BCS 300
Automatic oil and gas burner control system, for electronically monitoring and controlling burner systems

DUNGS®

Technical description
The BCS-Burner Control System- is an electronic automatic burner control system with a fuel-air compound control system, capacity regulator and gas valve proving system.
The BCS hardware components
- BCS 300 basic unit
- FLW 05 flame detector
- BCS 300 display and control unit
- Stepped motors

are linked together via a safety-oriented BUS system.
The BCS software, comprising safety core and programme modules with programmable basic functions is microprocessor-controlled.

Application
BCS is used in the case of both intermittent and permanent operation in oil and gas burner systems of all capacities.
BCS controls all of the burner system's operating modes and controls the burner capacity regardless of load.
BCS stores all operating and abnormal occurrence data, and reacts to all abnormal occurrences such as e.g. air deficiency, flame failure, servomotor malfunctions, etc.
All operating data and functions are displayed.

Approval
EU type test approval as per EU Gas Appliance Directive.

BCS 300 CE-0085AU2358

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BCS 300 operating and safety system for oil and gas burner systems

Automatic burner control system and flame monitoring device, electronic compound control, capacity regulator, gas valve proving system, initial fault message, CAN bus connection and PC data administration.

The Burner Control System **BCS 300** is a modular, processor-controlled automatic burner control system for controlling and regulating medium to high-capacity oil, gas and dual fuel burners. It is comprised of the following decentralised units, which communicate with one another via a safety-oriented bus system:

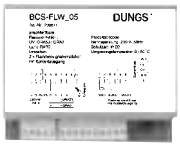
1 **BCS 300 module** for burner connection
2 **Control and display unit**
3 **BCS-FLW 05 flame detector**
4 **SAD 15.0 actuator**

BCS 300
Burner Control System

1


4

2



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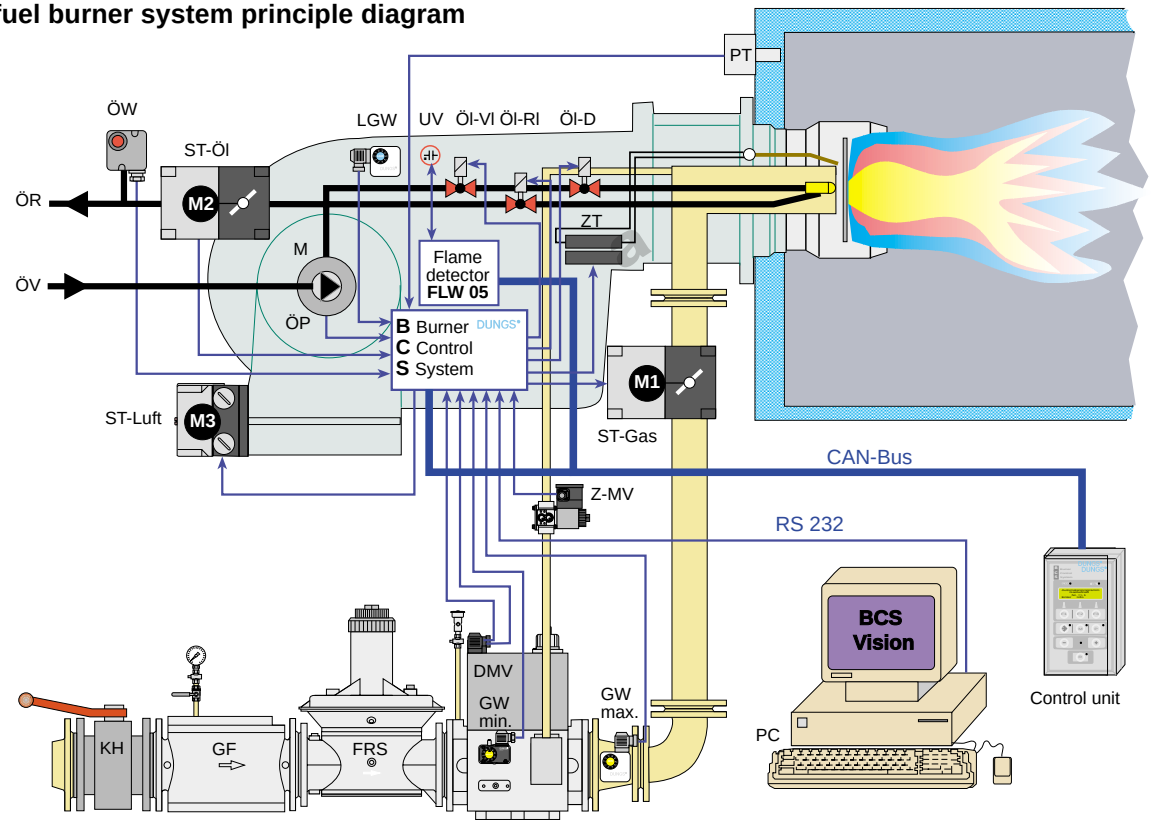
BCS 300
Burner Control System

