Oil Burner Safety Control DKO 974-N/ 976-N

For 1- or 2-stage oil burners up to 30 kg/h throughput and intermittent operations
with or without oil preheating
Flame detection:
- Photoresistor MZ 770 S
- Infrared-flicker detector IRD 1010.1

INTRODUCTION

The DKO 974-N/976-N oil burner safety control boxes are suitable for oil burners with or without preheater with throughputs up to 30 kg/h. They will be approved and certified according to the applicable European standards and regulations.
The microprocessor-based programming sequence ensures extremely stable timings independent of voltage variations, ambient temperature and/or switch-on cycles. The built-in information system not only provides a continuous monitoring of the actual state of the box (very helpful especially for monitoring the start-up phase) but also informs about the cause of a possible lock out. The lock out cause is stored in such a way that it can be retrieved even after a power failure.
The control box is designed for maximum safety in case of fluctuations in the voltage supply. If the mains voltage drops below the permitted level, operation is interrupted and the control box automatically prevents the start sequence from being repeated. In this way, the safety of the system is not put at risk by a drop in the mains voltage. This low-voltage protection works not only during start-up but also permanently during operation.

TYPES AVAILABLE

DKO 974-N	1-stage operation with override contact
DKO 976-N	2-stage operation with override contact

CONSTRUCTIONAL FEATURES

The control box circuitry is protected by a flame resistant, transparent plug-in type plastic housing. A central fixing screw locks the control box to the wiring base. The plug-in control box incorporates the microprocessor based timer, flame check and reset circuits. Manual reset from lock out and set to lock out is provided by a push button with an integrated lock out signal lamp. The wiring base S98 is equipped with spare- and extra terminals and allows together with a variety of cable entry points utmost flexibility of electrical wiring.
The DKO 974-N is compatible with the TF 834, TF 834.2. The DKO 976-N is in addition compatible with the TF 804, TF 804.2, TF 836, TF 836.2.

Using the DKO 976-N as a replacement for the TF 804 or TF 804.2, the flame sensor FZ 711 S must be replaced by its plug compatible type MZ 770 S. On flame supervision by a photo-cell, type MZ 770 S has to be connected to terminals 1 and 2. Older IR-Sensors of the types IRD 910 and IRD 911 is not possible.
Dxx-N is the EN298:2012 replacement of the Dxx.



TECHNICAL DATA

Operating voltage	220 / 240 V (-15... +10%) 50-60 Hz (±5%)
Fuse rating	10 A fast, 6 A slow
Power consumption	ca. 12 VA
Max. load per output	
- term. 3 ignition trafo	1.0 A, cos φ 0.2
- term. 4 motor	2.0 A, cos φ 0.4
- term. 5 + B solenoid valves	0.5 A, cos φ 0.4
- term. 6 oil preheater	2.0 A, cos φ 1.0
- term. 7 alarm indicator	0.5 A, cos φ 0.4
total load	4.0 A, cos φ 0.4 max. 16 A during 0.5 sec
Reset time from lock out	none

Re-cycling / repetition (max. 4x) after a loss-of-flame during operation

Flame detectors MZ 770 S	< 2 m length of cable side-on and end-on viewing
Light sensitivity IRD 1010.1	better 6 Lux side-on or end-on viewing
Weight incl. Wiring base	190 g
Mounting position	any
Protection class	IP40
Approved ambient parameter for control and flame detector	max. 95% bei 30 ° C
- for operation	-5° C... +60 ° C
- for storage	-20° C... +80 ° C
Build-up of ice, penetration of water and condensing water are	inadmissible
Approvals according to European standards	EN 298:2012 Conformity to: - EMC 2014/30/EU - LVD 2014/35/EU

Table of timings (sec.)

Model	max. warm-up time oil preheater ta	Pre-purge and pre-ignition time tv1	Stray light monitoring tf	safety time ts	Post-ignition time after V1 tn	delay time to V2 DKO 976-N only tv2
05	400	15	5	5	7	20
24	400	15	5	10	20	

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APPLICATION FEATURES

1. Information system

The information system is microprocessor based and reports on all aspects of burner control box operation and flame supervision. It informs continuously about the actual programming sequence the unit is just performing. Besides monitoring of the programming sequence it also allows to identify errors during start-up of operation without any additional testing devices. The automatically performed diagnoses is a valuable tool which facilitates service/ maintenance work and therefore saves costs. The analyses of the error cause can be done directly on stage or if not possible afterwards as the lockout reason is stored in a non-volatile lock out mode memory.
The information system communicates with the outside world using a LED (the used Flash-Code is similar to the Morse-Code). The messages are optically transmitted by flashing appropriately a LED. Using an (optional) additional terminal the messages can be recorded and displayed in easy readable form.

