DURAG

D-R 290
Service Manual

DURAG, Inc. 1355 Mendota Heights Road, Suite 200
Mendota Heights, MN 55120 · Tel. 651-451-1710 · Fax 651-457-7684

Contents

Figures

Document	:	man_dsr290_de3007.doc
Author	:	Günter Müller
Version	:	07 / 2001
Printed	:	25.02.11

1 D-R 290 AW Controller

1.1 Key Function

Key 

Puts the system into the "*data entry*" (save values) mode.
The LEDs on the "STO" and "MOD" keys will light in this mode. The Led on the "STO" key will blink to indicate a fault.

Key 

Puts the system into "*display parameters"* mode
The LED on the "MOD" key will light in this mode.

Key 

When the system is in the "*display measurements"* mode, this key will toggle between outputs 1 and 2. The LED on the "MOD" key will not be lit.
When the system is in the "*display parameters"* mode, this key will move to the next display screen. The LED on the "MOD" key will light.
In the *"data entry"* mode, this key will increase the value of the blinking digit by one. The "STO" and "MOD" keys will light.

Key 
This key changes the position on the blinking cursor in the display. This key is only active in the "*data entry"*. The "STO" and "MOD" keys will light.

If the cursor and the plus keys are pressed simultaneously for about five seconds, a calibration cycle will start.

1.2 Saving / Data Entry

The D-R 290 AW controller has a status relay input to enable data entry/ saving value: Plug 2, contacts 2 D - 2 Z = Terminals 20 - 40.
Open: Data entry disabled, closed: data entry enabled

1. Pressing the "MOD" key switches from the "*Measurement*" mode into the "*Display Parameters*" mode. Once in measurement, the LED on the "MOD" key will light.
2. Press the "+" key until the desired value appears in the display.
3. Pressing the "STO" key will put the system into "*Data entry*" mode. The LED on the "STO" will light.
4. The value of the digit blinking in the display will increase as long as the "+" key is pressed. Once "9" has been reached, "0" will reappear. The " ← " key will move the blinking cursor one digit to the left. Once the left-most digit is selected, pressing the key again will move the cursor back to the farthest right digit.
5. To save the newly entered values and return to the "display parameters" mode, press the "STO" key. The LED on the "STO" key will go out..

6. In the "*display parameters*" mode, pressing the "MOD" key will toggle the system back to the "measurement (display measurements)" mode. The light on the "MOD" key will go out and the current measured value will be displayed. However, if the "MOD" key is pressed while in "*data entry*" mode, the system will return to "*measurement*" mode without saving any changes.
7. Once all changes have been made in "*data entry*" mode and saved, close the terminals below to disable new data entries

   Plug 2, Contacts 2 D - 2 Z = Terminals 20 - 40.

1.3 Error Messages

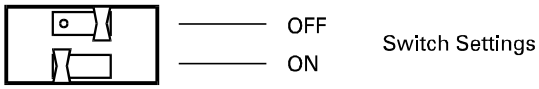
If a fault is detected, the top line of the LCD display will alternate between the current measured value and the error message. The LED on the STO key will also blink. After an approximately 10 seconds, an error message will be signaled on relay output 5. For fatal errors, a fault will also be signaled on relay output 6.

Errors 100 through 700 are specific to the D-R 290 AZ display.

ERROR	LCD-Display	R6	R5
Communication error	ERROR 000	X	X
Window contamination too high	ERROR 001		X
External AW error 1	ERROR 002		X
External AW error 2	ERROR 003		X
EEPROM fault	ERROR 004		X
RAM fault	ERROR 005	X	X
PROM fault	ERROR 006	X	X
AW system fault	ERROR 007	X	X
Comparison normal error	ERROR 010		X
External zero fault	ERROR 020		X
Internal zero fault	ERROR 030		X
Stepper motor failure	ERROR 040	X	X
LED fault	ERROR 050	X	X
Heated exit window fault	ERROR 060		X
MK system fault	ERROR 070	X	X
AZ input 1 fault	ERROR 100		X
AZ input 2 fault	ERROR 200		X
AZ input 3 fault	ERROR 300		X
AZ input 4 fault	ERROR 400		X
AZ input 5 fault	ERROR 500		X
AZ input 6 fault	ERROR 600		X
AZ system fault	ERROR 700	X	X

2 Switch Functions in the AW and AZ

By default, all switches are shipped in the ON position (towards back of unit).



2.1 Switches on the D-R 290 AW No. 30 Circuit Board

Switch	ON	OFF	Function D-R 290 AW / D-R 290 AZ	D-R 290 AZ
S1	**X**		Watchdog Timer **ON**	
S2		**X**	Operate with D-R 290 AZ	**N/A**
S3		**X**	**TEST STEP # 16** Current to 20 mA at P1 + P2	
S4		**X**	Show amplification and LED-Current	
S5		**X**	System Status -> load	**N/A**

Switch S1:

OFF Position: The watchdog timer is turned off.
ON Position: The watchdog timer is turned on.

Switch S2:

If the D-R 290 monitor is installed with the D-R 290 AZ display, switch S2 in the D-R 290AW must be in the OFF position (pushed forward).

Switch S3:

For checking or calibrating the signal outputs, switch S3 should be in the OFF position. The LCD display will read **TEST STEP #16** (20 mA). Outputs 1 and 2 can be set to 20 mA using potentiometers P1 and P2 if needed.

Switch S4:

The LED amplification and current will be shown in the LCD display if switch S4 is in the OFF position. For maintenance purposes, the current measured value can also be displayed.

Switch S5:

If switch S5 is in the OFF position and status relay input 1 is closed (enable data entry mode) when the system is powered up, the factory default settings for the AW unit will be loaded and overwrite all parameters. The display will read **System Status ->.**

2.2 Switches on the D-R290AW and AZ No. 40 Circuit Board

Switch	ON	OFF	Function
S1	**X**		Relay 3 will be used for controlling the transceiver side D-SK 290 fail-safe shutter.
S2	**X**		Relay 4 will be used for controlling the reflector side D-SK 290 fail-safe shutter.

Switches S1: / S2:

It is possible to automatically test the function of the D-SK 290 fail-safe shutters during the span phase of the calibration cycle. To enable this feature, both S1 and S2 should be in the ON (pushed towards back of unit) position.