Dual fuel burner system principle diagram



Legend for BCS system diagram

DMV	Double solenoid valve (gas-side and burner-side solenoid valve)	LGW	Air pressure switch	Oil-W	Oil pressure switch
FRS	Gas pressure regulator	M	Blower motor	PT	Regulator
GF	Gas filter	Oil-VL	Oil feed solenoid valve	ST-Oil	Oil regulator actuating mech.
GW min.	Gas pressure switch min.	Oil-RL	Oil return solenoid valve	ST-Gas	Gas flap actuator
GW max.	Gas pressure switch max.	Oil-D	Nozzle linkage valve	ST-Air	Air flap actuator
KH	Ball valve	Oil-P	Oil pump	UV	Flame sensor
		Oil-V	Oil feed	Z-MV	Ign. gas solenoid valve
		Oil-R	Oil return	ZT	Ignition transformer

BCS system components
BCS 300 module for burner connection and connections for:

230 VAC outlets
(3.14 A per outlet, total 6.3 A)
- Oil-VL/RL solenoid valve
- Nozzle linkage
- Ignition gas solenoid valve
- Gas solenoid valve 1 (safety)
- Gas solenoid valve 2 (burner)
- Combustion air blower motor
- Oil pump motor
- Gas ignition transformer
- Oil ignition transformer
- Capacity switch over
- Disturbance message
- Gas/oil operating mode message
- Burner operating message

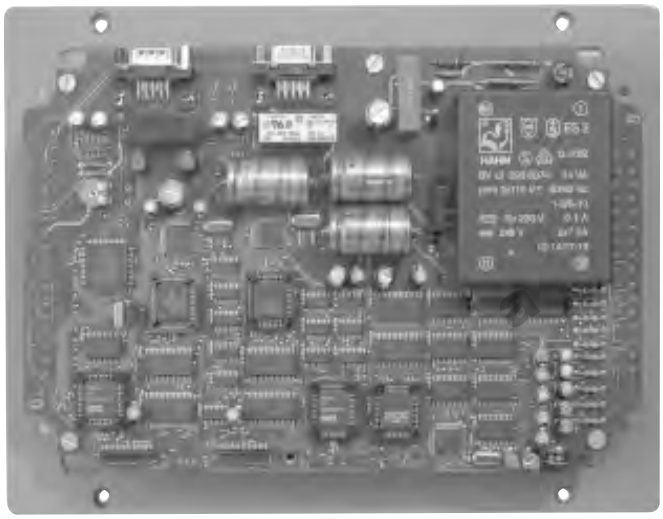
RS 232
- Connection for PC with BCS visualisation software

24 VDC inlets (potential-free)
- Boiler safety loop
- Oil safety loop
- Air pressure switch
- Gas pressure switch max.
- Gas pressure switch min.
- Control loop
- GAS/OIL fuel selection
- GW 1/2 valve check system
- Heavy fuel oil release
- Reset

Analogue inlet 4-20 mA
- Capacity regulator

Plug connections for stepped motors
- GAS actuating mechanism
- OIL actuating mechanism
- Air actuating mechanism

BCS 300 PCB



BCS control and display unit
with 4-line illuminated LCD display, each with 20 characters for commissioning and plain text display of individual operating and disturbance states.

The installation of the control unit into the front of a switching cabinet is made possible via an installation frame.

CAN - Controller Area Network
The BCS system components are linked together via CAN busses.
Bus topology:
As a result of the low transfer rate, the bus can be designed as a line or a star.
This guarantees
- high degree of availability
- maximum safety
- good price/performance ratio
- network expansion up to 1000 m at 25 kBit/s
- message prioritisation
- ISO / DIS 11898 standardisation
- hardware implementation on microprocessor.

Automatic burner control system programmes

BCS 300 is equipped with 6 different gas burner and 4 oil burner operating programmes, which may be prespecified as basic settings.

