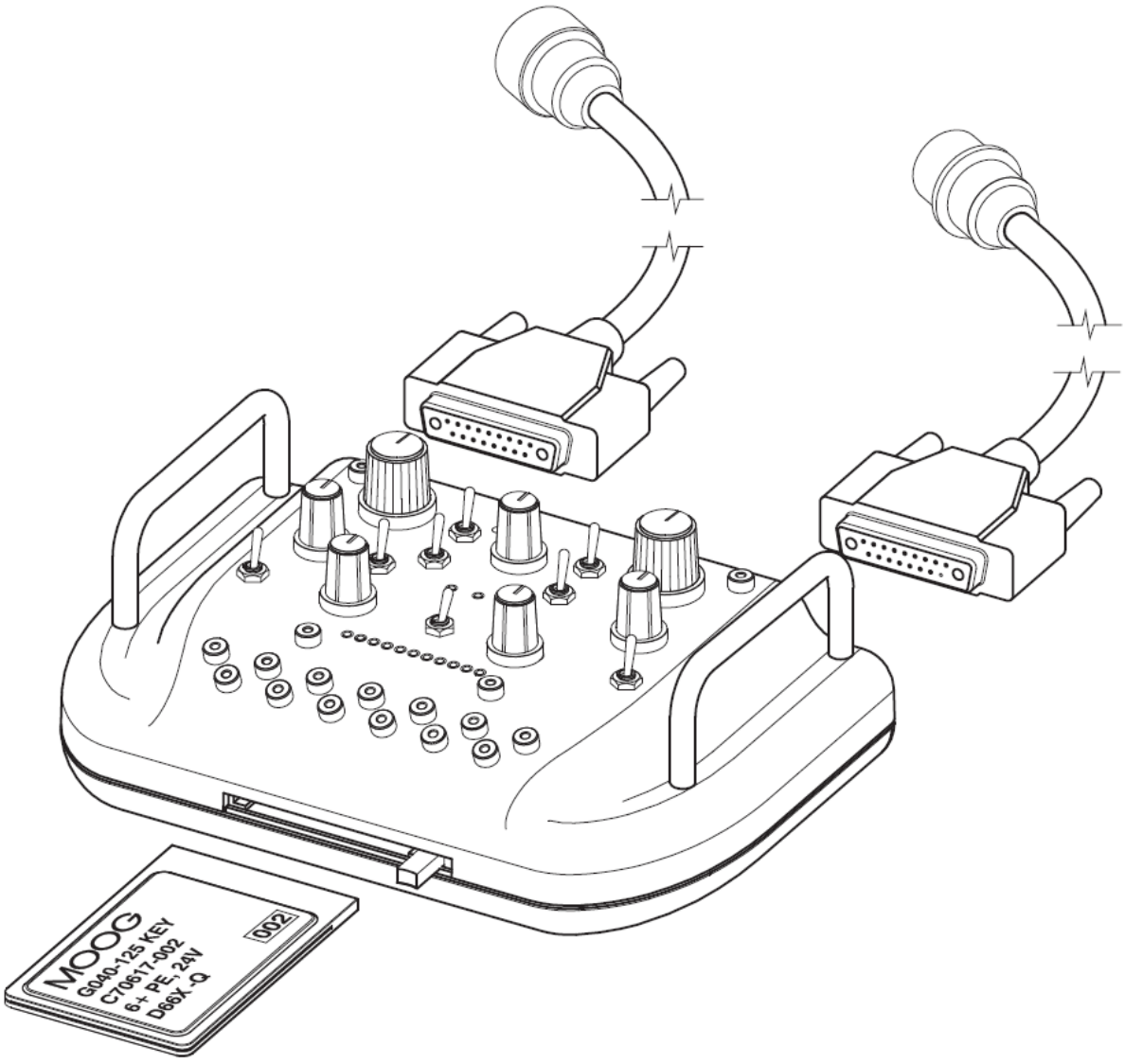
APPLICATION NOTES

PQ VALVE CHECKER

G040-125A002



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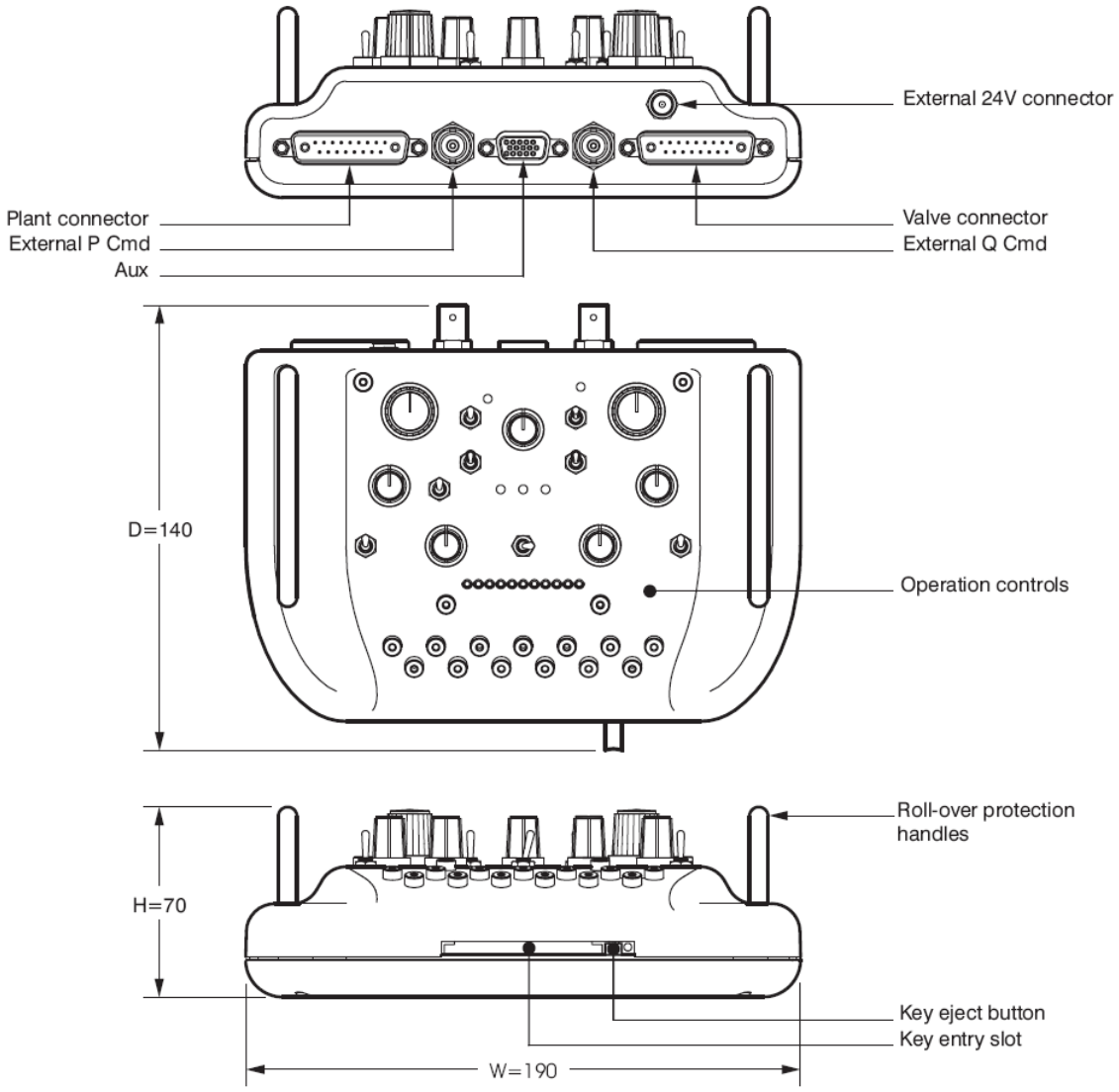
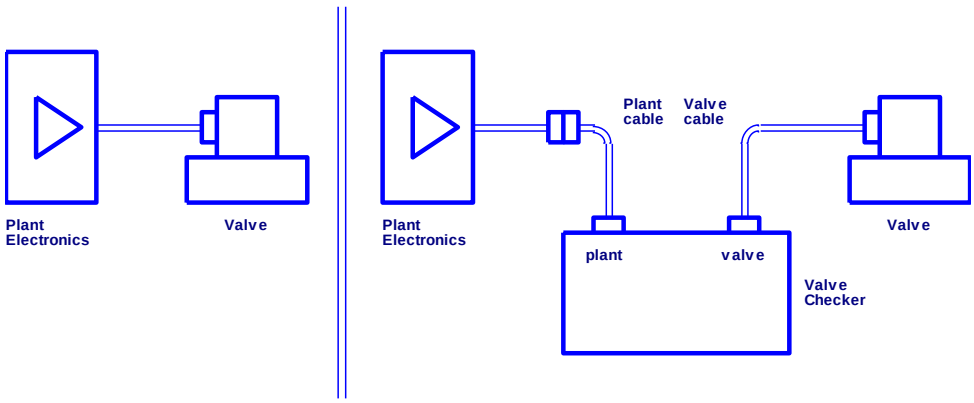
1. DESCRIPTION



