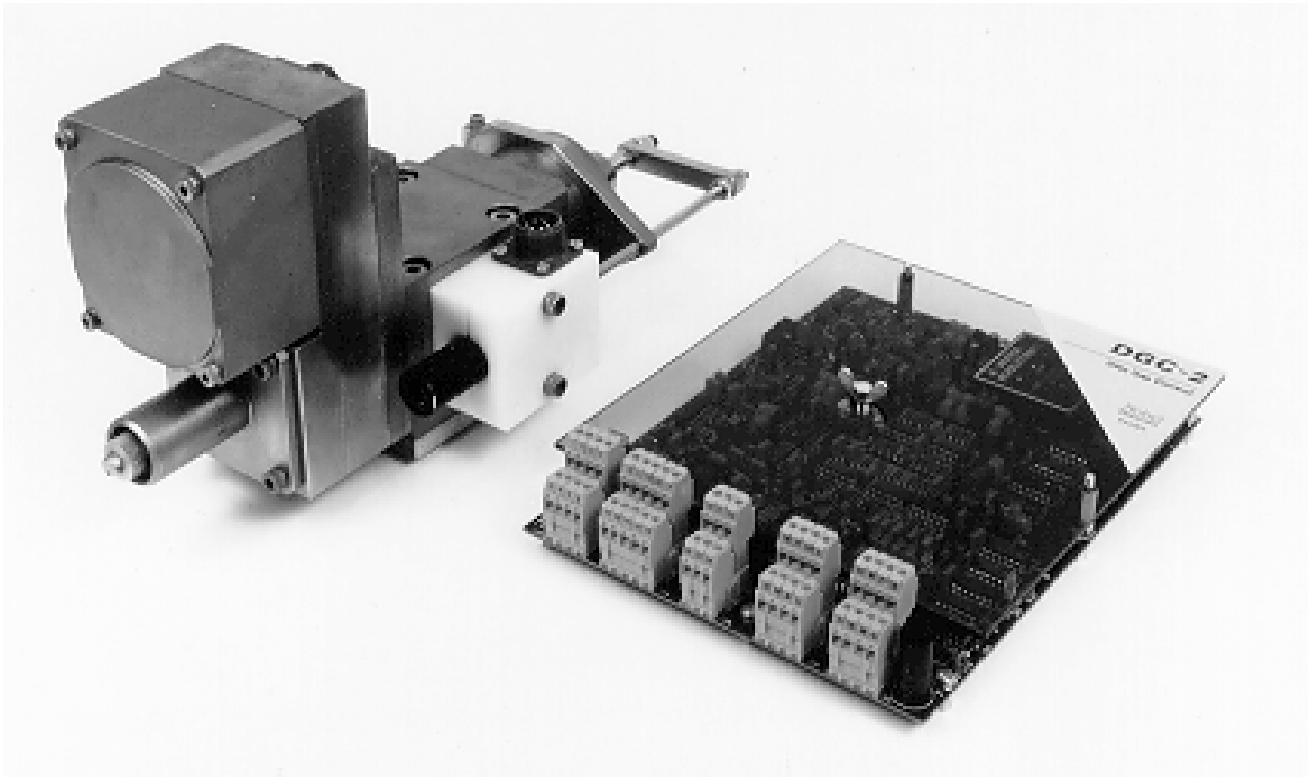
Measurement · Weighing · Control

GB

Disc Gap Control
DGC-2



Technical Manual

VISHAY PRECISION GROUP

Contents

Introduction

For production of mechanical pulp in disc refiners, accurate control of the disc gap is required to achieve a satisfying production quality.

Nobel Weighing Systems has developed an electrohydraulic servo system for disc gap control. It consists of a tracer valve, controlling the hydraulic piston for the disc gap, and an electronic unit controlling and supervising the tracer valve.

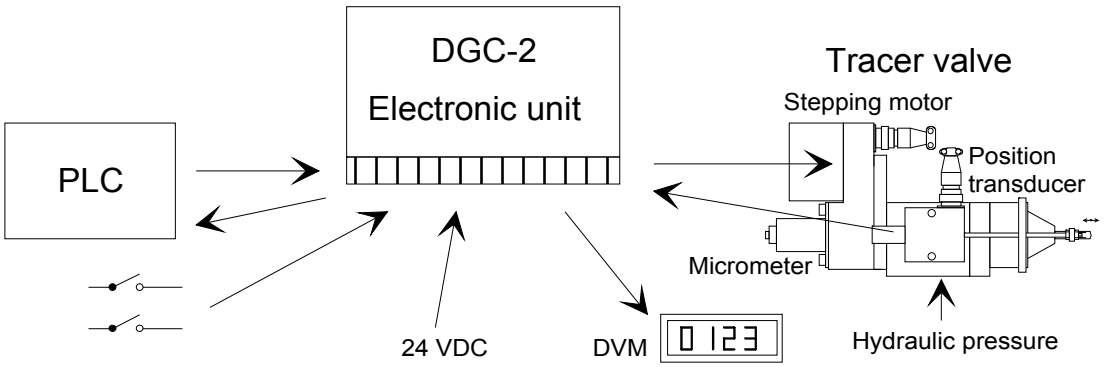
Several functions are included in the servo control system:
- control of the disc gap, manually or by computer,
- disc position measuring,
- display of the disc gap and the disc wear,
- setting of limits for the working range,
- fast opening of the disc gap in case of emergency.

Electronic unit

The electronic unit of the servo system consists of a single circuit board with plug-in screw terminals for connection of external units. The circuit board with cover is fixed on a steel plate, together with an earth rail for cable shields.
To conform with the EMC-requirements, the unit should be mounted in an interference free environment. A protective steel box can be ordered separately from Nobel Weighing Systems, see Appendix 2, Protective housing.

Tracer valve

The tracer valve is a hydraulic component controlling the oil flow to a hydraulic cylinder in the refiner, thus regulating the position of the controlled disc.
The position is set by a micrometer screw, manually or with a stepper motor, and by mechanical feedback the position is maintained, independent of load variations in the refiner. Hydraulic pressure to a separate connection of the tracer valve results in a fast opening of the disc gap, independent of the micrometer setting.



Block diagram for Disc Gap Control DGC-2 with electronic unit, tracer valve and external components.