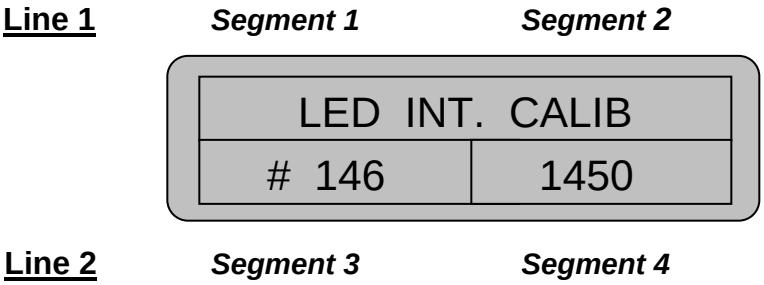
If the system installation includes the **D-R 290 AZ** display, this automatic fail-safe shutter test cannot be initiated by the D-R 290 AW controller but will be controlled by the D-R 290 AZ if S1 and S2 are switched on in the D-R 290AZ No. 40 board.

2.3 LCD Display During a Clear Path Calibration

Segment 1 + 2: Current calibration function:
LED INT. CALIB the comparison beam is set.
ZERO POINT CALIB the internal zero is set.
SPAN CALIB the reference value is set.
ZERO EXT. CALIB the external zero value is set.

Segment 3: Displays the amplification (10- 255), depending on the calibration function and the path length.

Segment 4: LED –current (0 to 4095). A current of 4000 corresponds to an LED – pulse rate of approx. 100 mA.



(Fig. 1) Display

Control unit D-R 290 AW		**Only for Use with D-R 290 AW in wall mount housing No D-R 290 AZ is used**						
Terminal	**Name**	**Function**						
PE	Ground	Power supply 90 - 264 Volt						
N	Neutral							
L	Line							
40	Digital Input 1	Programming Enable						
20								
39	Digital Input 2	Start Cal Cycle						
19								
38	Digital Input 3	Set up Mode 0x- External Error 002						
18		Set up Mode 6x Zero Check						
37	Digital Input 4	Set up Mode 0x- Range 2 for Analog Out 1						
17		Set up Mode 6x Window Check						
36	Digital Input 5	Set up Mode 0x- Range 2 for Analog Out 2						
16		Set up Mode 6x Upscale Calibration Check						
35	Digital Input 6	Set up Mode 0x- External Error 003						
15		Set up Mode 6x Display Stack Factor						
34	Relay 6	NO Measuring relay, energized when measuring,						
14		Commo Fault, in cal, or power off						
33		NC Relay is de-energized						
13	Relay 5	NO						
32		Commo Warning energizes relay						
12		NC						
Relays 1-4 Function Determined by set-up		0x	1x	2x	3x	4x	5x	6x
31	Relay 1	None	Limit 1 Analog1	Limit 1 Analog2	Limit 1 Analog1	Zero Check	Zero Check	Zero Check
11								
30	Relay 2	None	Limit 2 Analog1	Limit 2 Analog2	Limit 2 Analog2	Window check	Window check	Window check
10								
29	Relay 3	D-SK 1	D-SK 1	D-SK 1	D-SK 1	Upscale check	Upscale check	Upscale check
9								
28	Relay 4	D-SK 2	D-SK 2	D-SK 2	D-SK 2	Stack	D-SK 1	Stack
8						Factor		Factor
27	RS 422 Link	**Note:** When using D-R 290 AW without D-R 290 AZ Terminals 6 and7 must be connected with a jumper and Terminals 26 and27 must be connected with a jumper to Complete the RS 422 communication to the transceiver						
7								
26								
6								
4	Analog out 2	plus	4 – 20 ma, 2nd Normally not connected			Data on analog Outputs (opacity, optical density, calibration results) is also Function of the Set-up Mode See table 2C		
5		minus						
24	Analog out 2	plus	4 – 20 ma, 1st termination					
25		minus						
2	Analog out 1	plus	4 – 20 ma, 2nd Normally not connected					
3		minus						
22	Analog out 1	plus	4 – 20 ma, 1st termination					
23		minus						
1		⊥ PE (Ground)						

Fig. 2a Optional wiring diagram. For D-R 290 AW installed in D-R 290 AG wall mount housing. D-R 290 AW is connected directly to transceiver. No D-R 290 AZ is used.

Control unit D-R 290 AW		**For use when D-R 290 AW is connected to D-R 290 AZ**							
Plug	**Terminal**	**Name**	**Function**						
Plug 2	32 D Z	Ground	Power supply 90 - 264 Volt						
Plug 2	28 D Z	Neutral							
Plug 2	30 D Z	Line							
Plug 2	2 D	Digital Input 1	Programming Enable						
Plug 2	2 Z								
Plug 2	4 D	Digital Input 2	Start Cal Cycle						
Plug 2	4 Z								
Plug 2	6 D	Digital Input 3	Set up Mode 0x-5x	External Error 002					
Plug 2	6 Z		Set up Mode 6x	Zero Check					
Plug 2	8 D	Digital Input 4	Set up Mode 0x-5x	Range 2 for Analog Out 1					
Plug 2	8 Z		Set up Mode 6x	Window Check					
Plug 2	10 D	Digital Input 5	Set up Mode 0x-5x	Range 2 for Analog Out 2					
Plug 2	10 Z		Set up Mode 6x	Upscale Calibration Check					
Plug 2	12 D	Digital Input 6	Set up Mode 0x-5x	External Error 003					
Plug 2	12 Z		Set up Mode 6x	Display Stack Factor					
Plug 2	14 D	Relay 6	NO	Measuring relay, energized when measuring					
Plug 2	14 Z		Common	(If in Fault, in cal, or power off					
Plug 2	16 D		NC	Relay is de-energized)					
Plug 2	16 Z	Relay 5	NO						
Plug 2	18 D		Common	Warning energizes relay					
Plug 2	18 Z		NC						
Relays 1-4 Function by set-up mode			0x	1x	2x	3x	4x	5x	6x
Plug 2	20 D	Relay 1	None	Limit 1 Analog1	Limit 1 Analog2	Limit 1 Analog1	Zero Check	Zero Check	Zero Check
Plug 2	20 Z								
Plug 2	22 D	Relay 2	None	Limit 2 Analog1	Limit 2 Analog2	Limit 2 Analog2	Window check	Window check	Window check
Plug 2	22 Z								
Plug 2	24 D	Relay 3	D-SK 1	D-SK 1	D-SK 1	D-SK 1	Upscale check	Upscale check	Upscale check
Plug 2	24 Z								
Plug 2	26 D	Relay 4	D-SK 2	D-SK 2	D-SK 2	D-SK 2	Stack Factor	D-SK 1	Stack Factor
Plug 2	26 Z								
Plug 1	6D	RS 422 Communication	To D-R 290 AZG terminal 6						
Plug 1	6Z		To D-R 290 AZG terminal 26						
Plug 1	8D		To D-R 290 AZG terminal 7						
Plug 1	8Z		To D-R 290 AZG terminal 27						
Plug 1	16 D Z	Analog out 2	plus	4 – 20 ma, 2nd termination	Data on analog Outputs (opacity, optical density, calibration results) is also Function of the Set-up Mode See table 2C				
Plug 1	18 D Z		minus	Normally not connected					
Plug 1	20 D Z	Analog out 2	plus	4 – 20 ma, 1st termination					
Plug 1	22 D Z		minus						
Plug 1	24 D Z	Analog out 1	plus	4 – 20 ma, 2nd termination					
Plug 1	26 D Z		minus	Normally not connected					
Plug 1	28 D Z	Analog out 1	plus	4 – 20 ma, 1st termination					
Plug 1	30 D Z		minus						
Plug 1	32 D Z		? PE shielding for RS 422						