1.1 Function

The Moog G040-125 Valve Checker is an instrument that can check the complete range of Moog proportional and servo valves. The feature that makes it so versatile is the way it can test a valve while the valve is still installed in its normal operating plant. This is done at two levels:



1.1.1 **Plant (In Line)**

The plant and valve operate normally. The Valve Checker is connected between the plant electronics and the valve such that all the plant electronics' signals to and from the valve are connected as normal. The Valve Checker monitors the plant electronics' signals and the signals back from the valve, enabling a check of the valve's performance.

1.1.2 **Checker (Stand Alone)**

In this mode the Valve Checker generates the command to the valve and monitors the signals back from it. The valve still controls the plant actuator but the plant electronics command signals are disconnected. Checking while still installed in the plant provides the added benefit of checking the valve by observing the reaction of the plant actuator to the Valve Checker's commands.

1.2 **Power**

The Valve Checker is powered by the plant electronics, which also continue to supply the valve in both *plant* and *checker* modes of operation. There is a *+24V D.C power connector* on the rear panel that powers both the Valve Checker and the valve. Both ±15V and 24V D.C valves are powered by this +24V DC supply.

1.3 **Cables**

Two cables connect the Valve Checker, one to the plant electronics and one to the valve. Connection is made by removing the existing plant cable from the valve, connecting the Valve Checker *plant* cable to this cable and then connecting the Valve Checker *valve* cable to the valve. There are 10 cable pairs to cater for each type of valve connector. The cables are listed in chapter ten.

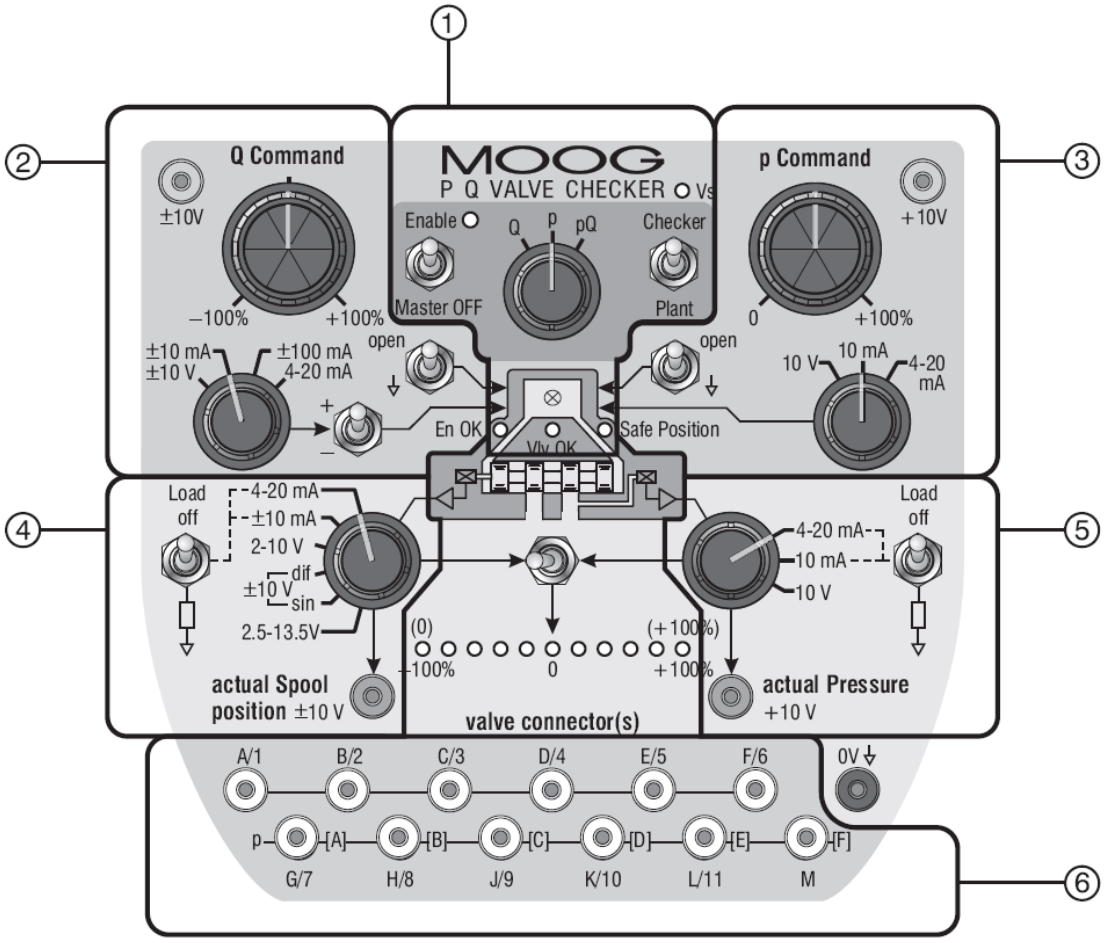
1.4 **Keys**

The Valve Checker is configured for the particular valve being tested by a plug-in key. The key is a PCMCIA card. It connects the appropriate signals and power supplies to the cable connector pins. There are 26 valve specific keys, listed in chapter nine.

1.5 Operation

There are six functional blocks on the front panel.

1. Control
2. Q command
3. P command
4. Actual spool position
5. Actual pressure
6. Valve connector test points



1.5.1 Control

The *Vs LED* indicates the internal ±15V supply is healthy.

The *valve OK LED* illuminates when the valve OK logic signal from the valve is positive.

The *enable OK LED* illuminates when the enable OK logic signal from the valve is positive.

The *safe position LED* illuminates when the safe position logic signal from the valve is positive.

The *Checker/Plant switch* selects the two operating modes:

- *Checker* gives valve commands of pressure P, flow Q and valve enable generated by the Checker, with the valve generated signals of actual

pressure, spool position, enable OK, valve OK and safe position, monitored on the Valve Checker and passed back to the plant electronics.

- *Plant* gives valve commands of pressure P, flow Q and valve enable generated by the plant electronics, with the valve generated signals tested in the same way as in checker operation.

The enable signal to the valve comes from the plant electronics when *plant* operation is selected. When *checker* operation is selected it comes from the *enable on switch*. However, the enable to the valve can be turned off by selecting *master off* when either *plant or checker operation* is selected.

As well as enabling the valve, the enable signal also enables the Valve Checker output signals derived from either the checker itself, or the plant electronics. This provides a safety feature that enables a user to quickly kill all signals, in the event of damaging or dangerous plant actuator movements.