Technical data

Electronic unit, art. no. 110 096

Power supply

Connector	2 way plug-in terminal block
Voltage	24 VDC ±10 %
Consumption	max. 750 mA
Fuse	1 A T

Stepping motor control

Outputs	6
Connector	6 way plug-in terminal block
Current sink	4 outputs, max. 200 mA/output
Current feed	2 outputs, max. 0–1.5 V below supply voltage see Power supply
Frequency	6, 12, 24, 48 Hz (by jumpers)

Control voltage output

Connector	2 way plug-in terminal block
Voltage	see Power supply
Max. current	100 mA

Digital inputs

Number	5 with common zero voltage
Connector	6 way plug-in terminal block
Input type	opto-insulated
None-active (low level)	0–6 VDC
Active (high level)	16–30 VDC
Input resistance	1.8 kohm
Isolation	500 VDC

Primary voltage output to LVDT

Connector	2 way plug-in terminal block
Voltage	2.7–3.3 Vrms
Frequency	2–2.7 kHz

Secondary voltage input from LVDT

Number	2
Connector	4 way plug-in terminal block

Zero adjustment of disc gap

Connector	3 way plug-in terminal block
Reference voltages	+10 VDC and -10 VDC ± 0.15 V
Input impedance	> 500 kohm
External load	> 4 kΩ

Voltage output for DVM

Number	3
Connector	6 way plug-in terminal block
Voltage (range)	±10 VDC
Load	> 10 kohm
Zero deviation	< ± 25 mV for 10 °C
Temperature drift	< 200 ppm/°C

Current output (insulated)

Connector	2 way plug-in terminal block
Measuring range	4–20 mA (0–10 mm)
Load	< 800 ohm
Zero deviation	< 40 μA for 10 °C
Temperature drift	< 250 ppm/°C
Isolation	> 50 VDC

Comparators

Hysteresis	30 mV

Relay outputs

Number	3, separated
Connector	6 way plug-in terminal block
Max. current	1.25 A
Max. voltage	24 VDC
Isolation	> 500 VDC

Temperature range

Operation	0–50 °C

Panel components

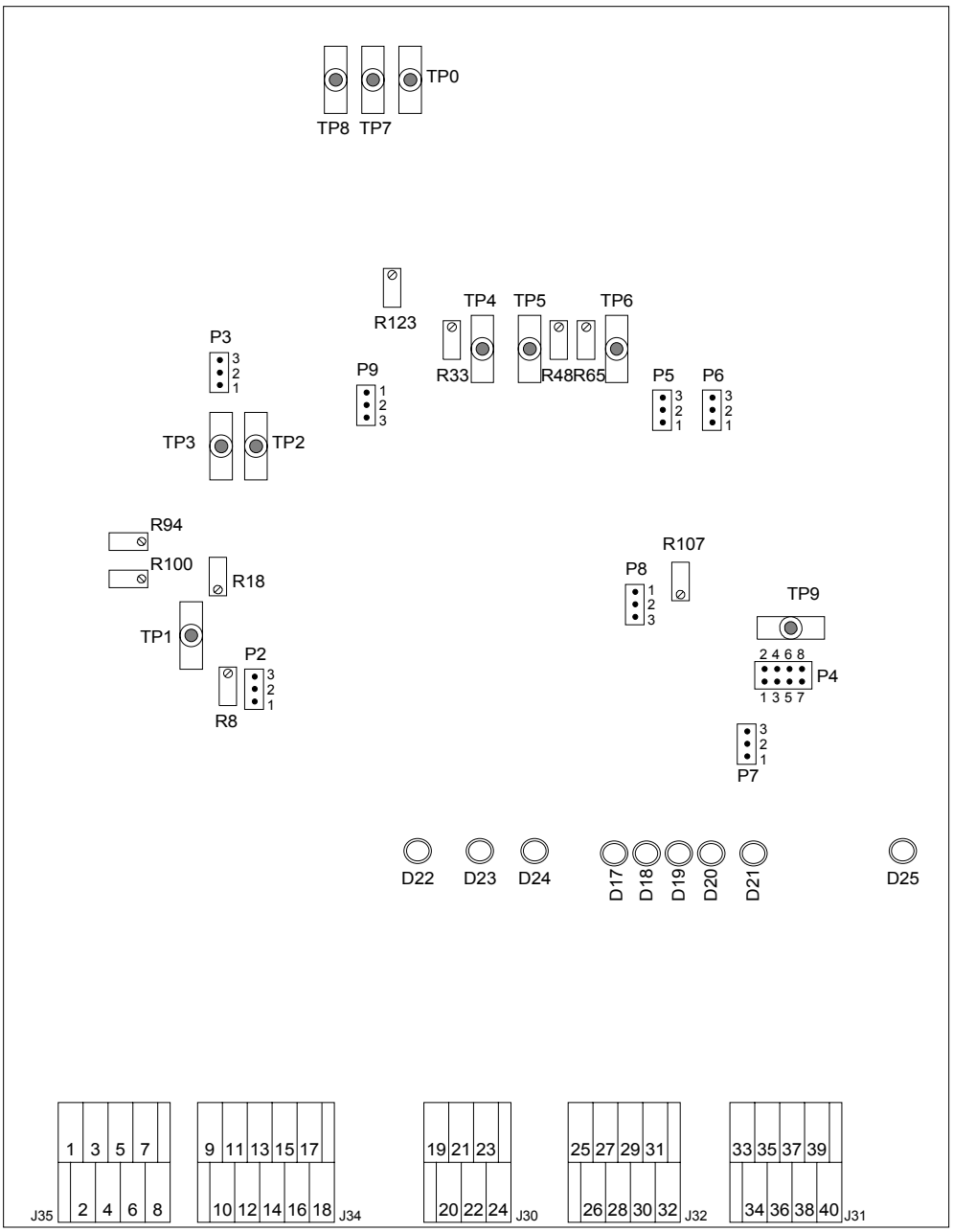
Potentiometer	10 kohm, 10 turns	6 343 668
Potentiometer dial	Brake, 100 mark./turn	6 343 670
Panel meter,	3½ digits, 13 mm LED	600 229
Ranges	0–±20 V, 4–20 mA	
Dimensions	H=48 mm, W=96 mm, D=130 mm,	
Sealed to	IP 50	
Supply voltage	19–29 VDC	

Tracer valve with displacement transducer, art. no. 5 184 909

Max. spool displacement	± 6 mm	
Max. stepping rate	100 steps/sec	
Displacement per step	0.00312 mm	
Sensory rod force	c:a 150 N	
Max. rated flow	49 l/min	
Pressure gain at 7 Mpa	c:a 0.05 Mpa/μm	
Adapter for hydraulic connections		4 066 293
Throttling insert	< 100 bar	6 316 239
Throttling insert	> 100 bar	6 320 037
Closing plug		6 300 726

Hydraulic supply demands

Min. supply pressure	1.5 Mpa (15 bar)
Max. supply pressure	30 Mpa (300 bar)
Min. control pressure at M	3.5 Mpa (35 bar)
Filtering	10 μm



Location of terminals, measuring and setting components on the circuit board.