Fig. 2b Standard wiring diagram for D-R 290 AW in panel mount housing when AW is used with D-R 290 AZ .

Opacity: = **OP%**, Extinction: = Optical Density = **OD**

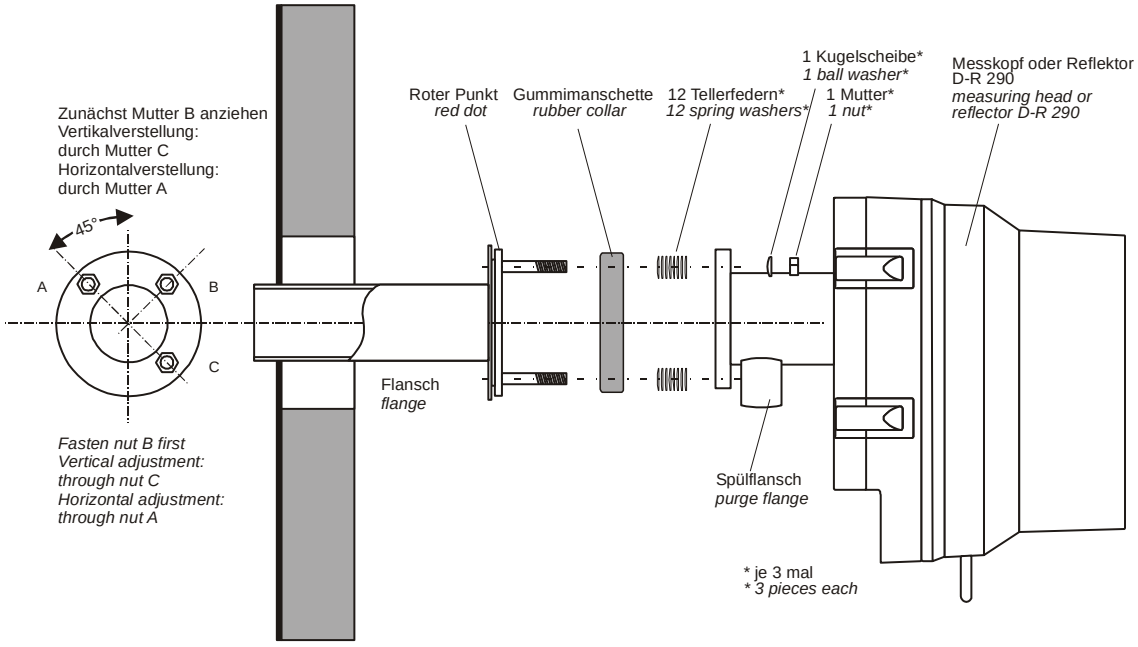
Set-up Mode I/O Function						
Display 1s digit	***Output - 1 Measuring in***	***Output - 2 Measuring in***	***Control cycle on***			
X 0 S	OD	OD	Output-1			
X 1 S	OP%	OD	Output-1			
X 2 S	OD	OP%	Output-1			
X 3 S	OP%	OP%	Output-1			
X 4 S	OD	OD	Output-1 + Output-2			
X 5 S	OP%	OD	Output-1 + Output-2			
X 6 S	OD	OP%	Output-1 + Output-2			
X 7 S	OP%	OP%	Output-1 + Output-2			
Display 10s digit	***Relay 1 Function***	***Relay 2 Function***	***Relay 3 Function***	***Relay 4 Function***		
0 X S	X	X	D-SK 1	D-SK 2		
1 X S	Limit 1, output 1	Limit 2, output 1	D-SK 1	D-SK 2		
2 X S	Limit 1, output 2	Limit 2, output 2	D-SK 1	D-SK 2		
3 X S	Limit 1, output 1	Limit 2, output 2	D-SK 1	D-SK 2		
4 X S	Zero Check	Window check	Upscale check	Stack Factor		
5 X S	Zero Check	Window check	Upscale check	D-SK		
6 X S	Zero Check	Window check	Upscale check	Stack Factor		
Display 10s digit	***Digital Input 1***	***Digital Input 2***	***Digital Input 3***	***Digital Input 4***	***Digital Input 5***	***Digital Input 6***
0 X S	Enable Programming (close to change parameters)	Start Cal Closed=no cal Open=cal by timer Upon opening =start cal	External Error 002 (Shutter, DP Cell)	Range 2 Output 1 Close to change analog output 1 to range 2	Range 2 Output 2 Close to change analog output 2 to range 2	External Error 003 (Shutter, DP Cell)
1 X S						
2 X S						
3 X S						
4 X S						
5 X S						
6 X S			Zero check	Window	Upscale	Stack factor

Table 2C

3 Transceiver

3.1 Optical alignment

1. Set-up Transceiver and Reflector in a dust-free room to the exact measurement path distance. Make sure to provide appropriate allowances for the cone washers and fail-safe shutters. The transceiver and reflector flanges should be as close to parallel as possible. Clean the optical surfaces (exit windows) with a soft, optics-safe cloth.
2. Once the transceiver and reflector are mounted as shown in figure 3 below, tighten down the three nuts on the reflector flange. The three nuts on the transceiver can then be used to optically align the system. Tighten down the nut labeled “B” in figure 3 first. Nut “A” can then be used to change the vertical alignment of the transceiver on the B-C axis. Adjusting the “C” nut will change the transceiver alignment along the A-B, or horizontal, axis. Once the transceiver position is correct, loosen the metal thumb screw on the transceiver optics that secures the position of the focus adjustment. Use the plastic knob to adjust the focus. For path lengths between 1 and 2.25 meters, the monitor is correctly adjusted when the image is the sight is clear. For path lengths greater than 2.25 meters (7 feet), turn the knob to the counter-clockwise until it stops. Once focusing is complete, retighten the metal thumb screw on the optics to secure the focus.