Turning on the *enable switch* in *checker* operation also energises the safety solenoid, on valves that have one.

The *Q/P/PQ mode selector switch* selects the operating mode by connecting the valve signal pins in the required manner:

- *Q mode* connects the signals so no pressure control is active.
- *P mode* gives only pressure control, flow being dependent totally on the pressure selected and the load.
- *PQ mode* gives flow control from the Q block until the load pressure rises to the P command pressure. At this point the PQ valve will close to maintain the pressure. If the pressure falls below the P command setting the valve reverts to flow control. This is also called Q + P limit mode.

1.5.2 **Q Command**

This block is active only when *checker* is selected and *Q* or *PQ* is selected on the *mode selector* switch. When *P* is selected the Q command is automatically set to zero.

The *blue test point* gives a 0 to ±10V signal proportional to ±100% of the full scale voltage or current being delivered to the valve.

The *± switch* connects the valve drive signal to the non-inverting (+ gives P →A) and inverting (– gives P→B) inputs. The *open/⏚ switch* connects an open circuit or ground to the unused input.

The actual voltage on the valve input pins can be measured on the green *D/4 and E/5 test points*. When the command to the valve is a mA signal, a knowledge of the valve input resistance is necessary to gain any benefit from this measurement.

1.5.3 **P Command**

This block is used in conjunction with, or in place of, the Q block, to test PQ valves. It is active only when *checker* is selected. The *yellow test point* gives a 0 to +10V signal proportional to 100% of the full scale voltage or current being delivered to the valve. The *open/⏚ switch* connects an open circuit or ground to the P– input.

1.5.4 **Actual Spool Position**

The spool position signal from the valve is always monitored and passed on to the plant electronics regardless of checker/plant selection and the mode of operation. The *blue spool test point* gives a 0 to ±10V signal proportional to the spool signal from the valve. An internal10kOhm resistor, in series with the test point, protects the Valve Checker from externally applied damaging voltages. A digital multimeter or oscilloscope with an input resistance of at least 1M Ohm must be used to make measurements on this test point. Most digital multimeters have in excess of 1MOhm input resistance and most oscilloscopes are either 1 or 10MOhm, so they are suitable.

The *LED display* to the right of the test point provides a low resolution indication of the signal. The centre *yellow null LED* will be illuminated when the spool signal is within ±10% of full scale.

An understanding of the *checker load switch* is important for successful use of the Valve Checker when the spool signal is a current (±10mA or 4-20mA). When the valve outputs a current, there must be a path through which the current can flow, for the Checker to be able to measure the current. When the plant electronics do not provide this load, or the Checker is not connected to the plant electronics, the *Checker load switch* connects a 500 Ohm load to ground on the spool signal, enabling a current to flow.

1.5.5 **Actual Pressure**

The pressure signal from the valve is always monitored and passed on to the plant electronics. The *yellow pressure test point* gives a 0 to +10V signal proportional to the pressure signal from the valve. An internal10kOhm resistor, in series with the test point, protects the Valve Checker from externally applied damaging voltages. A digital multimeter or oscilloscope with an input resistance of at least 1MOhm must be used to make measurements on this test point. Most digital multimeters have in excess of 1MOhm input resistance and most oscilloscopes are either 1 or 10MOhm, so they are suitable.

The *LED display* gives a 0 to 100% pressure indication, rather than 0 to ±100%, as for the spool position. The *yellow LED* is no longer an indication of a null condition.

The *checker load switch* provides a 500 Ohm current path when 10mA or 4-20mA signals are being monitored.

1.5.6 **Valve Connector Test Points**

These green test points are connected via 10kOhm resistors to the valve connector pins. The valve connector table in chapter seven shows the pin-out provided by each key. When measuring voltages on pins that have a current input signal on them, knowledge of the valve's input resistance is necessary. The input resistance varies between different valve models and if unsure of the valve, check with a Moog Application Engineer.

Likewise, on pins that have an output current signal, knowledge of the checker's input resistance is required.

The input resistance in checker operation, for both spool and pressure current signals, is 500 Ohm. In plant operation, with the checker load switch off, the valve checker adds 50 Ohm to the plant input resistance.

The 10kOhm resistor, in series with the valve connector test points, protects the Valve and Valve Checker from externally applied damaging voltages. A digital multimeter or oscilloscope with an input resistance of at least 1MOhm must be used to make measurements on these test points. Most digital multimeters have in excess of 1MOhm input resistance and most oscilloscopes are either 1 or 10MOhm, so they are suitable.

2. SPECIFICATION

Q Command Outputs:	±10V, ±10mA, ±100mA, 4-20mA, plant command
Q Command Test Point:	0 to ±10V
P Command Outputs:	0 to +10V, 0 to +10mA, 4-20mA, plant command
P Command Test Point:	0 to +10V
P&Q Commands output Swing:	10V
Q (Spool) Feedback:	2.5 to 13.5V, ±10V differential, ±10V single ended, ±10mA, 4-20mA, 2-10V
Q (Spool) Feedback Test Point:	±10V
P Feedback:	0 to +10V, 0 to +10mA, 4-20mA
P Feedback Test Point:	0 to +10V
Supply:	
±15V	±14.25 to±15.75V, ±80mA at ±15V, excluding valve
24V	22 to 28V, 140mA at 24V, excluding valve. 800mA at 24V and maximum ±350mA from the internal ±15V
Weight:	680gm
Dimensions:	190W x 140D x 70H
Enable OK, Valve OK, and Safe Position threshold:	on at 8.5V off at 6.5V
EMC:	EN61000-6-3, emission (not for S\N M101 to M120) EN61000-6-2, immunity (not for S\N M101 to M120)
Protective earth:	EN 60204-1 equal-potential

Q = Flow (proportional to spool position)
P = Pressure
m.f.b. = Mechanical feedback
e.f.b. = Electrical feedback

3. CONNECTING BETWEEN VALVE AND PLANT

3.1 Select the appropriate cable pair and key for the valve being tested. Use the lists in chapters nine and ten.

3.2 Disable the process that the valve is controlling by turning off electrical power and hydraulic pressure.

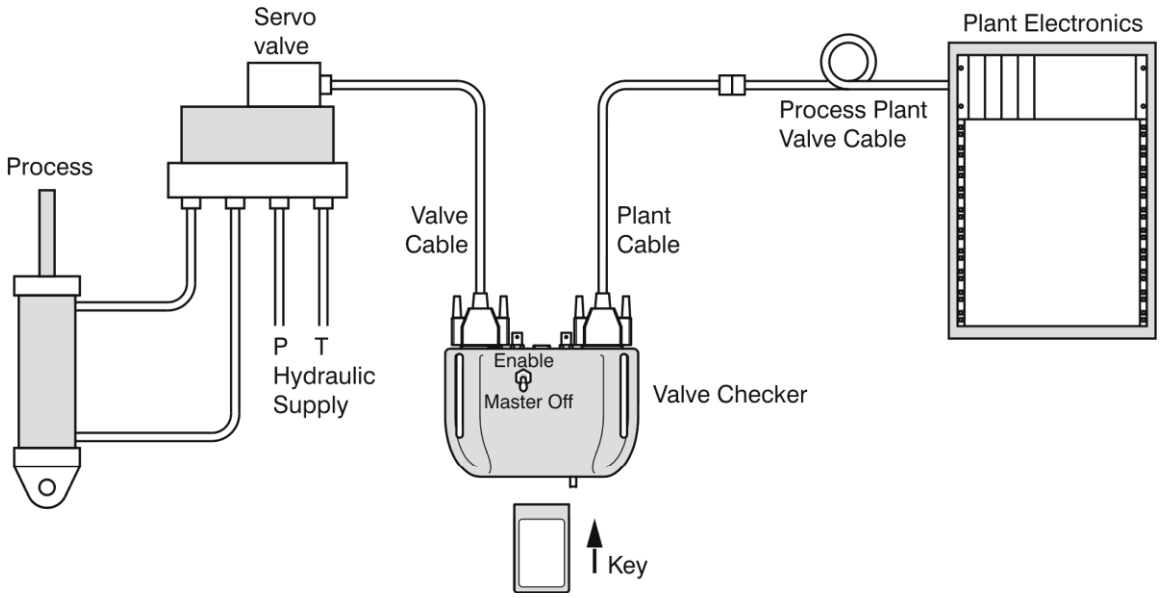
CAUTION: Be sure that the power down sequence is orderly, so no damage can be done to the plant.