Gas operation
Selection of automatic control system No.:
1 => 1 or 2 flame detectors, with ignition valve
2 => 1 flame detector, without ignition valve
3 => Leakage check, 1 or 2 flame sensors with ignition valve.
- Reduction of ignition gas before gas-side valve. Gas-side valve opens 5 s earlier than burner-side valve

4 => Leakage check, 1 or 2 flame sensors, with ignition valve
- Reduction of ignition gas between gas and burner-side valve. Gas-side valve opens with ignition gas valve earlier than burner-side valve

5 => Leakage check, 1 flame detector, without ignition gas valve
- Gas-side valve opens 5 s earlier than burner-side valve

6 => 2 flame detectors, with ignition gas valve
- Monitoring of ignition flame and main flame during operation

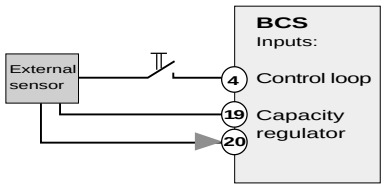
Valve checking system programme
1 => Valve leakage control before burner start-up with gas valves.

Oil operation
Selection of automatic control system No.:
10 => 1 or 2 flame sensors, with ignition valve, without DG
11 => 1 flame sensor, without ignition valve, without DG
12 => 1 or 2 flame sensors, with ignition valve and DG
- Open VR/VL solenoid valves after end of pre-ignition

13 => 1 or 2 flame sensors, without ignition valve, with DG
- Open VR/VL solenoid valves at start of pre-ignition.

See Page 6 for example of time lapses, the BCS documentation contains a comprehensive description.

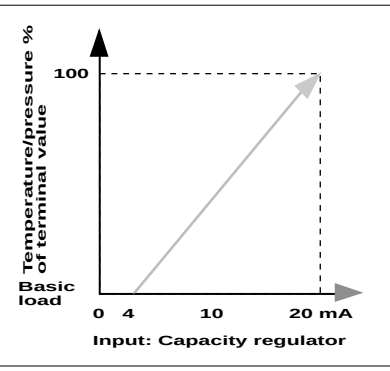
BCS capacity regulator



Regulator type 1

Settings as **standard regulator**:
- Sensor actual value,
- Capacity regulator input
- Sensor adjustment at 20 mA
- Sensor adjustment max.
- Switching difference
- Clearance
- Nominal value
- Kp range 0…60
  Gain factor, P-percentage
- Tn 0 …99,9 s I-percentage
- Tv 0 … 5,0 s D-percentage
- Neutral zone I (PID)

Favourable setting values:
Kp 10, Tn 80 s, Tv 0 s

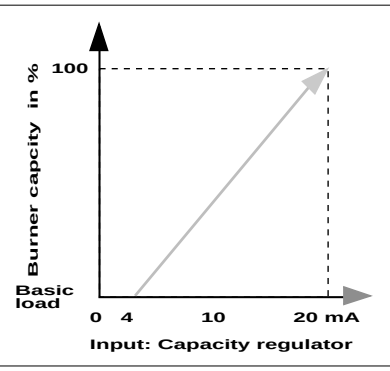


E.g. from sensor

Regulator type 2

Settings as **follow-up regulator**:
- Basic load 0 mA
- Full load 20 mA
  (not adjustable)

ON / OFF function via
control switch, input terminal:
CONTROL LOOP.



E.g. from external regulator

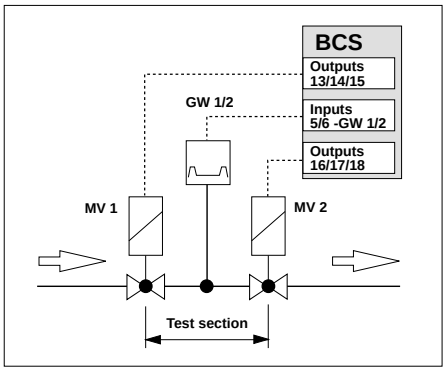
Valve proving system

The leakage test device is programmed so that the test cycle in the case of gas operation runs during pre-purge before the burner is started, releases burner start-up or, in the case of leakage, remains in fault lock-out.

In combination with a GW 1/2 gas pressure switch, BCS checks two sequential gas solenoid valves for leaks.

After evacuating the test section, the gas inlet-side valve (safety solenoid valve) is tested by monitoring the increase in pressure, the burner-side valve is tested by monitoring the fall in pressure after filling the test section.

If the pressure increases to an unreliably high level during the first test phase, or if the pressure decreases disproportionately during the second test phase, the system locks and prevents burner start-up.