Test connectors

TP0	Reference, 0 V
TP1	Valve pos. signal (inverted)
TP2	MAX. DISC GAP
TP3	Position signal, 'DISC GAP'
TP4	MIN.LIMIT DISC GAP
TP5	REAR ENDPOS. VALVE
TP6	FRONT ENDPOS. VALVE
TP7	+15 V
TP8	-15 V
TP9	Stepping frequency

Potentiometers

R8	GAIN. valve pos.
R18	MAX. DISC GAP
R33	MIN.LIMIT DISC GAP
R48	REAR ENDPOS. VALVE
R65	FRONT ENDPOS. VALVE
R94	20 mA, 'DISC GAP'
R100	4 mA, 'DISC GAP'
R107	STEPPING FREQ.
R123	ZERO ADJUSTM. DISC WEAR

LED-indicators

D17	MIN.LIMIT OFF
D18	OPERATION
D19	INC. DISC GAP
D20	DEC. DISC GAP
D21	STEP. MOTOR OFF
D22	MIN.LIMIT REACHED
D23	REAR ENDPOS. REACHED
D24	FRONT ENDPOS REACHED
D25	POWER SUPPLY

Jumper connectors

P2	Zero adj., disc gap
P3	Disc wear, 1 V/10 V
P4	Stepping frequency
P5	Front endpos. reached
P6	Rear endpos. reached
P7	Stepper motor off
P8	Min.limit off
P9	Disc gap, 1 V/10 V

Functions, electronic unit

The electronic unit for DGC-2 is a single board unit, containing the functions for controlling and supervising the refiner disc gap by the stepper motor controlled tracer valve from Nobel Weighing Systems.
Output signals from the unit indicates the disc gap width and the disc wear.
Potentiometers on the circuit board are used to set limits, activating alarm relays and preventing the tracer valve from moving outside a set working range.

Stepper motor operation

The position of the tracer valve, and the refiner disc, is controlled by a micrometer screw, operated manually or by the stepper motor. Power outputs from the electronic unit provides the currents for operating the stepper motor at constant speed or locking it in a selected position.
The stepper motor operation is controlled by external signals to opto-insulated control inputs and by signals from internal supervising circuits.

Outputs

The stepper motor is operated by current signals through the four motor windings. The motor is locked in a selected position by constant holding currents. As the INC. DISC GAP or DEC. DISC GAP input is activated, the motor is rotated at constant speed by current pulses. Circuit board settings influences the frequency of the pulses and thus the velocity for the disc gap change.

External inputs

STEP. MOTOR OFF (terminal 27)	As the input is active (24 V) the power to the stepper motor is disconnected to facilitate manual tracer valve operation. As the input is non-active (0 V) the stepper motor is locked by holding currents, or operated from the electronic unit, provided that OPERATION is active (24 V).
OPERATION (terminal 32)	As the input is active (24 V) the stepper motor can be operated by the INC. DISC GAP and DEC. DISC GAP inputs. As the input is non-active (0 V) operation is prevented.
INC. DISC GAP (terminal 29)	As the input is active (24 V) the stepper motor operates to increase the disc gap, provided that OPERATION is active (24 V), that STEP. MOTOR OFF is non-active (0 V) and that the internal limits does not prevent stepper motor operation.
DEC. DISC GAP (terminal 30)	As the input is active (24 V) the stepper motor operates to decrease the disc gap, provided that OPERATION is active (24 V), that STEP. MOTOR OFF is non-active (0 V) and that the internal limits does not prevent stepper motor operation.
MIN.LIMIT OFF (terminal 31)	As the input is active (24 V) the stepper motor can be operated to increase the disc gap below the MIN.LIMIT DISC GAP, set by potentiometer R33. As the input is non-active (0 V) the stepper motor is stopped at the limit set by R33. (Provided that the position of P8 is 1-2.)

Internal control signals

These signals are created in three comparators where internal measuring values are compared to levels, set by potentiometers.

As the measuring value for the disc gap reaches MIN.LIMIT DISC GAP, set by R33, a signal is given, stopping the stepper motor, provided the position of P8 is 1-2.
Then the stepper motor can only be operated to increase the disc gap.

As the internal position signal reaches REAR ENDPOS. VALVE, set by R48, a signal is given, stopping the stepper motor, provided the position of P6 is 1-2,
Then the stepper motor can only be operated towards the front end.

As the internal position signal reaches FRONT ENDPOS. VALVE, set by R65, a signal is given, stopping the stepper motor, provided the position of P5 is 1-2,
Then the stepper motor can only be operated towards the rear end.

Position measuring

Displacement transducer

The measuring is performed by a LVDT displacement transducer, attached to the tracer valve, recording the refiner disc position at normal operation.
The DGC-2 electronic unit produces the primary voltage for the transducer and converts the secondary voltages to an internal position signal. With potentiometer R8, GAIN, this position signal is calibrated to correspond to the micrometer scale.
See Adaptation, Position setting.

Measurement outputs

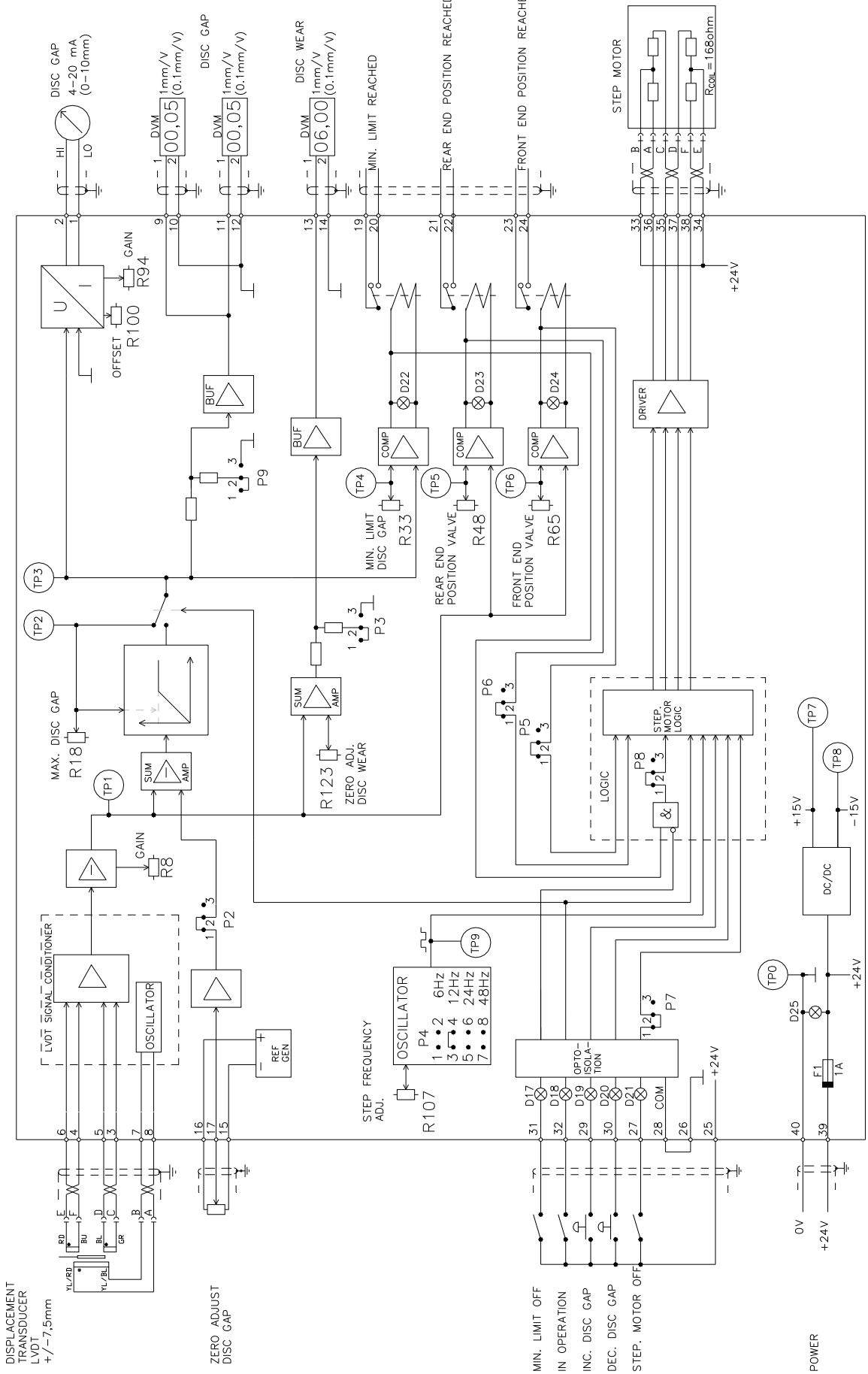
The internal position signal is used to produce the output signals below:

DISC GAP	One voltage output and one insulated, active current output. The outputs are continuously indicating the disc gap width, provided that OPERATION is active (24 V). The output signal is limited by potentiometer R18, MAX DISC GAP. As OPERATION is non-active (0 V) the output signal is a fixed value, set by the potentiometer R18, MAX DISC GAP. The output signal can be set to zero with an external potentiometer connected to terminals 15 - 17.
DISC WEAR	One voltage output that can be used to indicate the wear of the discs. This output signal is affected by the internal potentiometer R123, ZERO ADJ. DISC WEAR.

Relay outputs

Three relay outputs, controlled by the comparators for the internal control signals.

MIN.LIMIT REACHED	The relay is activated as the disc gap reaches the value set by potentiometer R33.
REAR END POSITION REACHED	The relay is activated as the internal position signal reaches the limit set by potentiometer R48.
FRONT END POSITION REACHED	The relay is activated as the internal position signal reaches the limit set by potentiometer R65.


DISC GAP
4–20 mA
(0–10mm)
HI
LO
DVM
00,05
1mm/V
(0.1mm/V)
DISC GAP
DISC WEAR
06,00
MIN. LIMIT REACHED
REAR END POSITION REACHED
FRONT END POSITION REACHED
STEP MOTOR
R_COIL=168ohm
+24V
GAIN
R94
OFFSET
R100
BUF
COMP
D22
D23
D24
DRIVER
TP4
TP5
TP6
MIN. LIMIT DISC GAP
R33
REAR END POSITION VALVE
R48
FRONT END POSITION VALVE
R65
P9
P3
P6
P5
P8
P7
P2
TP1
TP2
TP3
MAX. DISC GAP
R18
SUM
AMP
R123
ZERO ADJ. DISC WEAR
STEP. MOTOR LOGIC
LOGIC
&
TP7
TP8
+15V
–15V
DC/DC
TP0
D25
F1
1A
GAIN
R8
LVDT SIGNAL CONDITIONER
OSCILLATOR
REF. GEN
TP9
STEP FREQUENCY ADJ.
R107
P4
6Hz
12Hz
24Hz
48Hz
OPTO-ISOLATION
D17
D18
D19
D20
D21
COM
DISPLACEMENT TRANSDUCER LVDT +/–7,5mm
ZERO ADJUST DISC GAP
MIN. LIMIT OFF
IN OPERATION
INC. DISC GAP
DEC. DISC GAP
STEP. MOTOR OFF
POWER
0V
+24V

Functions, tracer valve

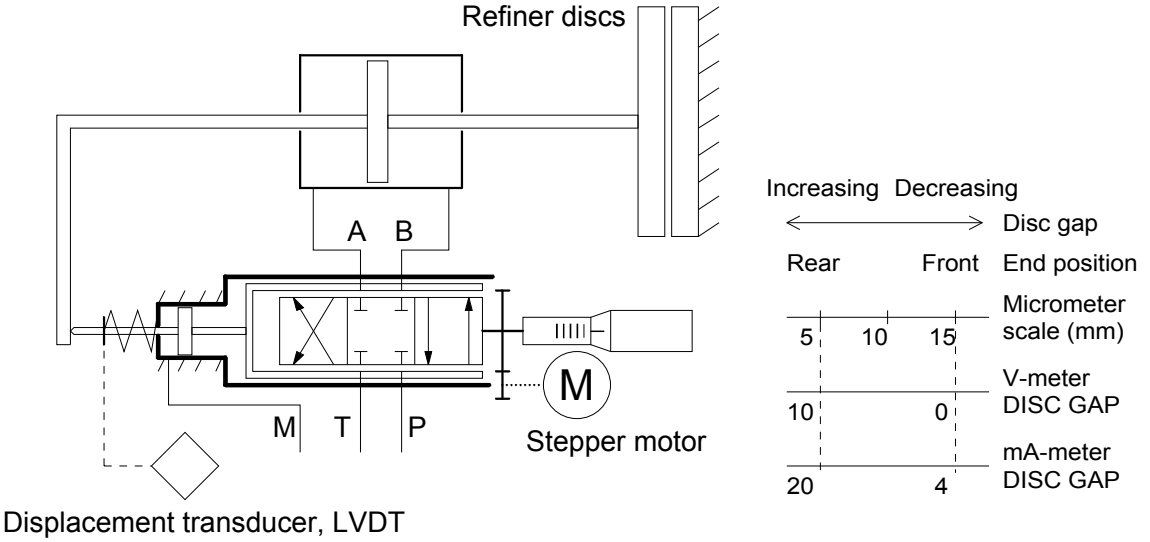
Working principle

The working principle and the function of the tracer valve and the controlled hydraulic cylinder is shown in the figure below.

The tracer valve features a spool, connected to a micrometer screw, and a movable bushing, spring loaded in one direction and connected to a sensory rod, constituting the mechanical feed-back from the controlled component.
The micrometer screw that controls the spool position can be operated manually or by means of a stepper motor. In both cases the position is indicated by the micrometer scale.

As the tracer valve spool and bushing are balanced (0-position) the spool covers the slots in the bushing, preventing an oil flow through the valve. As the spool is moved by the micrometer screw, slots are opened and an oil flow is obtained through P-A and B-T or through P-B and A-T, depending on the direction of spool movement. The oil flow displaces the piston in the controlled hydraulic cylinder, the piston displaces the sensory rod and the bushing in the same direction as the spool, and the slots are closed. As the bushing moves, the slot openings are gradually decreasing the oil flow, giving a soft retardation to a halt at the position of the spool.

The set position for the hydraulic piston is maintained, independent of variations in load on the piston. If the load is big enough to displace the piston, slots in the valve are opened by the sensory rod action and the hydraulic pressure will bring the piston back to the set position.



Tracer valve working principle.