3.3 Remove the process plant cable from the valve and mate this cable connector with the Valve Checker plant cable.

3.4 Mate the Valve Checker valve cable with the valve.

3.5 Insert the key, label side up.

3.6 Select *master off* on the *enable switch*.



3.7 Restore power and hydraulic pressure.

CAUTION: Be sure that the power up sequence is orderly, so no damage can be done to the plant.

3.8 Verify that the *checker power Vs LED* is illuminated.

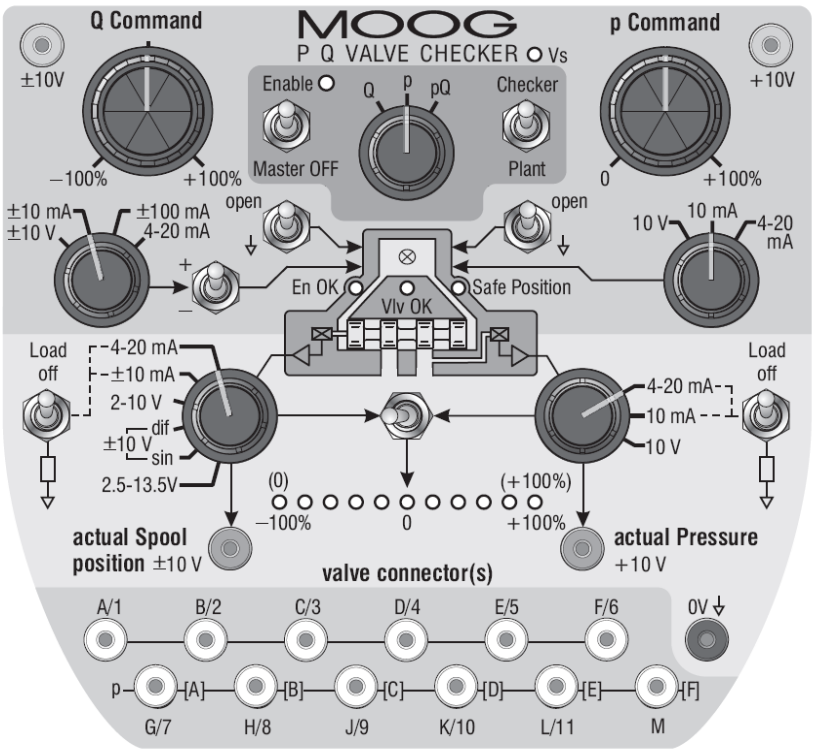
3.9 Select either *plant* (in line) operation or *checker* (stand alone) operation on the *control selector switch*.

See chapter four for instructions on plant operation and chapter five for instructions on checker operation.

CAUTION: Do not spill oil on the Valve Checker. Oil can enter the housing and damage the internal electronic circuit.

Do not subject the Valve Checker to severe shock or vibration. Damage to the internal electronic circuit can result.

4. PLANT MODE OPERATION



4.1 Having successfully connected the Valve Checker as per chapter three, select *plant operation* on the *checker/plant switch*.

CAUTION: Ensure the *enable switch* is in the *master off* position and leave it in this position until all switch selections are made and the test is ready to proceed.

4.2 In plant mode the Q and P command sections are inoperative. The P, Q and enable commands come from the plant electronics.

4.3 In the actual spool and actual pressure blocks select the appropriate spool (Q) and pressure (P) signals. If selecting either 10mA or 4-20mA check if the plant electronics provides a load that enables a current signal to flow. If there is no load, turn on the *load switch*.

4.4 Begin the test by turning on the *enable switch*. The *enable LED* should illuminate. On valves that do not have an enable signal input, the Valve Checker key generates a permanent enable signal so the enable LED illuminates and the Valve Checker can connect commands to the valve. The key list in chapter nine shows which valves have enable signals.

4.5 Measure the actual spool and pressure signals on the *blue and yellow test points*. The voltages on these test points are standardised to 0 to ±10V for spool (Q) and 0 to + 10V for pressure (P).

4.6 The plant electronics' command, directly on the valve input pins, can be measured on the *green valve connector test points*. A knowledge of the valve input resistance is required to interpret the voltage measured when a mA signal is flowing.

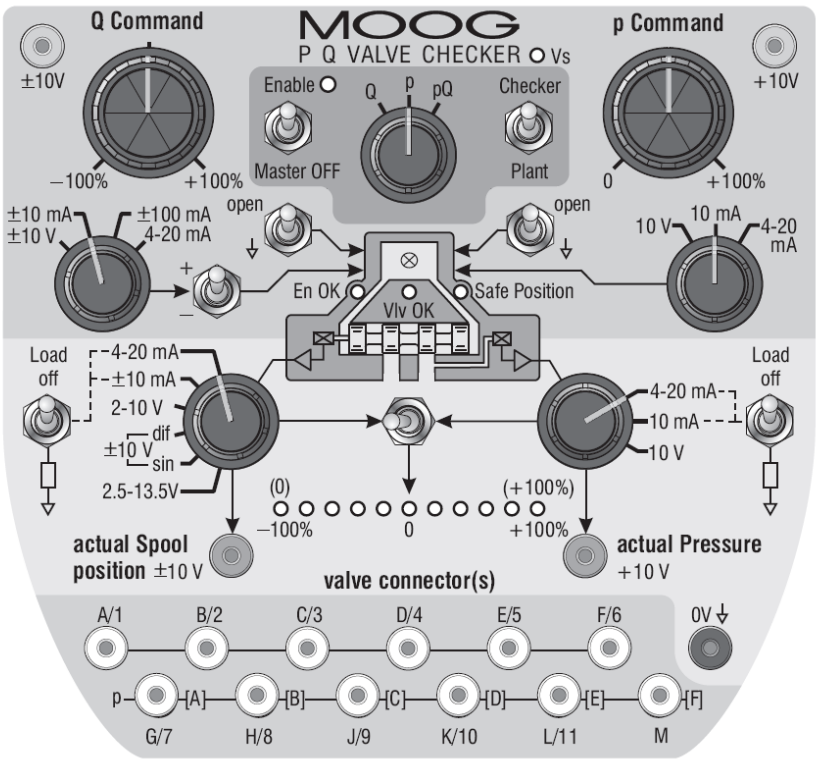
For example, a D66X valve with a ± 10mA Q command, an input resistance of 400 Ohm and the Qcmd– pin grounded will give a Qcmd+ voltage of ±4V. However, if you measure approximately +13V it is likely there is no current flowing. If you measure approximately OV it is likely the command from the plant is not connected. These test points are useful if a test shows a fault and you want to be sure that it is the valve, and not the Valve Checker, causing it.

Some Qcmd+ and Qcmd– valve pin numbers

Valve	Qcmd+ pin	Qcmd– pin
D66X 12 pin	D	E
D66X 11+PE	4	5
D66X 6+PE	D	E
D691 12 pin	D	-
D691 11+PE	4	-
D633/4 6 pin	D	E
D633/4 6+PE	D	E
D656 6/7 pin	D	-
D656 12 pin	D	-

4.7 The *LED display* shows the signal level selected by the display *toggle switch* between the actual spool position and actual pressure *test points*. This *display* provides a rudimentary check of the feedback signals. When *spool* is selected the centre *yellow null LED* is illuminated when the spool position is within ±10% of null. When *pressure* is selected it is no longer a null indicator, minimum pressure being indicated by the left (O) LED. The *display* does not operate for pressure when testing D651-4 PQ valves. This is because the pressure feedback signal for these valves is a negative voltage and the *display* operates only for positive pressure signals. However, the actual pressure test point has the negative signal.