Guidelines (Status 4/99)

The design and function of the BCS correspond to the following standards:

- EN 298 automatic burner control systems for gas burners and gas units with and without blower
- DIN IEC 255/VDE 0435 Electrical relays
- DIN VDE 0700
- EN 60730 Safety of electrical units for domestic use
- prEN 1643 Leakage test devices
- EN 230 Vapourising oil burners
- EN 676 Gas blower burners
- DIN VDE 3440 Temperature regulation and temperature limitation devices for water heating systems

and all affiliated standards.

SAD 15.0 actuator

The actuator is comprised of a stepped motor with electronic control system. In order to monitor function and direction of rotation, a driver with digital acknowledgement alarm via encoder disk is integrated.

Digitally-controlled stepped motors provide significant advantages in comparison with conventional synchronous motors (with return poten-tiometer)
- exact positioning, due to defined fuel-air stages per curve point
- hysteresis-free (play compensation via external load)
- positioning accuracy independent of potentiometer quality and service life.

Digital acknowledgement alarm signals

Monitoring of the mechanical and electrical section via an optical, dual-channel incremental sensor.
Reference point for defining the mechanical zero position of the drive shaft. The reference point does not have to correspond with the zero position of the flap, offset is permissible

Electronic actuator

The electronic system is comprised of a control module for the stepped motor with A-B interface, components for internal power supply and an acknowledgement alarm module. As regards potential, the entire electronic system is linked to the BCS automatic burner control system and is directly connected to mains potential.

BCS flame detector system
The FLW 05 flame detector is comprised of four separately-operating monitoring systems (UV, ionisation, light, contact).
These are
- installed in a housing
- completely equipped as regards hardware and supplied with voltage
- can be selected and configured via the BCS programme

The flame sensors are read out from the master computers via the CAN bus at the CAN controller, which continuously receives information from the flame sensor and causes flame detector tests to be carried out depending on the operating mode configuration which is selected.

According to the operating mode, the following are used in the case of:

Continuous operation
- QRA 53 UV sensor (cyclical self-test)
- Ionisation electrode with amplifier test
- RAR 7 light sensor (selenium photocell with failure-secure photocell voltage) and amplifier test.

In continuous operation, the secure function of the amplifiers is tested at 10 s intervals.

Intermittent operation
- QRA 2 UV sensor with UV diode which is constantly supplied with voltage
- Ionisation electrode

Flame sensor self-monitoring is only carried out during start-up.

Flame sensor operating modes

QRA 53 UV sensor
The flame sensor operates independently and dynamically.
As soon as UV radiation hits the diode, it generates a flame present signal via the flame signal amplifier, which is used to control a stepped motor in the flame sensor, which closes the light incidence aperture and opens it again after 200 ms.
As a result, the flame present signal must be deactivated. Following the release of the light incidence aperture, the presence of the flame is signalled, etc.

QRA 2 UV sensor
The flame sensor operates continuously.
As the UV sensor is only monitored during start-up, the system is switched off at least once every 24 hours.

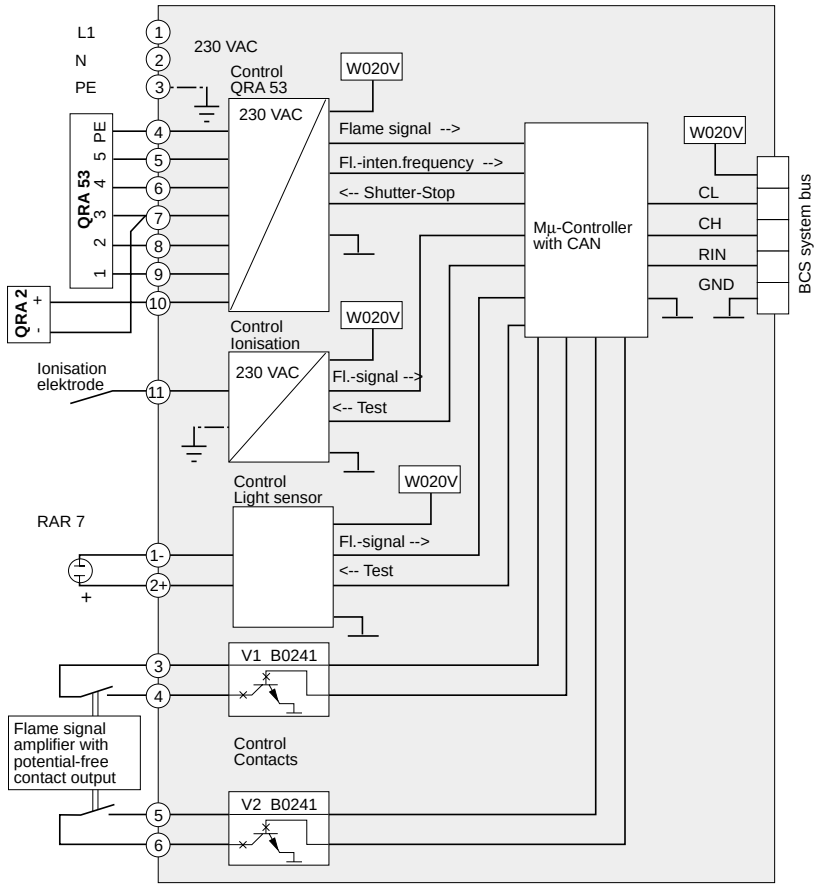
Ionisation electrode
The ionisation monitor uses the rectifier effect of a flame, and is regarded as fault-proof.