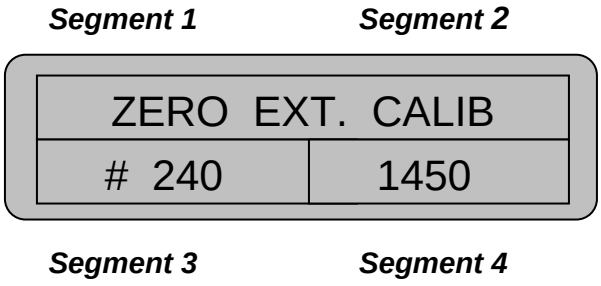
(Fig. 3) Mounting on the adjustment flange

3.2 Basic Adjustment of the Transceiver (Call Durag, Inc first)

During basic set-up, the transmitting LED (intensity) is set. Any previously saved values for the system will be erased. A new clear path adjustment will need to be performed after the basic adjustment. Do not perform this procedure unless specifically directed by DURAG.

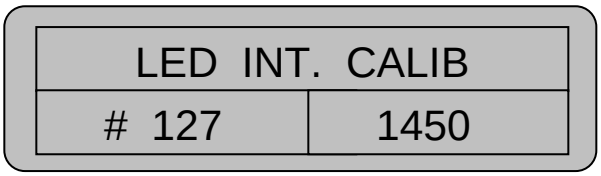
The basic transceiver set-up should be conducted as follows:

1. Set up the transceiver and reflector in a dust-free room (or use a measuring pipe) to set up the monitor to the maximum range of the reflector. Make sure the flanges on the transceiver and reflector are parallel. Clean the optical surfaces (exit windows) with a soft cloth designed for optics.
2. Next, open the four hasps on the transceiver head and swing it open. With a 4 mm allen wrench, remove the six screws that hold the cover in place. Close the transceiver and latch it shut with the hasps.
3. In the transceiver, push switches **S2** and **S3** into the "ON ↑" position, in the multiple switch **S4**, switch **S4/6** should be in the "OFF ↓" position and the three=position switch **S5** should be in the center (enabling data entry).
4. **Power up** the transceiver and AW controller (Plug St. 1).
5. Line 1 of the LCD display should read: **ZERO EXT. CALIB** .
6. Optically align the transceiver. (See page 8, Optical alignment)
7. Return switches **S2** and **S3** to the lower, OFF ↓ position, then push switch S5 toward the front of the monitor (for calibration cycles) until the yellow LED blinks. Return switch **S5** to the center position; the yellow LED should continue blinking for the rest of the basic set-up procedure. The red LED should be constantly lit, indicating that data entry is enabled. The LED current will be calculated against the external measurement path. The lower line of the LCD display should be working and segment four will display the LED current value. The displayed value should be between 700-1000. A value of 4000 corresponds to an LED signal of approximately 100 mA.
8. If **S4/6** on the **S4** switch is returned to the ON ↑ position *before the basic set-up is completed*, any previously recorded filter audit (linearity) data will not be erased.



9. After the LED current is set, the monitor will determine the amplification of the comparison normal light beam. The lower line of the display will be active and segment three will show the amplification factor. This should be between 10-50.

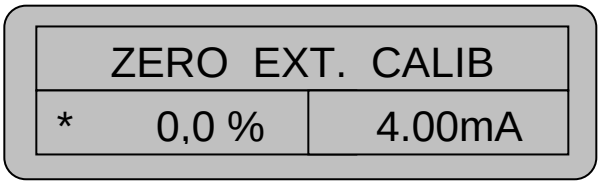
Line 1 ***Segment 1*** ***Segment 2***



Line 2 ***Segment 3*** ***Segment 4***

10. After the basic set-up is complete, a calibration cycle will run (the yellow LED will go out). To prevent any further changes to the monitor set-up, put switch **S5** to the back (the red LED will extinguish). On switch **S4** put **S4/6** in the ON ↑ position. If **S4/6** on the **S4** switch was already returned to the ON ↑ position before the basic set-up is completed, any previously recorded filter audit (linearity) data was preserved.

Line 1 ***Segment 1*** ***Segment 2***



Line 2 ***Segment 3*** ***Segment 4***

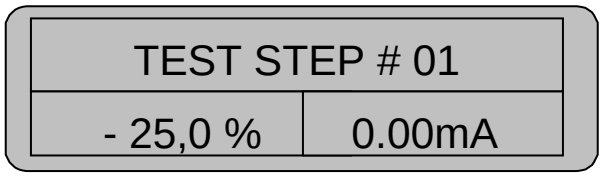
11. Once the basic set-up has been completed (the yellow LED will not be lit), disconnect the transceiver and controller (power off) and replace the cover with the six screws.

3.3 Offset Calibration (Call Durag, Inc first)

After the first basic set-up, the offset calibration must be run.

1. Switch **S2** should be in the ON position and switch **S6** should be in position **1**. The first line of the LCD display should read: **TEST STEP # 01**.
2. Press the **S7 +** key (see switch S6 test functions on page 22). This will toggle the transceiver head into comparison mode and the transmitting LED will be turned off. Te first line of the LCD display will alternate between the error message ** **ERROR 50** ** (LED fault) and **TEST STEP # 01**.
3. Use potentiometer P1 to adjust the current at test point **MP 3** to read 20 mV, using capacitor C37 as ground (1000 µF / 25 V).

Line 1 ***Segment 1*** ***Segment 2***



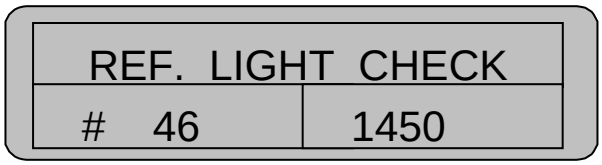
Line 2 ***Segment 3*** ***Segment 4***

4. Put switch **S2** in the OFF position and switch **S6** in the 0 position.
5. Disconnect the transceiver and controller (power off) and **repeat the basic set-up** in page 9.