5. CHECKER MODE OPERATION



5.1 Having successfully connected the Valve Checker as per chapter three, select *checker operation* on the *checker/plant switch*.

CAUTION: Ensure the *enable switch* is in the *master off* position and leave it in this position until all switch selections are made and the test is ready to proceed.

5.2 Set the *Q command pot* to its centre zero position and select the signal type appropriate to the valve being tested. Set the *± switch* and the *open/⏚ switch* as required. If testing a PQ valve, these switches are automatically over-ridden because PQ valves do not have dual (+ and −) Q command inputs. If you are uncertain of the polarity, it is recommended to use + and ⏚ as a starting point and check the direction of actuator travel in the process plant, when testing begins.

5.3 If testing a PQ valve, set the *P command pot* to minimum (fully counter clockwise) and select the signal type appropriate to the valve being tested. Select the mode of operation of the PQ valve.

Q - flow control only
P - pressure control only
PQ - flow control with Q command until P command pressure is reached, at which point pressure limiting control occurs.

CAUTION: The G040-125 Valve Checker is wired for PQ valves in the main flow path only. It is not suitable for testing PQ valves in bypass connection.

5.4 In the actual spool and actual pressure blocks, select the appropriate spool (Q) and pressure (P) signals. If selecting either 10mA or 4-20mA, check if the plant electronics provides a load that enables the current signal to flow. If there is no load, turn on the *load switch*.

5.5 Begin the test by turning on the *enable switch*. The *enable LED* should illuminate. On valves that do not have an enable signal input, the Valve Checker key generates a permanent enable signal so the enable LED illuminates and the Valve Checker can connect commands to the valve. Chapter nine lists which valves have enable signals.

5.6 Adjust the *P and Q commands pots*. Measure the command value, standardised to 0 to ±10V for Q and 0 to +10V for P, on the blue and yellow *test points*. Compare these values to the actual valve output on the *blue and yellow test points*. For correct function they should be the same; within accuracy limits of the valve and valve checker.

5.7 The accuracy limit of the Valve Checker is ±0.2V for all signals other than 4-20mA on the spool, where it is ±0.4V. This means that if you read a command of 5.6V, the feedback signal could be between 5.4 and 5.8V and the valve will be functioning correctly. For a spool signal of 4-20mA, this would be 5.2V to 6.0V for correct functioning.

See paragraph 4.6 for a table of Q+ and Q– valve pin numbers.

5.8 The *valve connector test points* enable a measurement directly on the valve connector pins. This is useful if a test shows a fault and you want to be sure it is the valve and not the Valve Checker causing it. A knowledge of the input resistance of the valve and Valve Checker is necessary to interpret these measurements.

5.9 The *LED display* shows the signal level selected by the *display toggle switch* between the actual spool and actual pressure *test points*. This *display* provides a low resolution check of the feedback signals. When *spool* is selected the centre *yellow null LED* is illuminated when the spool position is within ±10% of null. When *pressure* is selected the *yellow LED* is no longer a null indicator, minimum pressure being indicated by the far left LED, labelled (0). The *display* does not operate for pressure when testing D651-4 PQ valves. This is because the pressure feedback signal for these valves is a negative voltage and the *display* operates only for positive pressure signals. However, the actual pressure test point has the negative signal.

6. Q COMMAND ± and OPEN/⏚ SWITCHES

6.1 ± Switch

This switch is active in checker mode only. It sets the Q command from the pot to either the +(D/4) or −(E/5) valve pin. When PQ mode is selected, the ± switch is over-ridden and the pot Q command is automatically connected to the +(D/4) valve pin.

6.2 Open/⏚ Switch

This switch is active in both checker and plant modes.

Enable	Checker mode	Plant mode
on	sets unused Qcmd pin	no affect
off	sets Qcmd −	sets Qcmd −

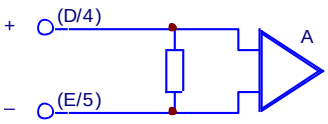
6.2.1 Enable on: In plant operation, the plant electronics control both the Qcmd pins. In checker operation, the Qcmd from the pot is set by the ± switch.
The open/⏚ switch sets the unused Qcmd pin.

6.2.2 Enable off: Both plant and checker commands are disconnected from the valve by the enable switch being in the off position. The valve checker sends a null signal to the Qcmd+ pin to ensure the valve is inactive. This null signal is ground for 10V and 10mA valves and 12mA for 4-20mA valves. The Qcmd− pin must also have its correct signal to ensure the valve is at null.
The open/⏚ switch is used to select this signal.

6.3 Switch selection criteria

6.3.1 From first principles: Input circuit schematics and switch selection table.

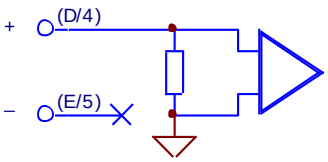
mA Floating

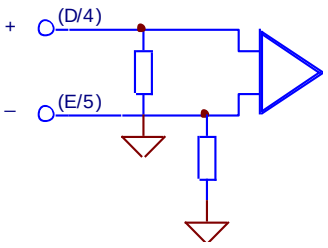


A= high input resistance differential amplifier.

±10mA, 4-20mA

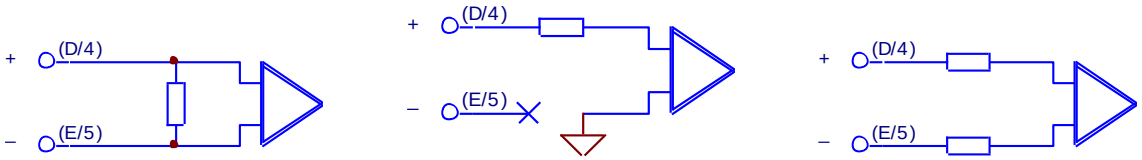
mA Single ended





4-20mA

± 10V, three types



Input circuit	Open/⏚	±
Single ended, ± 10mA and 4-20mA	open	+
± 10V	⏚	+ or –
Floating ± 10mA	⏚	+ or –
Floating 4-20mA	⏚	+

While it may seem incorrect to select open for single ended ± 10mA, this setting ensures maximum linearity of the command to spool relationship.

CAUTION: It is essential to select open for single ended 4-20mA signals. Selecting ground can cause some valves to malfunction.

6.3.2 From the valve typkey number: The 11th digit in the typkey number specifies the signal type. The table below lists the switch settings for all relevant signal types. E.g. D633-342B has a typkey R04K01M0NSP2. The 11th digit is P, which specifies a ± 10mA Qcmd that can have the command on + or –, and has the unused pin open.

Type	Q command	P command	± switch	Open/⏚ switch	floating
A	± 10V	10V	+ or –	⏚	
B	± 10mA	10mA	+ or –	open	
C	± 10mA	10mA	+ or –	open	
D	± 10V	–	+ or –	⏚	
E	4-20mA	4-20mA	+	⏚	yes
F	± 10V	–	+ or –	⏚	
G	± 10mA	–	+ or –	open	
K	± 10V	–	+ or –	⏚	
M	± 10V	10V	+ or –	⏚	
P	± 10mA	10mA	+ or –	open	
S	4-20mA	4-20mA	+	open	
T	± 10V	–	+ or –	⏚	
U	± 10mA	–	+ or –	open	
W	4-20mA	–	+	open	
X	± 10mA	10mA	+ or –	⏚	yes

7. P COMMAND OPEN/⏚ SWITCH

7.1 This switch sets the Pcmd – pin, either open or ground. It is active in checker mode when enable is on and active in both modes when enable is off.