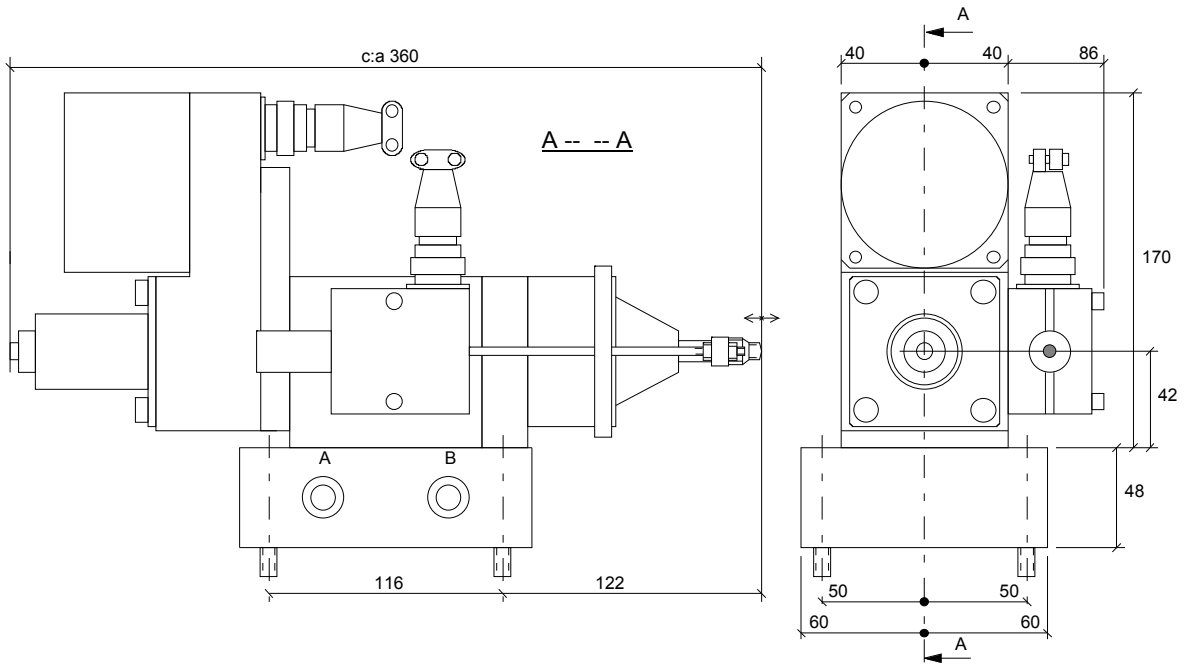
Security function

In addition to the operating functions, the tracer valve also has a security function,
rapidly opening the refiner disc gap as pressure is connected to inlet M.
The pressure applies an axial force on the bushing, overriding the spring load and bringing the bushing to a position where P-B and A-T are fully opened. This makes
the piston move to its rear end position, giving a maximum disc gap. (The mechanical feed-back to the tracer valve is opened). As the pressure at M is disconnected the tracer valve and the piston of the controlled hydraulic cylinder returns to the position set by the micrometer screw.

The control pressure for the security function must be at least 35 bar, but not over 100 bar. If the system pressure is higher a throttling insert can be mounted in the adapter, limiting the control pressure to 100 bar.

Adapter

The tracer valve is fixed on an adapter and all hydraulic connections are made to inlets at the adapter. From the inlets, marked A, B, P, T and M, bored holes in the adapter conduct the oil to the tracer valve.
In the adapter, an extra hole connects inlet M, controlling the security function, with inlet T, return flow to the hydraulic tank. Throttling inserts and plugs are used to utilise this hole in different ways.
For control pressures below 100 bar the hole is closed with a throttling insert in inlet M, article number is 6 316 239, possibly also a screw, mounted in the inlet T.
For control pressures above 100 bar a throttling insert with article number 6 320 037 is inserted in inlet M, and the screw in inlet T must be removed.
If the security function is not used, the adapter inlet M must be closed with a plug, article number 6 300 726, and the screw in inlet T must be removed.



Tracer valve and adapter dimensions.

Installation

Interference protection

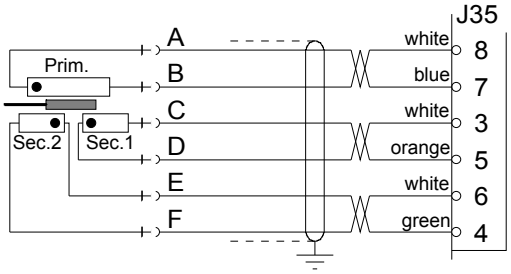
For electromagnetic interference protection, filters are included in the inputs and outputs of the electronic unit. To make the complete servo system meet the CE-requirements the electronic unit must be installed in a steel housing to avoid direct radiation from external high frequency interference sources. Screened cables must be used for all connections and the cable screens must be connected to earth, by preference at the earth rail on the mounting plate. At operation the housing should be closed.

Connection

All control system units are connected by screened cables to plug-in terminal blocks at the electronic unit. Marking and location for the blocks is shown at page 4 and in the following connection diagrams.

Displacement transducer

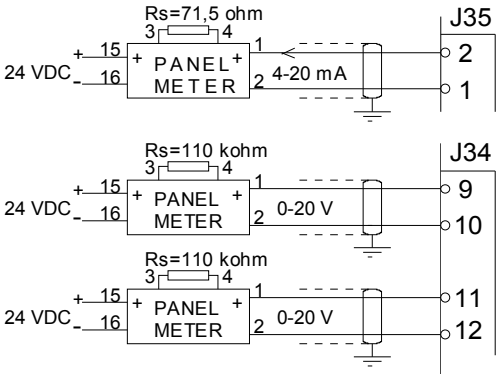
A cable from the displacement transducer 6-way connector is connected to the electronic unit as shown in the diagram.
Colour code and twisted pairs apply for the cable from Nobel Weighing Systems.
If the position measurement changes in the wrong direction, connections to terminals 7 and 8 should be changed.



Disc gap measuring

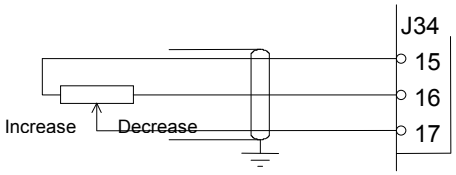
The disc gap width can be indicated on instruments, connected to current and voltage outputs as shown in these diagrams, valid for the panel meter from Nobel Weighing Systems.
The current output is opto-insulated, producing current.
The voltage output is available on two pairs of terminals in parallel.

Zeroing of the indication is performed with an external potentiometer. See below.



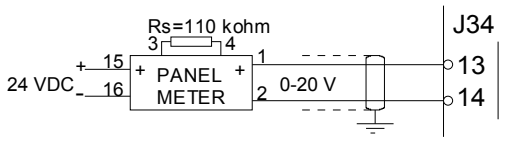
Disc gap zero adjustment

An external potentiometer for adjusting the disc gap indication to zero is connected as shown in this diagram.