1.1 Programming sequence display

The built-in microprocessor controls not only the programming sequence but the information system too. The individual phases of the programming sequence are displayed as Flash-Code.
The following messages can be distinguished:

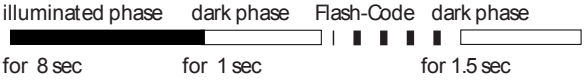
Message	Flash-Code
wait for preheater thermostat ON	▮ ▮
start	▮ ▮ ▮
burner in operation (from end of safety time)	▮
stop	▮ ▮ ▬ ▬
low mains voltage	▮ ▬ ▬ _

Description
▮ = short pulse
▬ = long pulse

1.2 Lock-out diagnoses

In case of a failure the LED is permanently illuminated. Every 10 seconds the illumination is interrup-ted by a flash code, which indicates the cause of the error. Therefore the following sequence is performed which is repeated as long as the unit is not reset.

Sequence:



Blinking codes: see appendix A

2. Flame control

The following detectors can be used for flame supervision:
– for yellow oil flame: photoresistor MZ 770 S
– for blue or yellow flame: infrared-flicker detector type IRD 1010.1

Generally, the no flame signal is generated at light levels below 3 Lux with respect to the operating cycle of the control. According to norm stray light safety level has to be established in conjunction with the accompanying burner. Connecting the IRD 1010.1, the correct wiring has to be observed.

2.1 Stray light monitoring

The stray light check is performed at the end of the pre-purge time for the duration as mentioned in the table of timimgs.

3. Burner control

With oil preheater
The fuel heater of the burner has to have a temperature control switch. The closing contact-switch of the heater has to be connected between terminals 4 and 6. A special contact in the control unit connects the thermo-switch of the heater as soon as the burner is operating and a photocurrent is generated. Therefore an interruption of the burner operation due to a decrease in oil temperature is prevented (e.g. in case of high oil f ow).
According to norm , the short circuiting of the thermoswitch is allowed only for an oil f ow of max. 10 kg/h oil. Burners with a higher throughput have to shut down if the oil temperature gets below the allowed minimum. In such a case the thermo-switch has to be put in the phase-circuit and terminals 4 and 6 have to be connected with a link.
The contact of the release thermostat of the oil preheater is monitored. If the contact does not close within the predef ned time (400 sec), the programmer goes into lock out mode.
Therefore excessive oil temperatures in the preheater over long periods can be prevented avoiding cracking of the oil and subsequent blocking of the preheater or nozzle.

Without oil preheater
In such a case the terminals 4 and 6 have to be connected with a link.



Attention
The switch of the release thermostat for the oil preheater must never be linked between 4 and 6 or 6 and 9!
During lockout, the preheater will not be separeted from power. This could lead to a defective pre-heater due to burn out its heating winding.

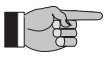
4. Lock out and reset

The unit can be reset or brought into lock out mode in two dif erent ways:

Internal
In the lockout case the unit can be reset by pushing the built-in button meaning a new start-up cycle is performed.

External
Instead of using the built-in lock out button the same function can be achieved by using an external button which connects terminal 9 with A (see also circuit and block diagram).

If the pushputton (internal or external) is pressed during normal operation or during the start sequence for more then 100ms and afterwards released, the control box will perform a shutdown.



Please note
The unit can only be brought to lockout mode or be reseted if power is applied to the unit.

5. Safety

The design and control sequence of the DKO 974-N/976-N controls will comply with the currently applicable standards and regulations (see also TECHNICAL DATA).

6. Mounting and electrical wiring

Wiring base:
– 3 earth terminals with additional terminal for burner earthing
– 3 neutral terminals with internal permanent connection to neutral terminal 8
– 2 independant spare terminals (S1 and S2)
– extra terminals A, B and C are standard (wiring base S98 12-pin)
– 2 slide-in plates and 2 easy knock out holes plus 2 knock out holes in the base bottom faciliate the base wiring



Please note
To assist trouble-free operation the main neutral connection terminal 8 in the wiring base must be fully tightened. The terminal screws are already in the undone position. To connect a wire to the terminal, the screw only needs to be fastened.

General: The control box and detector probes should not be subjected to excessive vibration.