Enable	Checker mode	Plant mode
on	sets Pcmd –	no affect
off	sets Pcmd –	sets Pcmd –

7.2 There are currently only two valves with a Pcmd – signal input, D635 P control DDV and D638 P control DIV. The table below lists the switch position required for the two valves and the three different Pcmd signals.

Valve	± 10V	± 10mA	4-20mA
D635	⏚	open	open
D638	⏚	⏚	⏚

8. EXTERNAL 24V SUPPLY

8.1 The Valve Checker can be powered from the plant electronics via the plant connector or the rear panel 24V connector. When 24V is supplied to this rear panel connector three things happen:

- The Valve Checker internal ±15V power is derived from this supply.
- The 24V supply to valves powered by 24V is derived from this supply.
- The supply to valves powered by ±15V comes from the internal ±15V supply.

8.2 Supply requirements are:

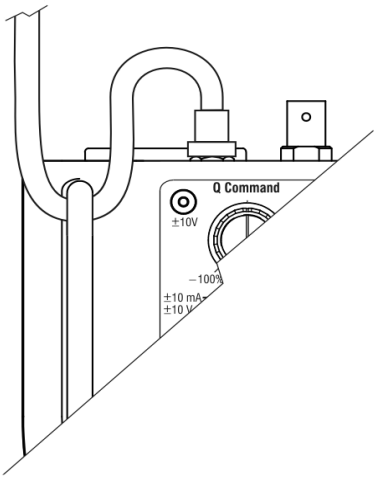
- 2.1mm diameter connector: 24V outside contact, OV inside contact
- 22V to 28V input range
- 140mA at 24V to power the Valve Checker with no load.
- 0.8A to power the Valve Checker and a ±15V valve, at a maximum valve current of ±350mA from the internal ±15V supply.

8.3 Typical 24V maximum supply requirements for some valves are:

- D633 - 1.2A
- D634 - 2.2A
- D635 - 1.0A
- D66X and D691 - 300mA

CAUTION: When the external 24V supply is connected, the plant supply is always automatically disconnected. The valve is then powered from the external 24V supply. It is essential that the external supply or the internal ±15V supply, which in turn is derived from the external 24V, has adequate current capacity to power the valve being checked.

CAUTION: Loop the external 24V supply cable around the handle to prevent the connector being accidentally pulled out.



9 KEY LIST

9.1 All keys have a base part number C70618, followed by a key specific dash number. The list below is for quick reference. Keys with the dash number in bold are recommended to be purchased with a new Valve Checker. Full details of each key are given in 9.2 to 9.8

Dash no.	Valve model	Valve type	Connector	Power	Comments	PE pin	Enable from:
-002	D66X	Q	6 or 6+PE	+24V		PE	plant
-003	D635	DDV-P	6+PE	+24V	P+ & P– cmd	PE	key
-004	D66X	Q	12 pin	±15V		-	key
-006	D69X	PQ	12 pin	+24V	Supply on J & M	K	plant
-007	D66X\765\64X	Q	6 or 6+PE	±15V		PE	key
-008	D656Z038	PQ	12 pin	±15V	J to E in P mode	-	key
-009	D651 to D654	PQ	5 & 6 pin	±15V		-	key
-010	D656	PQ	6 & 7 pin	±15V		-	key
-011	D656	PQ	12 pin	±15V		-	key
-012	D691	PQ	11+PE	±15V		PE	key
-013	D691	PQ	11+PE	+24V	No solenoid, diff spl	PE	plant
-014	D633\634 DDV	Q	6 or 6+PE	+24V		PE	key
-015	Mini DDV, mfb	Q	4 pin	-	Serial or parallel	-	key
-017	D651-346B	PQ	6 & 7 pin	±15V	Arburg connectors	-	key
-018	D659	PQ	7 pin	±15V		-	key
-020	D691	PQ	12 pin	±15V		K	key
-022	D66X	Q	11+PE	+24V	Supply 9-10, diff spl	PE	plant
-023	D636\638\941	PQ	11+PE	+24V		PE	plant
-024	D66X, D68X	Q	11+PE	+24V	No solenoid, sin spl	PE	plant
-025	D66X, D68X	Q	11+PE	+24V	Solenoid, sin spl	PE	plant
-026	D691Z4702	PQ	11+PE	+24V	Solenoid	PE	plant
-027	D68X	Q	11+PE	+24V	Solenoid, diff spool	PE	plant
-028	D638 DIV	P	6+PE	+24V	P+ & P– cmd	PE	plant
-029	659F101B	PQ	12 pin	±15V	Const PQ, diff Qcmd	-	key
-030	D633\634 DDV	Q	6+PE	+24V	100mA Qcmd	PE	key
-031	D67X	Q	11+PE	+24V	Supply 9-10, sin spl, no solenoid	PE	plant
-032	D67X	Q	11+PE	+24V	Supply 9-10, sin spl, with solenoid	PE	plant
-099	All	any	any	either	Universal link set	-	-

9.2 4 pin key

dash no.	**-015**
function	mfb
connector	4 pin
supply	-
valve models	62, G761, D631, etc
A	Qcmd +
B	Qcmd−
Notes: Serial or parallel cable. Enable from Vs.	

9.3 6 pin and 6 + PE key

dash no	**-002**
function	Q
connector	6 or 6 + PE
supply	24V
valve models	D66X
A	+ 24V
B	0V
C	enable
D	Qcmd +
E	Qcmd−
F	spool
PE	PE
notes:	

dash no	**-003**
function	P
connector	6 + PE
supply	24V
valve models	D635
A	+ 24V
B	0V
C	-
D	Pcmd +
E	Pcmd−
F	Pact
PE	PE
notes: Enable from Vs	

dash no	**-007**
function	Q
connector	6 or 6 + PE
supply	±15V
valve models	D66X,765 D64X
A	+ 15V
B	−15V
C	0V
D	Qcmd +
E	Qcmd−
F	spool
PE	PE
notes: Enable from Vs	

dash no	**-014**
function	Q
connector	6 or 6 + PE
supply	24V
valve models	D633/4 DDV
A	+ 24V
B	0V
C	-
D	Qcmd +
E	Qcmd−
F	spool
PE	PE
notes: Enable from Vs	

9.3 6 pin and 6 + PE key, continued

dash no	**-028**
function	P
connector	6 or 6 + PE
supply	24V
valve models	D638
A	+ 24V
B	0V
C	enable
D	Pcmd +
E	Pcmd−
F	Pact
PE	PE
notes:	

Dash no	**-030**
function	Q
Connector	6 + PE
Supply	24V
Valve models	D633/4 DDV
A	+ 24V
B	0V
C	-
D	Qcmd +
E	Qcmd−
F	spool
PE	PE
Notes: 100mA Qcmd	

9.4 7 pin key

dash no	**-018**
function	PQ
connector	7 pin
supply	±15V
valve models	D659
A	+15V
B	−15V
C	0V
D	Qcmd+
E	Pact
F	Pcmd+
G	-
notes: Enable from Vs	

9.5 11+PE key

dash no	**-012**
function	PQ
connector	11+PE
supply	±15V
valve models	D691
1	+15V
2	−15V
3	0V
4	Qcmd+
5	-
6	spool
7	relay
8	relay
9	Pcmd+
10	Pact
11	-
PE	PE
notes: Enable from Vs. Relay (7&8) not monitored	

dash no	**-013**
function	PQ
connector	11+PE
supply	24V
valve models	D691
1	+24V
2	0V
3	enable
4	Qcmd+
5	-
6	spool diff+
7	spool diff−
8	enable OK
9	Pcmd+
10	Pact
11	valve OK
PE	PE
notes:	