Disc wear measuring

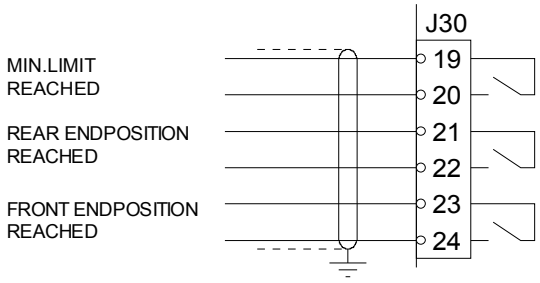
The disc wear can be indicated on an instrument, connected to a voltage output as shown in this diagram, valid for the panel meter from Nobel Weighing Systems.
Zeroing of the indication is performed with an internal potentiometer (R123).



Relay outputs

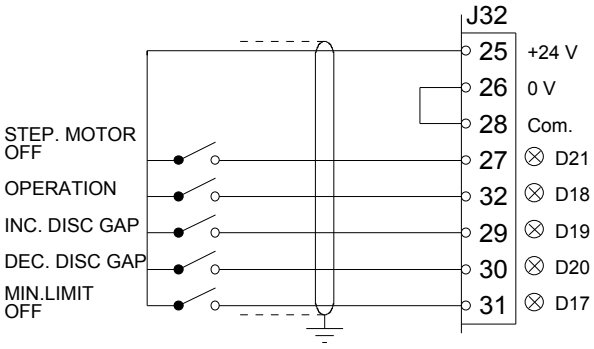
Three output relays are provided with contacts closing as the disc gap and the position signal respectively reaches their set limit values.

Connection of spark protection is recommended!



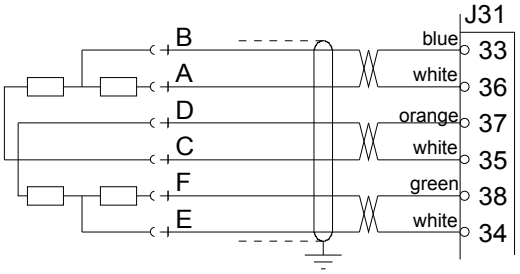
Digital inputs

Control functions for DGC-2 are activated by opto-insulated digital inputs as shown in this diagram.
Power can be taken from the electronic unit or from a suitable external source.



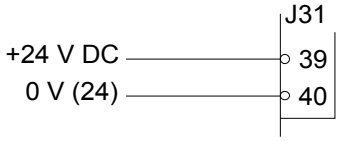
Stepper motor

A cable from the stepper motor 6-way connector is connected to the electronic unit as shown in the diagram.
Colour code and twisted pairs apply for the cable from Nobel Weighing Systems.
If the increase and decrease commands give the wrong direction to the motor, connections to terminals 35 and 36 should be changed.



Power supply

Supply voltage is connected to the terminals as shown in the diagram.



Adaptation

This section describes the procedure, adapting the DGC-2 electronic unit to the tracer valve and to the actual refiner operation.
It is assumed that the tracer valve is installed in the refiner and that the hydraulic system is in operation.

The section deals with setting of the displacement transducer range, measuring of voltages and currents at the outputs and selection of some internal control functions by jumpers.

Power supply

After the connections are completed in accordance with the previous section, the supply voltage may be switched on, indicated by the LED D25. The supply voltage can be measured at terminal 25 with TP0 as zero voltage reference. Also check the voltages at TP7 (+15 VDC ± 0.15 V) and TP8 (-15 VDC ± 0.15 V).

Position range setting

The tracer valve working range is from 4 mm (rear end position) to 16 mm (front end position) at the micrometer scale. The displacement transducer should be set to the same working range and the electronic unit calibrated to give correct reading in mm on the 'DISC GAP' instrument. Initially the tracer valve position is set manually with the micrometer screw.

Activate (24 V) inputs 'STEP. MOTOR OFF' and 'OPERATION' so that the stepper motor can be hand operated and the position signal measured by a 'DISC GAP' voltmeter at terminals 9/10 or 11/12. Set jumper P9 to 1-2 for a 10 V 'DISC GAP' instrument, jumper P9 to 2-3 for a 1 V instrument.

1. Read and make a note of the voltage at TP2, then adjust it to over 10 V with potentiometer R18.
2. Disconnect the zero adjustment potentiometer by jumper P2 at 2-3.
3. Adjust the micrometer to the centre of the range, 10 mm.
4. Read the 'DISC GAP' instrument (terminal 9/10 or 11/12). Unfasten the locking screw for the transducer core position and move the core until the 'DISC GAP' instrument indicates 0 (mm). Fasten the locking screw.
5. Adjust the micrometer to a wider disc gap, (by decreasing the mm-reading at the scale), and check that the 'DISC GAP' instrument indicates positive values. (If 'DISC GAP' goes negative, the connections at terminals 7 and 8 must be shifted.)
6. Set the micrometer to 4 mm, i.e. a change by 6 mm.
7. Read the 'DISC GAP' instrument and adjust the gain with potentiometer R8 to make the instrument indicate 6 (mm).
8. Return the micrometer to 10 mm.
9. Connect the zero adjustment potentiometer by P2 at 1-2. Check that the 'DISC GAP' instrument is affected by the external potentiometer 'ZERO ADJUST DISC GAP', connected to terminals 15 - 17.
10. Return the voltage at TP2 to the noted value with potentiometer R18.

Current output ‘DISC GAP’

A calibration should be performed to make a disc gap change of 10 mm, giving ‘DISC GAP’ voltage output change of 0-1 V or 0-10 V, correspond to a ‘DISC GAP’ current output change of 4-20 mA.

Activate (24 V) the inputs ‘STEP. MOTOR OFF’ and ‘OPERATION’ so that the stepper motor can be hand operated and the position signal measured as voltage and current at the ‘DISC GAP’ outputs. Set jumper P2 to 1-2 (zero adjust active).

1. Read and make a note of the voltage at TP2, then adjust it to over 10 V with potentiometer R18.
2. ‘Position 0 mm’ Set the micrometer scale to 15 mm, then adjust the external potentiometer ‘ZERO ADJUST DISC GAP’ to make a ‘DISC GAP’ voltage instrument indicate 0 mm.
3. ‘Position 10 mm’ Set the micrometer scale to 5 mm. The ‘DISC GAP’ voltage instrument should now indicate 10 mm, or the calibration with R8 in the previous section must be repeated.
4. When in ‘Position 10 mm’, set the current output at terminals 1/2 to 20 mA, using the internal potentiometer R94.
5. Adjust the micrometer back to ‘Position 0 mm’ and set the current output to 4 mA using the internal potentiometer R100.
6. Adjust the micrometer to ‘Position 10 mm’ again, or adjust ‘ZERO ADJUST DISC GAP’ to make the ‘DISC GAP’ voltage instrument indicate 10 mm. Then adjust the current output to 20 mA with potentiometer R94.
7. Adjust the micrometer back to ‘Position 0 mm’ or adjust ‘ZERO ADJUST DISC GAP’ to make the ‘DISC GAP’ voltage instrument indicate 0 mm and adjust the current output to 4 mA with potentiometer R100.
   Repeat 6. and 7. until the current output is 4 mA and 20 mA in ‘Position 0 mm’ and ‘Position 10 mm’ respectively.
8. Return the voltage at TP2 to the noted value with potentiometer R18.