3.4 Setting the Light Intensity of the Internal Zero Point Reflector

1. The internal zero point reflector must be adjusted so that it reflects the light beam with the same intensity as the D-R 290 R reflector on a dust-free measuring path.
2. Set up the transceiver and reflector in a dust-free room to the exact path length at the installation site. Make sure to calculate the additional distance needed to account for the washers and fail-safe shutters. If the path length at the installation is unknown, use the maximum length for the reflector (2.25 m for reflector 1, 12 m for reflector 2).
3. Open the four hasps on the transceiver head and swing it open. Remove the six 4 mm hex screws and remove the cover. Close the transceiver head and refasten the hasps. Connect the transceiver head and controller (plug St. 1). Once turned on, the D-R 290 will run a self-check and the comparison light beam will be checked. Line 1 of the display should read: **REF. LIGHT CHECK**. After the system automatically sets the LED intensity, the unit can be adjusted (the yellow LED will go out).

Line 1 ***Segment 1*** ***Segment 2***

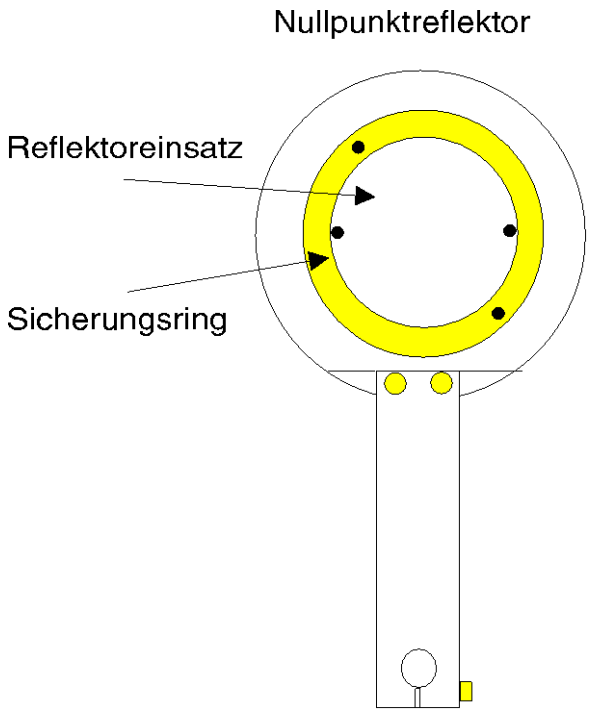


Line 2 ***Segment 3*** ***Segment 4***

4. For this calibration, push switch **S2** on the D-R 290 MK number 20 board into the upper **ON** ↑ position, and the service switch **S6** in the test function 4 position. Press the **S8 —** key to bring the reflector into position on a dust-free path (clear-path). Measure the signal at test jack MP.2 (external zero point) to the ground on the C37 (1000 µF / 25 V) capacitor.
5. Press the **S7 +** key to bring the internal zero reflector into position and measure the voltage at the MP.2 test jack. The internal zero point reflector must be adjusted to have the same light intensity (current) that was measured with the external zero point reflector (max. tolerance: 5).
6. To run he calibration, loosen the ring on the zero point reflector that locks its position (turn to the left). The reflector can be calibrated by rotating the reflector insert. Turning to the right will reduce the light intensity and give a lower current reading. Turning to the left will increase the light intensity and yield a higher current. When the measured signal for the internal zero reflector is the same as the signal measured for the external

reflector, tighten the locking ring on the reflector insert by turning it to the right. ***After you are done with the adjustment return the switches.***

7. Run the clear path calibration procedure from page 12 starting at paragraph 3.

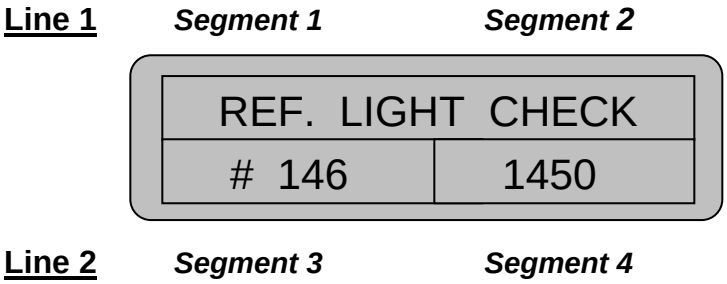


(Fig. 4) Internal Zero Point Reflector

3.5 Clear path procedure

The clear path procedure should be run in the following order:

1. Set up the transceiver and reflector in a dust-free room to the exact path length of the stack where they will be installed. Make sure to include the appropriate allowances for the disk washers and fail-safe shutters. Clean the optical surfaces (exit windows) with a soft, optics-safe cloth.
2. Open the four hasps on the transceiver and swing the housing open. With a 4 mm allen wrench, remove the six screws that secure the cover and remove it from the housing. Swing the transceiver head closed. Supply power (connect plus "St1") to the transceiver and the D-R 290 AW controller. Once turned on, the D-R 290 will run a self-check cycle and check the value of the comparison light beam. The LCD display will read: **REF. LIGHT CHECK** on line 1. Once the automatic start-up has been completed and LED intensity has been set, the system can be calibrated (the yellow LED will go out).



3. Put switches **S2** and **S3** in the upper, "**ON** ↑ " position, Display line 1: **ZERO EXT. CALIB** .
4. Optically align the transceiver head.
   (see page 8, Optical alignment)
5. Return switches **S2** and **S3** to the lower, "OFF ↓" position, the press switch **S5** (towards the front of the monitor). Switch **S5** can then be moved back to the center position, at which point the yellow LED should continue blinking and the red LED should be continuously lit. The lower line of the display (on the AW controller) should be working.
6. Display line 1: **LED INT. CALIB** the comparison light beam is calibrated.
7. Display line 1: **ZERO POINT CALIB** the internal zero point value is calibrated.
8. Display line 1: **SPAN CALIB** The reference light path is calibrated.
9. Display line 1: **ZERO EXT. CALIB** the external zero point value is calibrated.
10. After the clear path calibration procedure, the system will run a self-check again, indicated by the blinking of the yellow LED. To allow these new clear path values to be saved, switch **S5** must be pushed back (the red LED will go out).
11. Disconnect the power to the transceiver head and the AW controller. Loosen the 4 hasps on the transceiver head, swing open the transceiver, and replace the lid to the housing, making sure to secure all six screws. The transceiver head can then be closed and the hasps fastened again.
12. Reconnect the transceiver and AW controller (supply power). When the D-R 290 is turned back on, the system will again run a self-check cycle.

3.6 Manual calibration of the internal zero point (Window Check)

If the internal zero point value still requires adjustment after the automatic calibration procedure, this calibration can also be initiated manually.