INSTALLATION INSTRUCTIONS AND MAINTENANCE

1. Important notes

- The controls must be installed by qualif ed personnel only. The relevant national regulations have to be observed.
- On commissioning the wiring has to be carefully check-ed according the appropriate diagram, Incorrect wiring can damage the unit and endanger the installation.
- The fuse rating has to ensure that the limits specif ed in TECHNICAL DATA will not be exceeded. If these precautions are not observed, the ef ect of a short circuit can cause severe damage to the control and installation.
- For safety reasons a minimum of one control shut down per 24 hours has to be observed.
- Disconnect the mains before the control box is plugged in or out.
- The control box is a safety device and must not be opened!

2. Function control

For safety reasons the f ame detection system should be tested on commissioning the installation as well as after a service or longer shut-down.

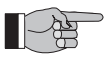
a) Start-up with covered f ame detector
   – After lock out safety time is over the unit has to go into lock out mode!

b) Start-up with exposed f ame detector
   – After prepurge time the unit has to go into lock out mode!

c) Normal start-up with burner in the normal position, cover up the f ame detector
   – After start-up, and end of lock out safety time the unit has to go into lock out mode!

3. Fault f nding

The built-in information system facilitates the troubleshooting in the case of problems occurring during start-up or during operation.
A list of possible lock out messages can be found in APPLICATION FEATURES chapter 1.2.

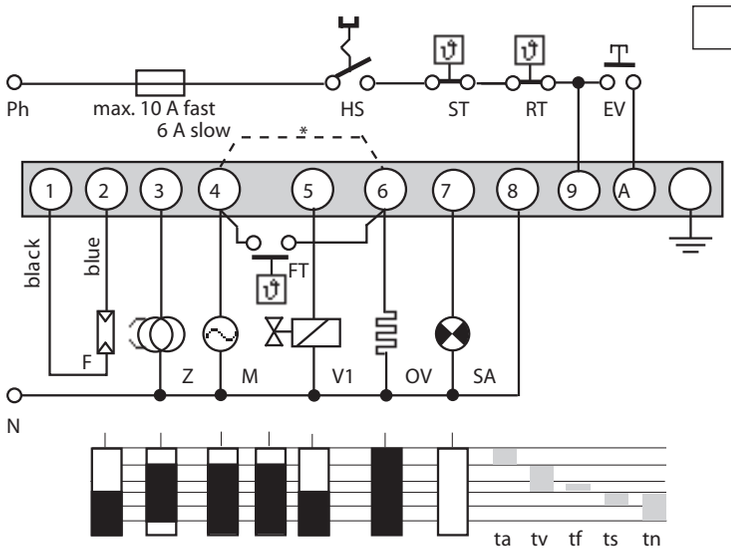


Please note:
The control box is locked in lock out mode and the reasen for the lock out is displayed until the control box is reset, either by en internal or external reset (see also subject “4. Lock out and reset").
Removing the control box from its wiring base or by interrupting the supply line may not reset a lock out (according to norm).

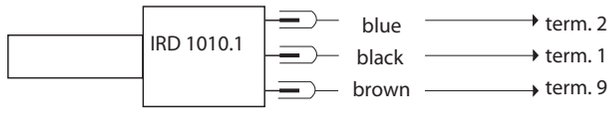
Error	Possible fault
Burner not working	- Thermostat circuit open - Faulty electrical wiring - Mains voltage < 187 V - Terminal A continuously on power (e.g. terminal A is used as a support terminal)
Burner starts, f ame not established, lock out	- Stray light on f ame detector - No ignition or no fuel
Burner starts, f ame established, after safety time, lock out	- Dirty or faulty f ame detector - Insuf cient light on detector - Sensitivity adjustment too low on IRD