9.5 11 + PE key, continued

dash no	**-022**
function	Q
connector	11 + PE
supply	24V
valve models	D66X
1	-
2	-
3	enable
4	Qcmd +
5	Qcmd−
6	spool diff +
7	spool diff−
8	enable OK
9	+ 24V
10	0V
11	valve OK
PE	PE
notes:	

dash no	**-023**
function	PQ
connector	11 + PE
supply	24V
valve models	D636/8 DIV, D941
1	-
2	-
3	enable
4	Qcmd +
5	0V
6	spool
7	Pcmd +
8	Pact
9	+ 24V
10	0V
11	valve OK
PE	PE
notes:	

dash no	**-024**
function	Q
connector	11 + PE
supply	24V
valve models	D66X D68X
1	+ 24V
2	0V
3	enable
4	Qcmd +
5	Qcmd−
6	spool
7	aux spool
8	enable OK
9	-
10	-
11	valve OK
PE	PE
notes: Aux spool (7) not monitored	

dash no	**-025**
function	Q
connector	11 + PE
supply	24V
valve models	D66X D68X
1	+ 24V
2	0V
3	enable
4	Qcmd +
5	Qcmd−
6	spool
7	aux spool
8	enable OK
9	safe sol +
10	safe sol−
11	spool in safe posn
PE	PE
notes: Aux spool (7) not monitored	

9.5 11 + PE key, continued

dash no	**-026**
function	PQ
connector	11 + PE
supply	24V
valve models	D691Z4702
1	+ 24V
2	0V
3	enable
4	Qcmd +
5	safe sol +
6	spool
7	aux spool
8	enable OK
9	Pcmd +
10	Pact
11	valve OK
PE	PE
notes: Aux spool (7) not monitored	

dash no	**-027**
function	Q
connector	11 + PE
supply	24V
valve models	D68X
1	+ 24V
2	0V
3	enable
4	Qcmd +
5	Qcmd−
6	spool diff +
7	spool diff−
8	enable OK
9	safe sol +
10	safe sol−
11	spool in safe posn
PE	PE
notes:	

dash no	**-031**
function	Q
connector	11 + PE
supply	24V
valve models	D67X
1	
2	
3	enable
4	Qcmd +
5	Qcmd−
6	spool
7	
8	enable OK
9	+ 24V
10	0V
11	valve OK
PE	PE
notes:	

dash no	**-032**
function	Q
connector	11 + PE
supply	24V
valve models	D67X
1	safe sol +
2	safe sol −
3	enable
4	Qcmd +
5	Qcmd−
6	spool
7	
8	enable OK
9	+ 24V
10	0V
11	spool in safe posn
PE	PE
notes:	

9.6 12 pin key

dash no	**-004**
function	Q
connector	12 pin
supply	±15V
valve models	D66X
A	+15V
B	−15V
C	0V
D	Qcmd+
E	Qcmd−
F	spool
G	position loop error
H	pilot spool
J	-
K	-
L	relay
M	relay
notes: Pilot spl (H), pos loop err(G) & relay (L&M) not monitored. Enable from Vs.	

dash no	**-006**
function	PQ
connector	12 pin
supply	24V
valve models	D69X
A	-
B	valve OK
C	enable
D	Qcmd+
E	Pact
F	spool diff+
G	spool diff−
H	enable OK
J	+24V
K	PE
L	Pcmd+
M	0V
notes:	

dash no	**-008**
function	PQ
connector	12 pin
supply	±15V
valve models	D656Z038
A	+15V
B	−15V
C	0V
D	Qcmd+
E	P cont I/P
F	spool
G	-
H	Pact
J	P err O\P
K	Pcmd+
L	relay
M	relay
notes: Enable from Vs. Relay (L&M) not monitored.	

dash no	**-011**
function	PQ
connector	12 pin
supply	±15V
valve models	D656
A	+15V
B	−15V
C	0V
D	Qcmd+
E	P cont O/P
F	spool
G	pos loop err
H	Pact
J	-
K	Pcmd+
L	relay
M	relay
notes: Enable from Vs. Pos loop err (G) & relay (L&M) not monitored	

9.6 12 pin key, continued

dash no	**-020**
function	PQ
connector	12 pin
supply	±15V
valve models	D691
A	+15V
B	−15V
C	0V
D	Qcmd+
E	-
F	spool
G	-
H	Pact
J	Pcmd+
K	PE
L	relay
M	relay
notes: Enable from Vs. Relay (L&M) not monitored.	

dash no	**-029**
function	PQ
connector	12 pin
supply	±15V
valve models	659F101B
A	+15V
B	−15V
C	0V
D	Qcmd+
E	Qcmd−
F	-
G	-
H	Pact
J	-
K	Pcmd+
L	relay
M	relay
notes: Constant PQ. Diff Qcmd.	

9.7 5 and 6 pin key

dash no	**-009**
function	PQ
connector	5 & 6 pin
supply	±15V
valve models	D651 to D654
Q side	
A	+15V
B	−15V
C	0V
D	Qcmd+
E	P cont I/P
P side	
A	+15V
B	−15V
C	0V
D	Pact
E	P err O/P
F	Pcmd+
notes: Enable from Vs.	

9.8 6 and 7 pin key

dash no	**-010**
function	PQ
connector	6 & 7 pin
supply	±15V
valve models	D656
Q side	
A	+15V
B	−15V
C	0V
D	Qcmd+
E	P cont I/P
F	spool
Pside	
A	+15V
B	−15V
C	0V
D	Pact
E	P err O/P
F	Pcmd+
G	-
notes: Enable from Vs.	

10. CABLE LIST

Cables shown in bold are recommended to be purchased with a new Valve Checker.

Connector\function	Valve C70615	Plant C70616	Comments
6 pin	-001-002	-001	Common valve cable for 6 and 6 + PE
6 + PE	**-001-002**	**-002**	Common valve cable for 6 and 6 + PE
11 + PE	**-003**	**-003**	Hirschmann N11R
12 pin	**-004**	**-004**	MIL-C-26482 bayonet
12 pin (K = PE)	-005	-005	MIL-C-26482 bayonet with extended male pin for PE
4 pin mfb series and Mini DDV	-006	-006-007	Common plant cable for series and parallel coils
4 pin mfb parallel and Mini DDV	-007	-006-007	Common plant cable for series and parallel coils
5 & 6 pin	-008	-008	Dual PQ valve connectors
6 & 7 pin	-009	-009	Dual PQ valve connectors
7 pin	-010	-010	MIL-C-5015 14S bayonet

11. AUXILIARY CONNECTOR

The auxiliary connector provides power and signal outputs and a 24V input to power the Valve Checker.

Pin	Signal	Description
1	+24V	Power input to Checker. 0.8A max required
2	Qcmd+ (note 1)	0 to ±8V output at 2 mA max
3	0V	Zero volts (ground) reference input\output
4	Pcmd+ (note 1)	0 to +8V output at 2 mA max
5	Spool	0 to ±8V output at 2 mA max
6	+15V	+15V supply output at 50mA max
7	NC	
8	NC	
9	0V	Zero volts (ground) reference input\output
10	+5V	+5V supply output at 10mA max
11	–15V	–15V supply output at 50mA max
12	Enable	+5V output at 2mA max when active
13	Enable OK	+5V output at 2mA max when active
14	Pact	0 to +8V output at 2mA max
15	Valve OK	+5V output at 2mA max when active

Note 1: The Qcmd+ and Pcmd+ signals are dependent on the setting of the c*hecker\plant* switch. In checker operation the signals come from the Checker front panel pots. In plant operation the signals come from the plant electronics.

12. PERFORMANCE CHECKS

The Checker can be used to test null, threshold, step response and hysteresis. Because threshold and hysteresis on efb valves are very low, it can be difficult to get an accurate figure if the valve is operating within specification. Testing threshold and hysteresis is only of value if the valve is well out of specification; and then only to confirm incorrect operation, rather than accurately quantifying it.