1. Clean the optical surfaces (exit windows) with a soft, optics-safe cloth. Using the "MOD" and "**+**" keys on the D-R 290 AW controller, select the "Window Check" measurement.
2. On the D-R 290 MK No. 20 board in the D-R 290 MK transceiver, switch **S4/4** on the 6-slot switch block #**4** should be set to the "OFF ↓" position, and switch **S3**, which controls the calibration cycle, should be in the "ON ↑" position. Switch **S5** must be positioned to enable data entry (center position), as indicated when the red LED is lit. The first line of the LCD display should alternate between OFFSET **-- +** and WINDOW CHECK.
3. With the **S8** [-] key (decrease displayed value) and the **S7** [+] (increase displayed value), the internal zero point can be corrected to 4.0 mA. It is important, however, to ***remember that the internal zero point is calculated over a 10 second integration time*.** Using the S7 and S8 keys briefly best makes this adjustment, and then waiting ten seconds to view the changes after the integration time has passed. If the value is still not correct, repeat this process as necessary. As long as one of these keys is pressed, the yellow LED will light.
4. Once the calibration is complete, return the switches to there default positions: **S5** locked (the red LED goes out), switch **S4/4** on **#4** should be in the ON ↑position. Switch **S3** should be in the OFF ↓ position. Replace the cover and tighten the mounting screws.

3.7 Manual Calibration of the External Zero Point (Call Durag, Inc first)

If the external zero point value still requires adjustment after the automatic calibration procedure, this calibration can also be initiated manually.

1. Set up the transceiver and reflector in a dust-free room (or use a measuring pipe between the heads) to the exact path length of the stack where they will be installed. Make sure to include the appropriate allowances for the disk washers and fail-safe shutters. Clean the optical surfaces (exit windows) with a soft, optics-safe cloth. Select a short integration time, such as 8 seconds, on the D-R 290 controller and then choose "External Zero".
2. On the D-R 290 MK No. 20 board in the D-R 290 MK transceiver, switch **S4/5** on the 6-slot switch block **#4** should be set to the "OFF ↓" position, and switch **S3**, which controls the calibration cycle, should be in the "ON ↑" position. Switch **S5** must be positioned to enable data entry, as indicated when the red LED is lit. The first line of the LCD display should alternate between OFFSET - + and OUTPUT X.
3. With the **S8** [-] key (decrease displayed value) and the **S7** [+] key (increase displayed value), the external zero point can be corrected to 4.0 mA. It is important, however, to remember that the external zero point is calculated over an integration time. Using the S7 and S8 keys briefly best makes this adjustment, and then waiting a few seconds to view the changes after the integration time has passed. If the value is still not correct, repeat this process as necessary. As long as one of these keys is pressed, the yellow LED will light.
4. At the end of the calibration, return the switches to their default positions.

3.8 Checking the linearity on the path length (EPA filter audit)

Set the D-R 290 to a short integration time and select the value (external zero point) that will be tested. The display should read **OUTPUT 1**.

Testing according to EPA regulations.

The linearity of measurements in the measurement range from 0-100% with a stack correction factor of 1.000 are tested. A filter holder should be set-up at the midway point of the measurement path angled at less than 10-15^{o}. During testing, the monitor should read within ± 1.5 % of the standard value for the filter. If the linearity needs to be recalibrated, follow the procedure on 18, EPA filter audit test (linearity calibration).

3.9 Filter audits in the control mode

Die The control mode also allows for filter audit testing to EPA regulations. The testing should run using the output 1 measuring range. This will measure the OP measuring range with a stack correction factor of 1.

be test

(Fig. 5) EPA – Test filter

After selecting the control mode (display: **CONTROL MODE**), press the STO key to run a window contamination check and bring the display to 4 mA, if needed. Open the hasps on the transceiver head and swing it open. The unit is now ready for filter audit testing. A special holder has been built into the transceiver to hold the calibration filters, (see illustration above. During testing the, the monitor should read the standard value of the filter within ± 1 %. If these values are not linear, repeat the procedure on 18, EPA filter audit test (linearity calibration).

3.10 Testing the reference filters

Select the span / reference value check, (the display should read **SPAN CHECK**) from the D-R 290 AW controller. If the span value is approximately 71%, this value should be recalibrated, as described on page 18, EPA filter audit test (linearity calibration).

3.11 EPA filter audit test (linearity calibration) {Call Durag. Inc first}

Select the desired value on the D-R 290 AW controller. For the linearity calibration for the external zero (OUTPUT X), select a short integration time.

1. After opening the cover of the D-R 290 MK transceiver, put switch **S3** (calibration function) into the ON ↑ position. Switch **S5** must be set to enable data entry and the red LED should be lit to indicate this. On the 6-throw switch **S4**, put the switch for the value to be calibrated into the OFF ↓ position, as indicated in the table below.

S4/1	**OUTPUT X**, (current measured value „ External Zero Point “)
S4/2	**CONTROL MODE**, (EPA filter audit test)
S4/3	**SPAN CHECK**, (Internal Reference Filter)

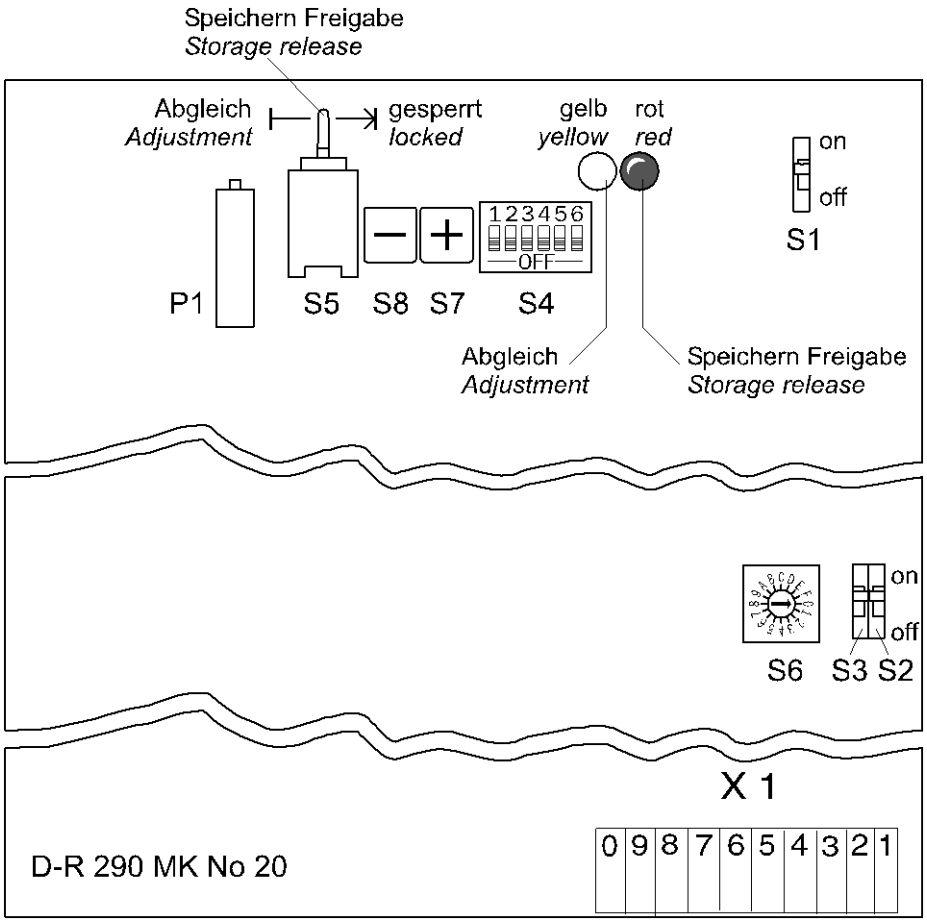
2. The first line of the display should alternate between **Slope -+** and the value to be adjusted <u>when the measured value is greater than 4.00 mA.</u>