DKO 974-N/ 976-N

CIRCUIT AND TIMING DIAGRAM DKO 974-N

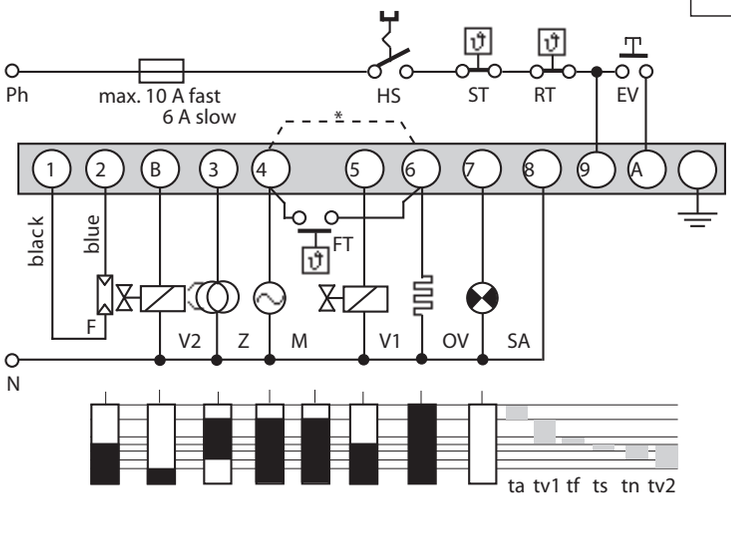


IRD-CONNECTION

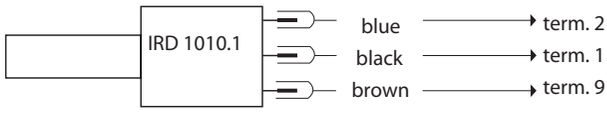


HS	Mains switch
ST	Limit thermostat
RT	Control thermostat
EV	External reset and lock out button
F	Flame detector MZ 770 S (IRD 1010.1 see ssparate diagram)
Z	Ignition
M	Burner motor
FT	Release thermostat oil preheater
*	For burners without fuel heaters term. 4 and 6 have to be connected with a link
V1	Oil solenoid valve
OV	Oil preheater
SA	External lock out signal
ta	Pre-heat-time oil preheater
tv	Pre-purge and pre-ignition time
tf	stray light monitoring
ts	Lock out safety time
tn	Post-ignition time

CIRCUIT AND TIMING DIAGRAM DKO 976-N



IRD-CONNECTION



HS	Mains switch
ST	Limit thermostat
RT	Control thermostat
EV	External reset and lock out button
F	Flame detector MZ 770 S (IRD 1010.1 see separate diagram)
Z	Ignition
M	Burner motor
V1, V2	Solenoid valves
OV	Oil preheater
FT	Release thermostat oil preheater
*	With burners without fuel heaters term. 4 and 6 have to be connected with a link
SA	External lock out signal
ta	Pre-heat-time oil preheater
tv1	Pre-purge and pre-ignition time
tf	stray light monitoring
ts	Lock out safety time
tn	Post-ignition time
tv2	Delay time to oil V2

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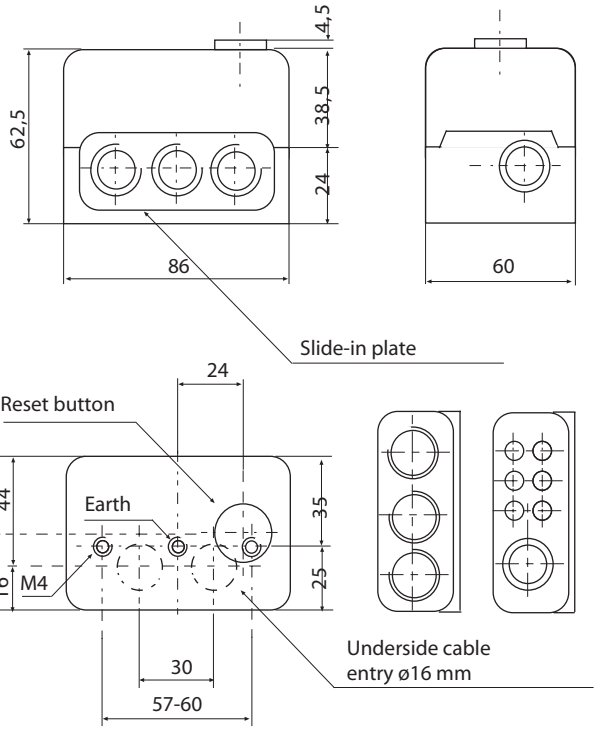
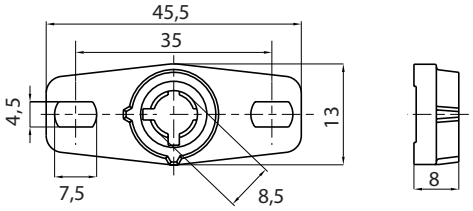
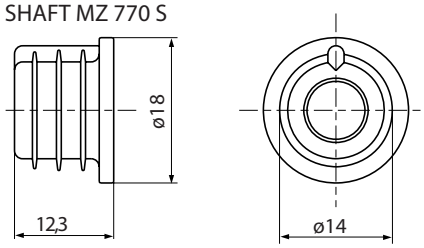
DKO 974-N/976-N AND SOCKET