12.1 Null

The Spool null position of a flow control (Q) valve is generally the point at which there is no flow from either port. This is the case with axis cut spools. However, valves can have overlapped, underlapped and combinations of the three types that can make checking null a little tricky.

An accurate understanding of the specified null characteristic of a valve is essential before any sense can be made of null measurement results.

12.1.1 To check the null of an axis cut, or quasi axis cut spool (<3% overlap), set the *Q Command* so the actuator controlled by the valve is stationary. Measure the command. This measurement is the null offset, or null error, of the valve. It will be difficult to get the actuator to stop for both types of axis cut spool. A slight drift one way or another is acceptable.

12.1.2 Checking the null on an overlapped valve is a little more difficult. Find a *Q Command* that holds the actuator stationary, or near stationary. A small amount of actuator creep is normal. Increase the *Q Command* until positive actuator movement is observed. Record this value.

Decrease the *Q Command* until an equal reverse actuator movement is observed. Record this value. The two readings should be equal in magnitude but opposite in sign. The difference in the magnitude of the two readings is a measure at the null offset.

12.2 Threshold

12.2.1 Threshold on all types of valves is so low that it is difficult to use the Valve Checker to get an accurate figure. However the procedure outlined below will enable you to determine if the valve being checked is faulty, assuming the actuator has low threshold.

- Bring the actuator to a stop with the *Q Command.*
- Place your hand on the rod and gland and carefully move the *Q Command* back and forth around null.
- Check the motion of the rod as its direction reverses. The motion should be smooth and free of jerks.

12.2.2 On efb valves with spool position feedback, the same test can be done while monitoring the spool feedback signal with an oscilloscope or chart recorder. As the *Q Command* is smoothly reversed about null, the spool signal should show no discontinuity.

12.3 **Step Response**

Set the *Q Command* to a small value, say 10%. By switching the command on and off with the *enable switch* and observing the spool position feedback signal on an oscilloscope, the step response can be shown. An alternative method is to set a 10% Q Command and reverse the command to the valve by switching the *± switch.* This method is applicable to Q only efb valves.

Caution: **This test may be detrimental to the process, so should only be done with care.**

12.4 **Hysteresis**

12.4.1 To check hysteresis on an efb valve, ie; a valve with spool position feedback, set the *Q Command* fully negative. Increase the *Q command* until the spool is at null. Only increase the *Q command*. Do not decrease it. Measure the command signal.

12.4.2 Over a period of several seconds increase the *Q Command* to maximum and then back to null. It is important to come to null while decreasing the command. The measurement will be invalid If the command is reversed as null is approached. Now measure the command signal at null.

12.4.3 The difference between the two null measurements is the hysteresis. This figure actually includes threshold. However, threshold is normally much smaller than hysteresis and so the figure obtained is a valid hysteresis value.

13. TESTING A RKP-D PUMP

13.1 Flow (Q) and pressure (P) testing

The G040-125 is used in its normal way to test the flow and pressure control of the pump by connecting to the 11+PE X1 connector of the Digital Input Valve (DIV). Note that the *spool test point* and *LED display* on the Checker will indicate the position of the pump stroke ring, not the position of the DIV spool.

Follow the instructions in chapters 3, 4 and 5 to test the pump. Choose + and open on the ± and open/⏚ switches, because the DIV has only one pin for Q command.

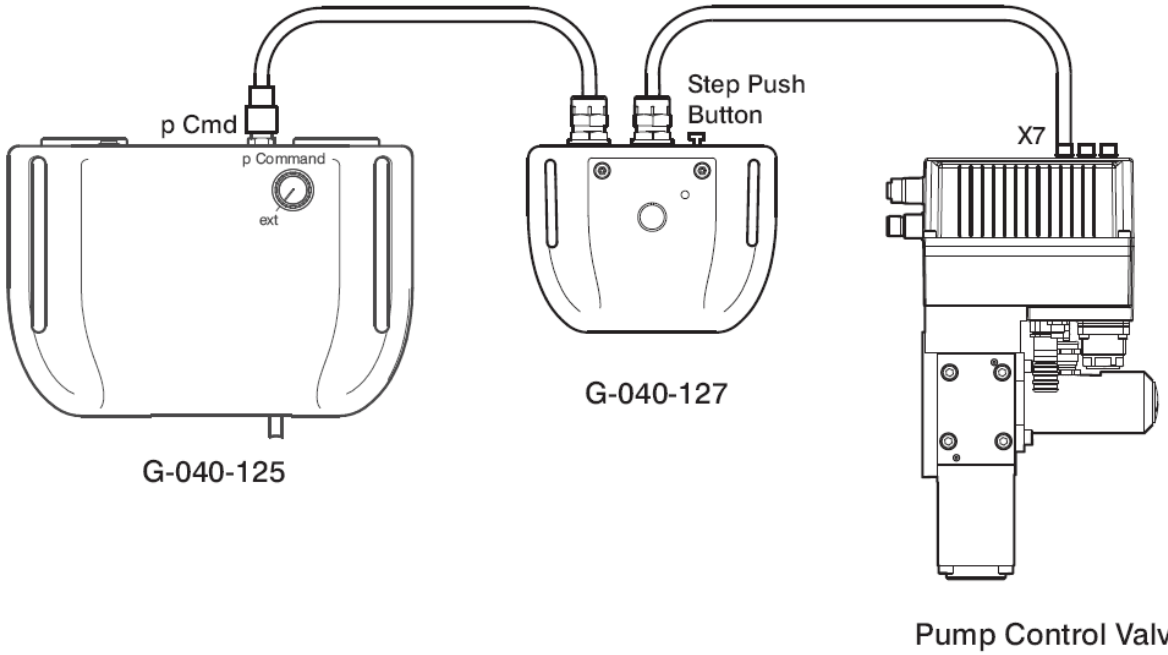
An understanding of the operating modes of the pump is essential to correctly interpret the results. For example, the stroke ring will not respond to a negative command unless there is a positive pressure at the output port. That is port A for clockwise rotation and port B for counter clockwise.

13.2 Tuning parameter selection

The G040-127 is used to select a tuning parameter to optimise the pump's dynamic performance. Each parameter corresponds to an oil volume at the output of the pump. The 16 positions select a volume as defined in the table below.

To set the parameter:

- Plug in the G040-127 Pump Tester cable to DIV connector X7and the p command coaxial cable into the external p command connector on the rear of the G040-125 Checker.



- Set the G040-125 p Command pot to ext (external)
- Input a step pressure command from the G040-127 by pressing the rear panel *step push button*
- Use an oscilloscope to monitor the response on the G040-125 *pressure test point*.
- Select a tuning parameter, with the front panel rotary switch, that gives the required response.
- When the optimum parameter has been determined and the tester removed, pin 4 of X7 must have the corresponding voltage, as shown in the table below, permanently connected to it, by a voltage divider. The voltage delivered by the divider must be within ±0.1V of the value in the table.

Parameter set	**Oil volume**	**Control mode**	**Operational mode**	**Voltage at X7 pin 4**
1	0.1 litres	p/Q	Solo	1.5
2	2.5 litres	p/Q	Solo	2.0
3	5.0 litres	p/Q	Solo	2.5
4	7.5 litres	p/Q	Solo	3.0
5	10.0 litres	p/Q	Solo	3.5
6	12.5 litres	p/Q	Solo	4.0
7	15.0 litres	p/Q	Solo	4.5
8	20.0 litres	p/Q	Solo	5.0
9	25.0 litres	p/Q	Solo	5.5
10	30.0 litres	p/Q	Solo	6.0
11	35.0 litres	p/Q	Solo	6.5
12	40.0 litres	p/Q	Solo	7.0
13	50.0 litres	p/Q	Solo	7.5
14	p regulator off	Q	Solo	8.0
15	0.1 litres	p/Q	Hybrid	8.5
16	p regulator off	Q	Solo (slave)	9.0