3. With the **S6** [-] (decrease displayed value) and **S7** [+] (increase displayed value) keys, the slope can be corrected to match the value of the test filter. Make sure to allow for the selected integration time to make sure the desired value has been set. Make sure to press the keys briefly then wait out the integration time before pressing the keys again. While the **S6** and **S7** keys are pressed, the yellow LED will light if the <u>measured value is greater than 4.00 mA.</u>

4. After the adjustment, return the switches to orginal default positions: **S5** locked with the red LED extinguished, **S3** in the OFF ↓ position. Replace the cover and tighten the mounting screws. Reset the integration on the D-R 290 AW controller and save the value.

5. Disconnect the transceiver and controller (power down). Open the four hasps on the transceiver head, swing it open, and replace the cover. Close the transceiver and the hasps.

Reconnect the transceiver and controller (and supply power). Once turned on, the D-R 290 will run a control cycle: for 1:30 minutes each, the D-R 290 will determine its internal zero point, window check, and reference point values (displayed in %).



(FIg. 7) Location of Switches in the Transceiver Head

3.12 Transceiver Head Switch Functions

Switch S1

ON	OFF	Default Setting
X		Watch Dog Timer **ON**

Switch S2 and S3

	ON	OFF	Function
S2		**X**	**Default Setting**
S3		**X**	**Default Setting**
S2	**X**		Enables a calibration cycle start using switch S5
S3	**X**		Enables a calibration cycle start using switch S5
S2	**X**		Enables the use of the service program switch S6
S3	**X**		Enables the start of a calibration function using switch S4

DIL- Switch S4

S4	ON	OFF	Default settings
6	**X**		Basic configuration/ calibration disabled
5	**X**		OFFSET External zero point (measurement)
4	**X**		OFFSET Internal zero point (Window Check)
3	**X**		SPAN Slope
2	**X**		CONTROL MODE Slope
1	**X**		OUTPUT Slope

Switch S5

Switch S5	Function	
Press switch in:	Start Calibration Cycle	Yellow LED blinks
Center position	Enable data/parameter entry	Red LED is lit
On position	Disable data/parameter entry Default **Setting**	Red LED is not lit

3.13 Changing the EPROM's

D-R 290 AW

After replacing the EPROM chip (IC D6 on the D-R 290 AW number 30 board), the following steps should be taken. Make sure switch **S5** is in the "OFF" position and the status relays (enable programming) are closed (Plug2 2D to 2Z is shorted). When the system is powered up, the default settings will be loaded and saved over any existing parameters. The display should show "**System Status ->**", after which switch **S5** should be returned to the "ON" position. **You will need to reprogram your mode and all the setting on the D-R290AW.**

D-R 290 AZ

If you replace the EPROM chip (IC D6 on the D-R 290 AZ number 30 board) there is no set-up procedure required. Just reinstall the unit and make sure it is working right.

D-R 290 MK

When the EPROM is replaced (IC D9 on the D-R 290 MK number 20 board) a basic adjustment maybe required, this also needs to be done if the number 20 board is replaced with a new board. {**Call Durag, Inc. first** }

After the basic adjustment a clear path and filter audit test will need to be preformed.

3.14 Test function (Switch S6)

To call up the test function, put switch **S2** on the D-R 290 MK No 20 board into the upper ON ↑ position and select the desired test function with service switch **S6** as shown in the table below. Use keys **S8 --** and **S7 +** to initiate the test step.

Watch Dog Timer Test

For test step 09, the watchdog timer must still be active, that is switch **S1** should be in the OFF ↓ position. Pressing **S8 --** or **S7 +** keys will deactivate the watchdog timer so it doesn't trip. The transceiver will restart the program. The program start begins by checking the comparison light beam. The first line of the display will read: **REF. LIGHT CHECK.**

Switch S2	Switch S6	Key " - " S8	Key " + " S7	LCD – Display, Line 1
ON	**0**			**TEST STEP # 00**
ON	**1**	External zero LED ON		**TEST STEP # 01**
ON	**1**		Comparison LED OFF	**TEST STEP # 01 ERROR 50**
ON	**2**	External zero	Comparison	**TEST STEP # 02**
ON	**3**	External zero	Reference value	**TEST STEP # 03**
ON	**4**	External zero	Internal zero	**TEST STEP # 04**
ON	**5**	Internal zero	Comparison	**TEST STEP # 05**
ON	**6**	EE Prom	Test	**TEST STEP # 06**
ON	**7**	E Prom	Test	**TEST STEP # 07**
ON	**8**		Transceiver fault	**TEST STEP # 08 ERROR 70**
ON	**9**	**Watchdog**	**Timer**	**TEST STEP # 09**

4 Circuit Board Installation

4.1 Installing a new D-R 290 MK No. 20 board

Disconnect the transceiver and controller from the power supply. Open the four hasps on the transceiver head and swing it open. With a 4 mm Allen wrench, remove the mounting screws that secure the cover and remove it.

1. On the D-R 290 MK No. 20 board, pull plugs X1 through X4 from their sockets.
2. Remove the three screws that secure the circuit board. Put the new circuit board in place and secure it with the three screws.
3. Check the operating voltage. Connect the transceiver and the controller and power them up. Check the voltage at socket **X1**. The tolerance of the 15 Volt line is ±5%, and the tolerance for the +5 Volt current is +5%.
4. Connect the transceiver and controller and connect sockets X1 to X4 with the pins on D-R 290 MK No. 20 board.
5. Power up the transceiver and controller and test the current on the right most pin of the voltage **N1 = +12V**, **N2 = -12V** and **N3 = +5V** (tolerance ± 5 %) against the ground of the C 37 capacitor (1000 µF / 25 V).