RAR 7 light sensor
The flame sensor contains a selenium photocell. Under the effect of light, this emits photoelectric voltage, and is regarded as fault-proof.

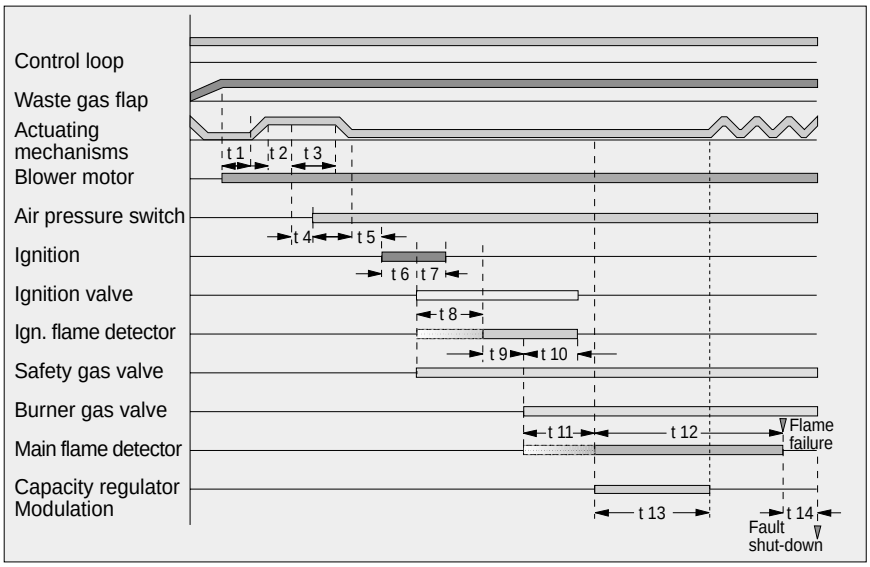
Flame detectors with contact output
must be fault-proof for continuous operation, as only the control component in the BCS flame detector is tested every 10 s as regards certain function.

Flame intensity measurement
BCS evaluates the intensity of all flame sensor signals (UV, ionisation, light) and displays these via a computer.
This therefore also enables these data to be remotely transmitted.
If a minimum value is not reached, e.g. a message regarding preventative maintenance may be output.

FLW 05 principle diagram



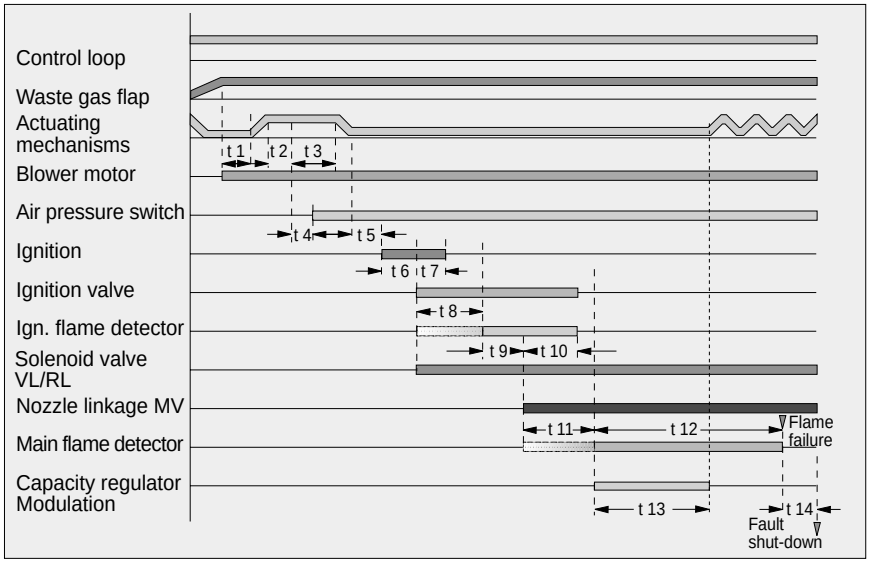
Gas operation with ignition valve, two flame detectors and valve proving system
(ignition gas reduction between safety and main gas valve)