‘MAX. DISC GAP’ setting

As ‘OPERATION’ is active (24 V) the output signals ‘DISC GAP’ are indicated and a maximum limit for the output signals can be set with the internal potentiometer R18, ‘MAX DISC GAP’.
As ‘OPERATION’ is non-active (0 V) the ‘DISC GAP’ instruments indicate the limit value for ‘DISC GAP’, set by ‘MAX DISC GAP).

1. Make the input signal ‘OPERATION’ non-active (0 V).
2. Read the ‘DISC GAP’ output signal and adjust it with the potentiometer R18 ‘MAX DISC GAP’, for example to 10 mm (10 V(1 V)/20 mA).

Output signal DISC WEAR

This output signal is made up from the displacement transducer signal and a zero off-set signal from potentiometer R123. ‘ZERO ADJ. DISC WEAR’.
It is always indicated on the ‘DISC WEAR’ instrument, connected to terminals 13/14.
If the ‘DISC WEAR’ instrument is a 10 V voltmeter, set jumper P3 to 1-2.
If the ‘DISC WEAR’ instrument is a 1 V voltmeter, set jumper P3 to 2-3.

Setting limits for the tracer valve working range

In two comparators the internal position signal (TP1) is compared with adjustable voltages from two internal potentiometers, R48 and R65. As the position signal reaches a limit, an internal command signal is given and an output relay with LED-indication is activated.

REAR END POSITION

The position is a limit for backwards operation, i.e. for increasing disc gap.

1. Set the tracer valve to the desired rear end position, manually or by stepper motor.
2. Adjust potentiometer R48 until LED D23 and output relay 'REAR END POSITION REACHED' are activated.

With 'REAR END POSITION REACHED' activated and jumper P6 at 1-2, operation for increasing disc gap is prevented, but operation for decreasing disc gap is still possible.
With jumper P6 at 2-3 the stepper motor operation is not affected.

FRONT END POSITION

The position is a limit for forwards operation, i.e. for decreasing disc gap.

1. Set the tracer valve to the desired front end position, manually or by stepper motor.
2. Adjust potentiometer R65 until LED D24 and output relay 'FRONT END POSITION REACHED' are activated.

With 'FRONT END POSITION REACHED' activated and jumper P5 at 1-2, operation for decreasing disc gap is prevented, but operation for increasing disc gap is still possible.
With jumper P5 at 2-3 the stepper motor operation is not affected.

Setting of min. limit for the disc gap

In a comparator the disc gap width signal (TP3) is compared with the adjustable voltage from the internal potentiometer R33. As the disc gap signal reaches the set potentiometer voltage, an internal command signal is given and an output relay with LED-indication is activated.

MIN. LIMIT DISC GAP

1. Adjust the external potentiometer 'ZERO ADJUST DISC GAP' until the 'DISC GAP' instruments indicate the desired value for 'MIN. DISC GAP'.
2. Adjust potentiometer R33 until LED D22 and output relay 'MIN. LIMIT REACHED' are activated.

With 'MIN. LIMIT REACHED' activated and jumper P8 at 1-2, stepper motor operation is prevented, provided that 'MIN. LIMIT OFF' is non-active (0 V).
If 'MIN. LIMIT OFF' is active (24 V), the stepper motor operation is not affected by the activation of the relay 'MIN. LIMIT REACHED'.
With jumper P8 at 2-3 the stepper motor operation is affected neither by 'MIN. LIMIT REACHED' nor by the digital input 'MIN. LIMIT OFF'.

Step frequency

When activated, the stepper motor is operating at a constant step frequency that can be set to four values by the jumper P4:

P4:1-2	Frequency,	6 Hz	Disc gap change,	0.019 mm/s
P4:3-4		12 Hz		0.038 mm/s
P4:5-6		24 Hz		0.075 mm/s
P4:7-8		48 Hz		0.15 mm/s

In addition, fine adjustment of the frequency can be performed with an internal potentiometer, R107 ‘STEP FREQUENCY ADJ.
The set frequency can be measured at TP9.

Jumpers for the control functions

Jumper positions control the influence on the stepper motor operation from external input signals (at the digital inputs) and internal control signals.

FRONT END POSITION REACHED:

With jumper P5 at 1-2 operation to decrease the disc gap is stopped by an internal control signal as ‘FRONT END POSITION REACHED’ is activated. However the stepper motor can still be operated by the input signal ‘INC. DISC GAP’ to increase the disc gap.

With jumper P5 at 2-3 the control signal does not influence the operation.

REAR END POSITION REACHED:

With jumper P6 at 1-2 operation to increase the disc gap is stopped by an internal control signal as ‘REAR END POSITION REACHED’ is activated. However the stepper motor can still be operated by the input signal ‘DEC. DISC GAP’ to decrease the disc gap.

With jumper P6 at 2-3 the control signal does not influence the operation.

STEP. MOTOR OFF:

With jumper P7 at 1-2 the stepper motor operation is influenced by input ‘STEP. MOTOR OFF’.
As the input is active (24 V) the stepper motor can only be operated manually, as the input is non-active (0 V) the stepper motor is operated by the electronic unit.

MIN. LIMIT OFF:

With jumper P8 at 1-2, and input ‘MIN. LIMIT OFF’ non-active (0 V), operation to decrease the disc gap is stopped by an internal control signal as ‘MIN. LIMIT REACHED’ is activated. However the stepper motor can still be operated to increase the disc gap.
As input ‘MIN. LIMIT OFF’ is active (24 V), operation to decrease the disc gap is possible.

With jumper P8 at 2-3 the stepper motor operation is affected neither by control signal from ‘MIN. LIMIT REACHED’ nor by input ‘MIN. LIMIT OFF’.

Operating instructions

Calibration

Calibration is used to make the readings on the 'DISC GAP' instruments correspond to the mm-scale at the micrometer screw.

1. Read and make a note of the voltage at TP2, then adjust it to over 10 V with potentiometer R18.
2. Make input 'OPERATION' active (24 V) so that the disc gap width is indicated by the 'DISC GAP' instruments.
3. Set the disc gap to a small value.
4. Use potentiometer 'ZERO ADJUST DISC GAP' to set the reading of the 'DISC GAP' voltage instruments (terminals 9/10 or 11/12) to zero.
5. Make a note of the micrometer scale indication, then increase the disc gap by a certain distance.
6. Adjust potentiometer R8 to get a reading of the same distance at the voltage instruments.
7. Use potentiometer 'ZERO ADJUST DISC GAP' to set the reading of the 'DISC GAP' voltage instruments (terminals 9/10 or 11/12) to 10 mm.
8. Set the current output to 20 mA (10 mm) with potentiometer R94.
9. Use potentiometer 'ZERO ADJUST DISC GAP' to change the reading of the 'DISC GAP' voltage instruments (terminals 9/10 or 11/12) to 0 mm.
10. Set the current output to 4 mA (0 mm) with potentiometer R100.
11. Go through the points 6. to 9. again, until 0-10 mm corresponds to 4-20 mA.
12. Return the voltage at TP2 to the noted value with potentiometer R18.
13. Perform 'Zeroing, disc gap' according to instructions below.