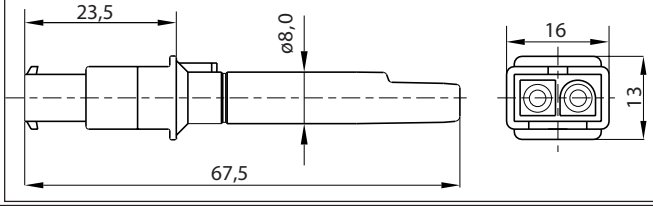
HOLDER FOR MZ 770 S



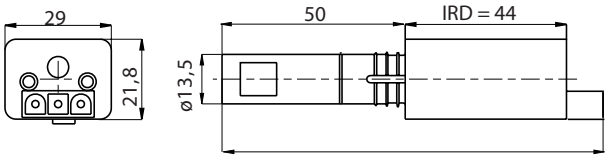
SHAFT MZ 770 S



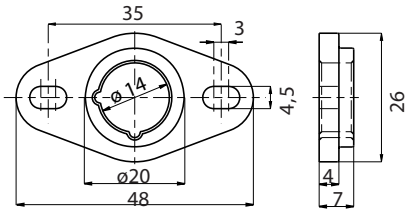
PHOTORESISTOR MZ 770 S



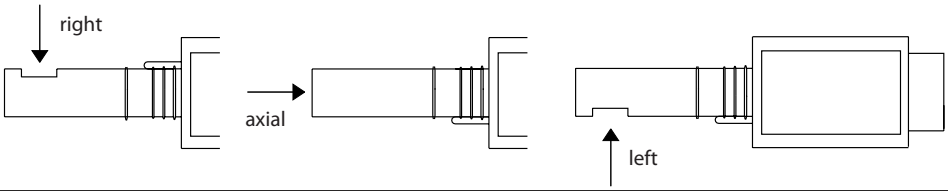
IRD 1010.1



HOLDER M74 FOR IRD



VARIATION IRD



ORDERING INFORMATION

ITEM	DESIGNATION	ITEM NO.
Control box	DKO 974-N Mod. 05	0414005
or	DKO 974-N Mod. 24	0414024
or	DKO 976-N Mod. 05	0416005
Socket	Wiring base S98 12-pin	75310
Insert plate	PG-Plate	70502
optional	Cable entry plate	70503
Flame detector	MZ 770 S	50001
optional	MZ 770 S with shaft	51001
optional	IRD 1010.1 right	16501
	IRD 1010.1 end-on	16502
	IRD 1010.1 left	16503
Support for flame detector	Holder for MZ 770 S	59101
optional	Holder M 74 for IRD	59074
Connection cable	Plug type, 3 core cable, 0.6 m with tag wire ends	7236001
Connection cable	Plug type, 2 core cable, 0.5 m with tag wire ends	7225001

The above ordering information refers to the standard version.
Special versions are also included in our product range. Specifications subject to change without notice

Appendix A
Blinkcode Dxx-N

1 Normal Operation

● —	Idle state, no heat demand
● — —	Power supply not ok (frequency or voltage)
● ● —	Start delay (cooling down ignition device, RT is on)
● ●	Waiting for FT-on, LW-off, LK-open
● ● ●	Burner is starting
●	Burner in operation (from end of safety time)
● ● — —	Burner is stopping (e.g. in post-purge)

Code is sent every 5 s; in between the LED is off

2 Special Codes (no lock-out)

● ● ● ● ● ●	Device in Status „Parameter-Download“
● ● ● — — —	Parameter set for test; device will start only after release with serial communi-cation
— — — — — —	“End of Life” warning

Code is sent every 5 s; in between the LED is off

3 Burner lock-out

— ●	False flame
● —	No flame at the end of the safety time
● ● —	Flame failure in operation
— ● ●	Flame present after the end of operation phase
● ● ● —	No flame signal during ignition spark supervision
— ● ● ●	Two flame sensors connected
● — —	Air pressure switch (LW) opened during supervised phase
— — ●	Air pressure switch (LW) didn’t close
● — — —	Air pressure switch (LW) didn’t open
● ● — —	Oil pre-heater release temperature couldn’t be reached (FT didn’t close)
— — ● ●	Oil temperature below threshold during supervised phase (FT opened)
— — — —	Manual lock-out
● ● ● ●	Unknown error code

Code is sent every 10 s; in between the LED is always on

4 Special Codes (lock-out)

— — — — — —	„End of Life“ lock-out
X X X X X X	Other 6-pulse code indicates system lock-out (internal failure)

Code is sent every 10 s; in between the LED is always on

Legend: flashlight signal: — long (½ s) ● short (0.1 s)
RT: heat demand
FT: pre-heater release thermostat
LW: air proving switch
LK: air damper