Legend for time course diagram

t 1	Air flap delay period (star-triangle switchover)	0...60 s
t 2	Acknowledgement alarm Start pre-purge	0...250 s
t 3	Pre-purge period	1...250 s
t 4	Air pressure switch standby test (30% of pre-purge period)	
t 5	Ign. start acknowledgement alarm	0...250 s
t 6	Pre-ignition	0...30 s
t 7	Ignition	2 s
t 8	1st safety period	3 s
t 9	Ignition flame stabilising time Ign. valve operation safety period	0...10 s <1s = t 14
t 10	Within the time range t 10 Ign. valve operation safety period	2 s <1s =t 14
t 11	2nd safety period	3 s
t 12	Within the time range t 12 --> main valve operation safety period	<1s = t 14
t 13	Regulator release delay period	
t 14	Flame detector safety period Duration of external light monitoring from end of t 4 to start of t 5	<1 s

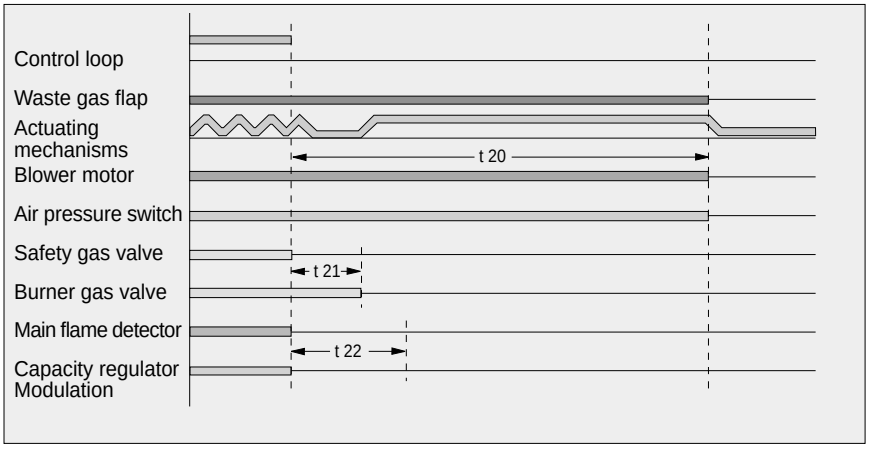
Oil operation with ignition valve, nozzle linkage solenoid valve and two flame detectors



Legend for time course diagram

t 1	Air flap delay period (star-triangle switchover)	0...60 s
t 2	Acknowledgement alarm Start pre-purge	0...250 s
t 3	Pre-purge period	1...250 s
t 4	Air pressure switch standby test (30% of pre-purge period)	
t 5	Ign. start acknowledgement alarm	0...250 s
t 6	Pre-ignition	0...30 s
t 7	Ignition	4 s
t 8	1st safety period	5 s
t 9	Ignition flame stabilising time Ign. valve operation safety period	0...10 s <1s = t 14
t 10	Within the time range t 10 Ign. valve operation safety period	4 s <1s =t 14
t 11	2nd safety period	5 s
t 12	Within the time range t 12 --> main valve operation safety period	<1s = t 14
t 13	Regulator release delay period	
t 14	Flame detector safety period Duration of external light monitoring from end of t 4 to start of t 5	<1 s

Gas operation "controlled shut-down" programme course diagram



Legend for time course diagram

t 20	Post-purge period	1...250 s
t 21	Burner-side valve closes after gas-side valve for evacuating the test section	2 s
t 22	External light monitoring after controlled shut-down	0...50 s