Zeroing, disc gap

Zeroing of the disc gap reading is performed as a mechanical zeroing of the disc gap, followed by an adjustment to zero for the 'DISC GAP' instruments.

1. Make 'MIN. LIMIT OFF' active (24 V) or set jumper P8 at 2-3.
2. Operate the micrometer, manually or by stepper motor, to make the disc gap 'zero'.
3. Use the external potentiometer 'ZERO ADJUST DISC GAP' to get a corresponding reading at the 'DISC GAP' instruments.

Disc wear measuring

Set the 'DISC WEAR' instrument to zero for new refiner discs:

1. Operate the tracer valve to get the refiner discs 'in contact'.
2. Use potentiometer R123 to set the 'DISC WEAR' reading to 0 mm.

Later the disc wear can be measured:

3. Operate the tracer valve to get the refiner discs 'in contact' again.
4. Read the value on the 'DISC WEAR' instrument.

Potentiometer settings

The potentiometer settings at delivery are shown in the table below.
Notations of Your settings after start-up might be useful.

Function and potentiometer:		Measure at:	At delivery:	After start-up:
MAX. DISC GAP	R18	TP2	10 V	.....
MIN. LIMIT DISC GAP	R33	TP4	0.2 V	.....
REAR END POSITION VALVE	R48	TP5	–5.5 V	.....
FRONT END POSITION VALVE	R65	TP6	–5.5 V	.....
STEP FREQUENCY	P4 (R107)	TP9	12 Hz (P4:3-4)	.....

Jumper settings

The jumper settings at delivery are shown in the table below.
Notations of Your settings after start-up might be useful.

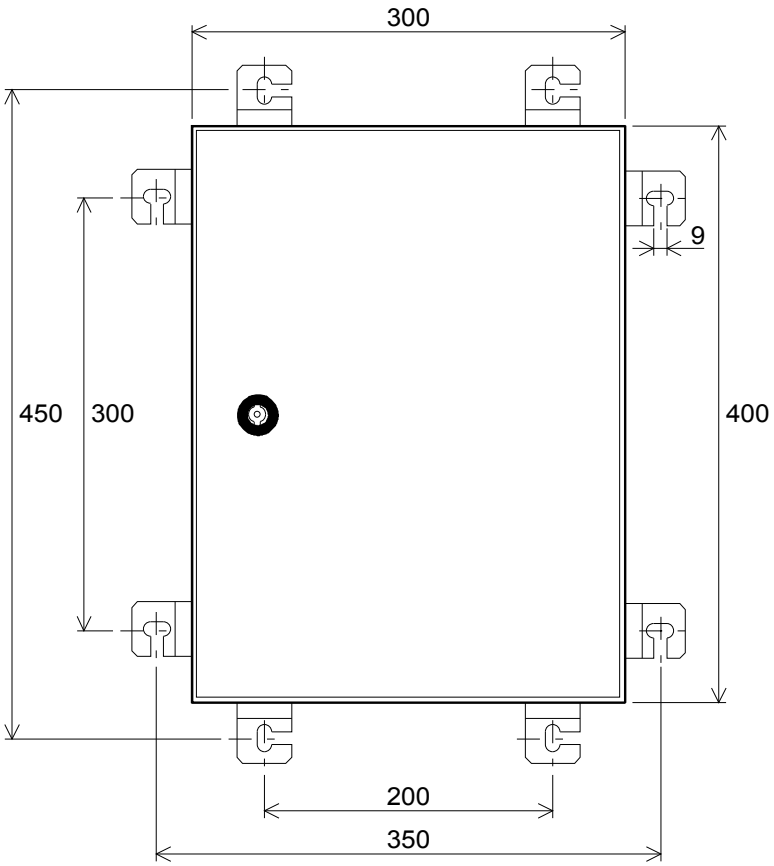
Jumper:	at:	Function:		At delivery:	After start-up:
P2	1-2	Zero adj. disc gap	ON	1-2	
	2-3	-"-	OFF		.....
P3	1-2	'DISC WEAR'	0-10 V	1-2	
	2-3	'DISC WEAR'	0-1 V		.....
P4	1-2	Step frequency	6 Hz		
	3-4	-"-	12 Hz	3-4	
	5-6	-"-	24 Hz		
	7-8	-"-	48 Hz		.....
P5	1-2	Stop at front end pos.		1-2	
	2-3	Not stop at front end pos.			.....
P6	1-2	Stop at rear end pos.		1-2	
	2-3	Not stop at rear end pos.			.....
P7	1-2	'Step. motor off' enable		1-2	
	2-3	'Step motor off' disable			.....
P8	1-2	Stop at 'Min.limit' enable		1-2	
	2-3	Stop at 'Min.limit' disable			.....
P9	1-2	'Disc gap'	0-10 V	1-2	
	2-3	'Disc gap'	0-1 V		.....

Appendix 1
Potentiometer settings
and jumper settings.

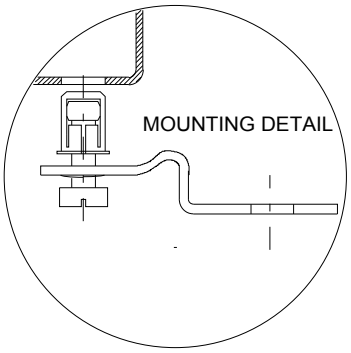
Protective housing

The DGC-2 electronic unit is intended for installation in an electronic cabinet or a similar location, protected from electromagnetic interference. In case no protected location is available, a protective steel housing can be ordered separately from Nobel Weighing Systems. The housing is dust and moisture proof and, when screened
cables are used, it gives a good electromagnetic protection.

Mechanical dimensions



Deep: 150 mm



Appendix 2
Protective housing.

Declaration of Conformity

We Nobel Elektronik AB
Box 423, S-691 27 KARLSKOGA
SWEDEN

declare under our sole responsibility that the product

DGC-2
Disc Gap Control system

to which this declaration relates is in conformity with the following standards or other normative documents

EMC:

SS-EN 55011 (1991)	/ SS EN 50081-2 (1993):	Class A, Group 1
SS-ENV 50140 (1993)	/ SS-EN 50082-2 (1995):	10 V/m
SS-EN 61000-4-2 (1995)	/ SS-EN 50082-2 (1995):	4 kV Contact discharge 8 kV Air discharge
SS-EN 61 000-4-4 (1995)	/ SS-EN 50082-2 (1995):	2 kV DC Mains 2 kV Control 2 kV Signal

The product to which this declaration relates is in conformity with the essential requirements in the
EMC Directive 89/336/EEC with amend. 92/31/EEC and 93/68/EEC

KARLSKOGA November 10, 1996

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Bengt-Åke Sjögren, Managing Director

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