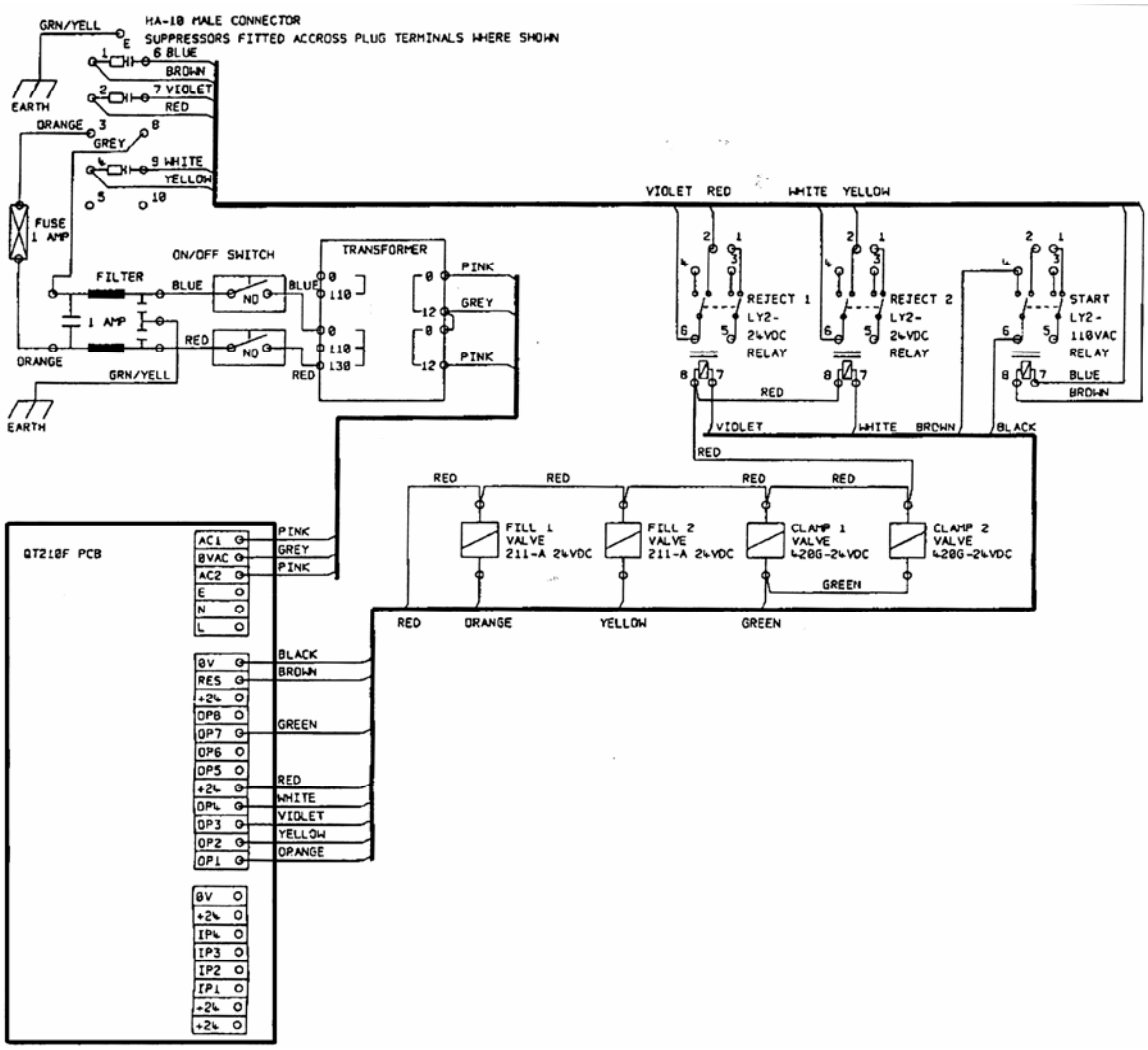


FIG. 8.11 PCB LAYOUT


HA-10 MALE CONNECTOR
SUPPRESSORS FITTED ACCROSS PLUG TERMINALS WHERE SHOWN
GRN/YELL
E
EARTH
1
6 BLUE
BROWN
2
7 VIOLET
RED
ORANGE
3
GREY
8
9 WHITE
YELLOW
4
5
10
FUSE
1 AMP
ON/OFF SWITCH
FILTER
BLUE
NO
1 AMP
RED
NO
ORANGE
GRN/YELL
EARTH
TRANSFORMER
0
110
12
0
110
130
12
PINK
GREY
PINK
BLUE
RED
VIOLET
RED
WHITE
YELLOW
REJECT 1
LY2-
24VDC
RELAY
REJECT 2
LY2-
24VDC
RELAY
START
LY2-
110VAC
RELAY
BLUE
BROWN
RED
VIOLET
WHITE
BROWN
BLACK
RED
RED
RED
RED
RED
FILL 1
VALVE
211-A 24VDC
FILL 2
VALVE
211-A 24VDC
CLAMP 1
VALVE
420G-24VDC
CLAMP 2
VALVE
420G-24VDC
GREEN
RED
ORANGE
YELLOW
GREEN
QT218F PCB
AC1
8VAC
AC2
E
N
L
PINK
GREY
PINK
0V
RES
+24
OP8
OP7
OP6
OP5
+24
OP4
OP3
OP2
OP1
BLACK
BROWN
GREEN
RED
WHITE
VIOLET
YELLOW
ORANGE
0V
+24
IP4
IP3
IP2
IP1
+24
+24