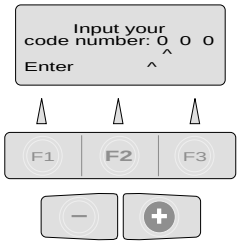
Software structure

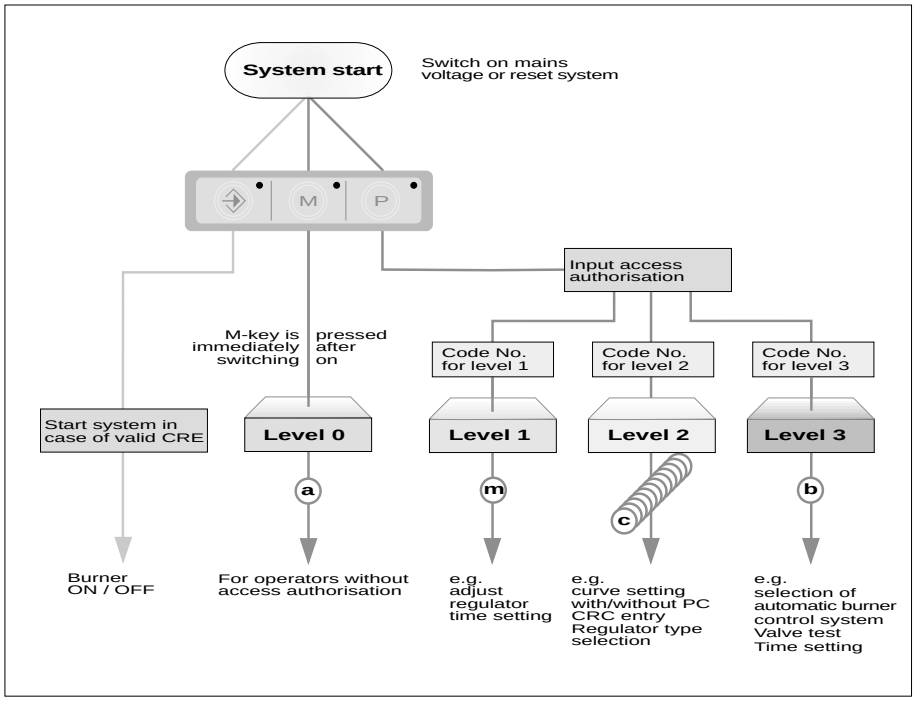
System start
Activation of mains voltage or via reset

Burner start
without changing settings

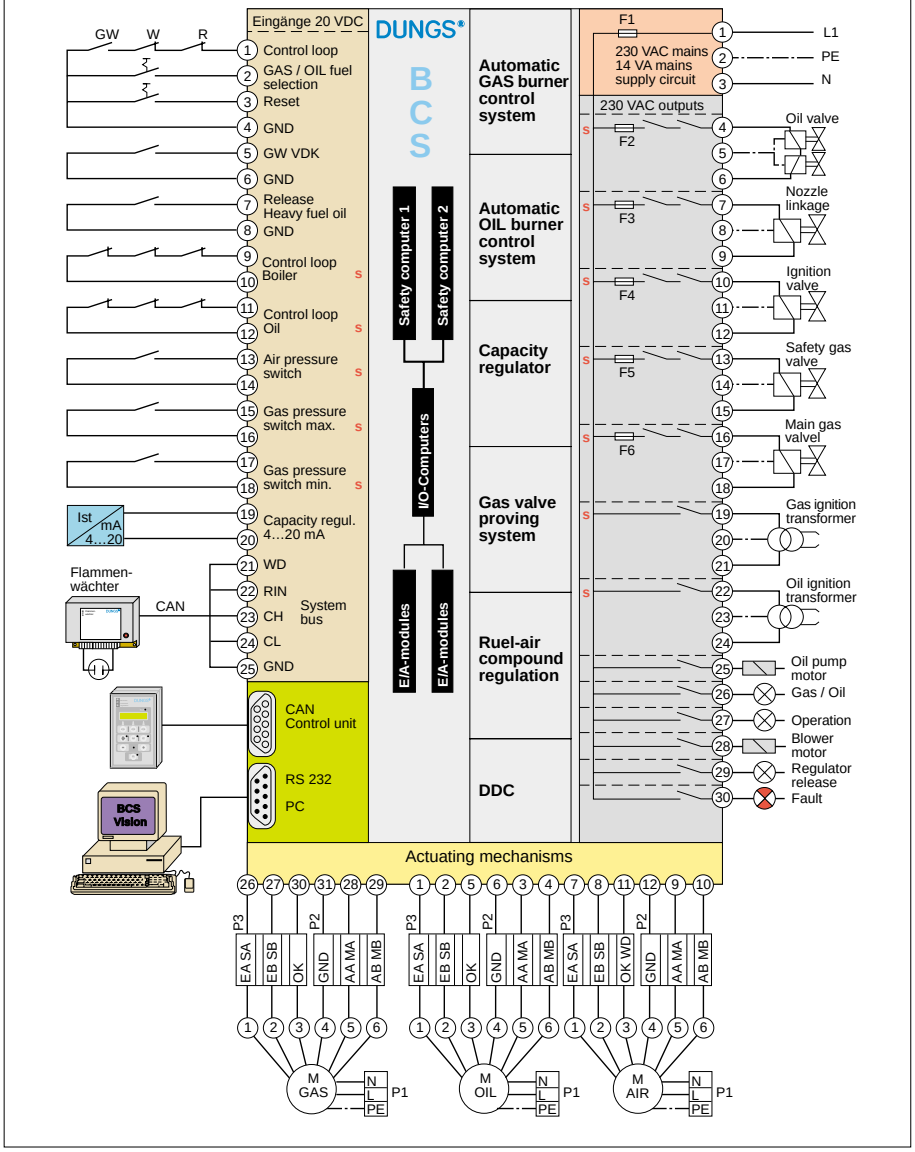
Basic settings at level 0 "a"
without access authorisation

Basic settings at levels 1, 2 and 3 "b… r"
with access authorisation only





BCS block diagram



BCS characteristics

The Burner Control System is especially characterised via:

- open hardware structure -> Can be expanded via CAN bus
- open software structure -> incl. PC connection / service
- Units are predominantly implemented in the software
  - automatic burner control systems
  - gas valve proving system
  - flame monitoring device
  - capacity regulator
- standardised hardware for all expansion stages
- simple menu-driven system programming
- practical experience with the operating system
- with a guaranteed future

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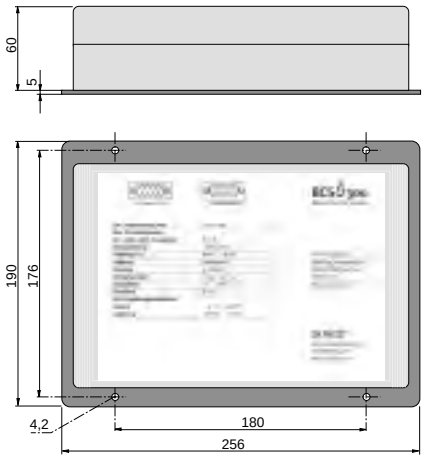
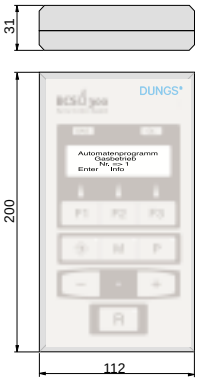
Dimensions

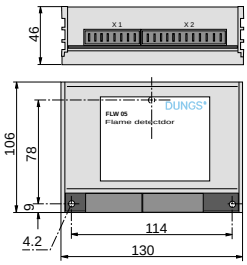
BCS 300



Manual control unit



FLW 05 flame detector



BCS 300 technical data

Operating voltage	230 V(+10 % / -15 %)
Frequency	50 ... 60 Hz
Protection class	II according to 3 x 10^6 nach TRD 604
Kontaktbelastbarkeit	3,15 A nach EN 298
Analogue input compliance resistance	25 Ohm
	max. 10 A F
Back-up fuse	6,3 A träge
Unit fuse	0,1 A träge
	EN 298
Interference immunity	EN 55011 Class A, 150 kHz - 1 GHz
Emission	
Perm. ambient temperatures	
Storage	-20 °C … +70 °C
Operation	0 °C … +60 °C
Housing protection type (EN 60529)	
BCS basic unit	Housing IP 40, terminals IP 20
Display and control unit	Housing IP 54, terminals IP 20
BCS-FLW 05, flame detector	Housing IP 40, terminals IP 20
	IP 40 must be ensured if installled
Installation position	arbitrary
Terminals, can be disconnected	2 x 1.5 mm oder 1 x 2.5 mm
Power consumption	
BCS (incl. control unti)	< 10 VA
FLW 05	< 1.5 VA
Automatic burner control system classification designations	F B L L B B

Actuator data (for comprehensive information and dimensions, see AMD dataheet)

Max. torque:	15 Nm
Actuating time (at 200 Hz)	22.3 s/90°
Supply voltage	230 VAC +10/-15%, 50 Hz
Protection type	IP 54
Shaft, flattened with parallel pin	ø 12_{h8} ; DIN 6325-4 m6 x 30
Ambient temperature with operating time of 50 s/5 min and in current-supplied standby position on initial operation	-20 °C to +60 °C

We reserve the right to make any changes in the interest of technical progress.

CERTIFIED DIN ISO 9001 QUALITY SYSTEM REG.NO 14 313

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