After changing the circuit board, run the following procedure:

6. Basic configuration of the transceiver (see Page 9).
7. Offset calibration (see Page 11).
8. Set the light intensity of the internal zero point reflector (see Page 12).
9. Clear path calibration procedure (see Page 14).
10. Filter audit / linearity test (see Page 18).

4.2 Changing the EPROM (D-R 290 MK controller) (Call Durag, Inc. first)

After installing a new EPROM chip (IC D9 on the D-R 290 MK number 20 board), the following procedures must be run:

1. Basic transceiver configuration (see Page 9).
2. Clear path calibration procedure (see Page 14).
3. Linearity calibration / EPA filter audit test (see Page 18).

4.3 Changing the LED

Disconnect the DR 290 MK transceiver and the D-R 290 AW control panel (power down). Open the four hasps on the transceiver head and swing it open. With a 4 mm Allen wrench, take out the six screws on the lid and remove it.

1. On the D-R 290 MK number 20 board, pull the 2-pin LED connector (socket X2) from the plug. Unscrew the three setscrews on the LED assembly.
2. Remove the old LED-assembly and put the new one in place (make sure to match the positions of the screws) and tighten all three Allen screws. Reconnect the 2-pin LED connector (socket X2 with the plug on the D-R 290 MK number 20 board.

After changing the LED, the following procedures need to be run:

1. Clear path calibration (see Page 14).
2. EPA filter audit test / linearity (see Page 18).

5 Plug X 1 Wiring Plan

Connection to D-R 290 MK transceiver					
D-R 290 AW Controller		**Transceiver cable connections**			
Plug	**Contact**	**Plug**	**Wire Number**	**X1 Terminals**	**Function**
St. 1	32 D Z	Housing	Shield		Shielding
St. 1	12 D Z	B	1	**1**	**+ 15 Volt**
St. 1	32 D Z	D	2	**2**	**GND**
St. 1	14 D Z	C	3	**3**	**- 15 Volt**
St. 1	2 D Z	A	4	**4**	**+ 5 Volt**
St. 1	32 D Z	E	yellow / green	**5**	**Earth ground**
St. 1	32 D Z	F	6	**6**	**GND**
St. 1	8 D	J	7	7	RS 422 < --
St. 1	8 Z	H	8	8	RS 422 < --
St. 1	6 D	G	9	9	RS 422 -->
St. 1	6 Z	M	10	10	RS 422 -->

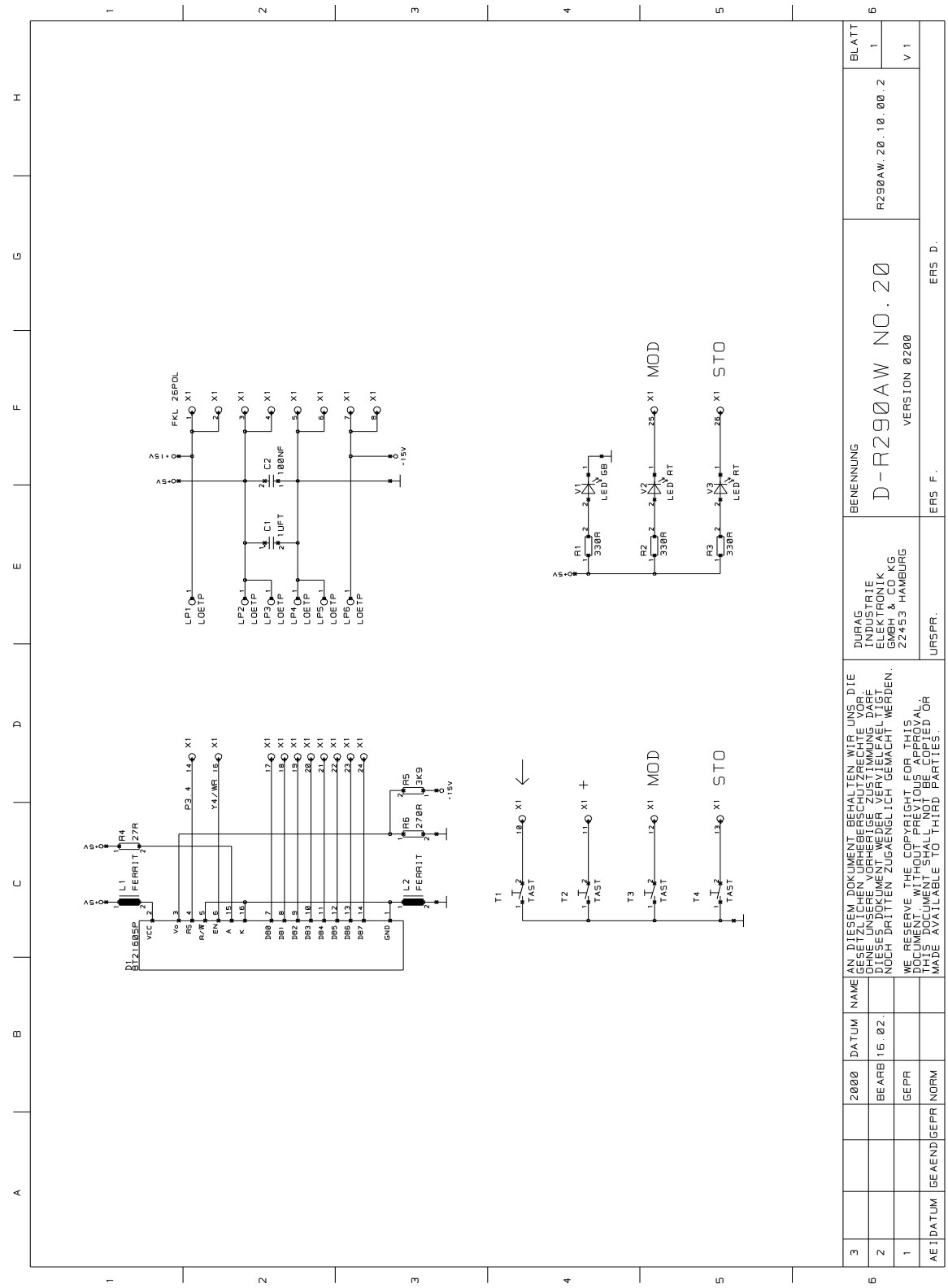
6 Plug X4 Wiring Plan

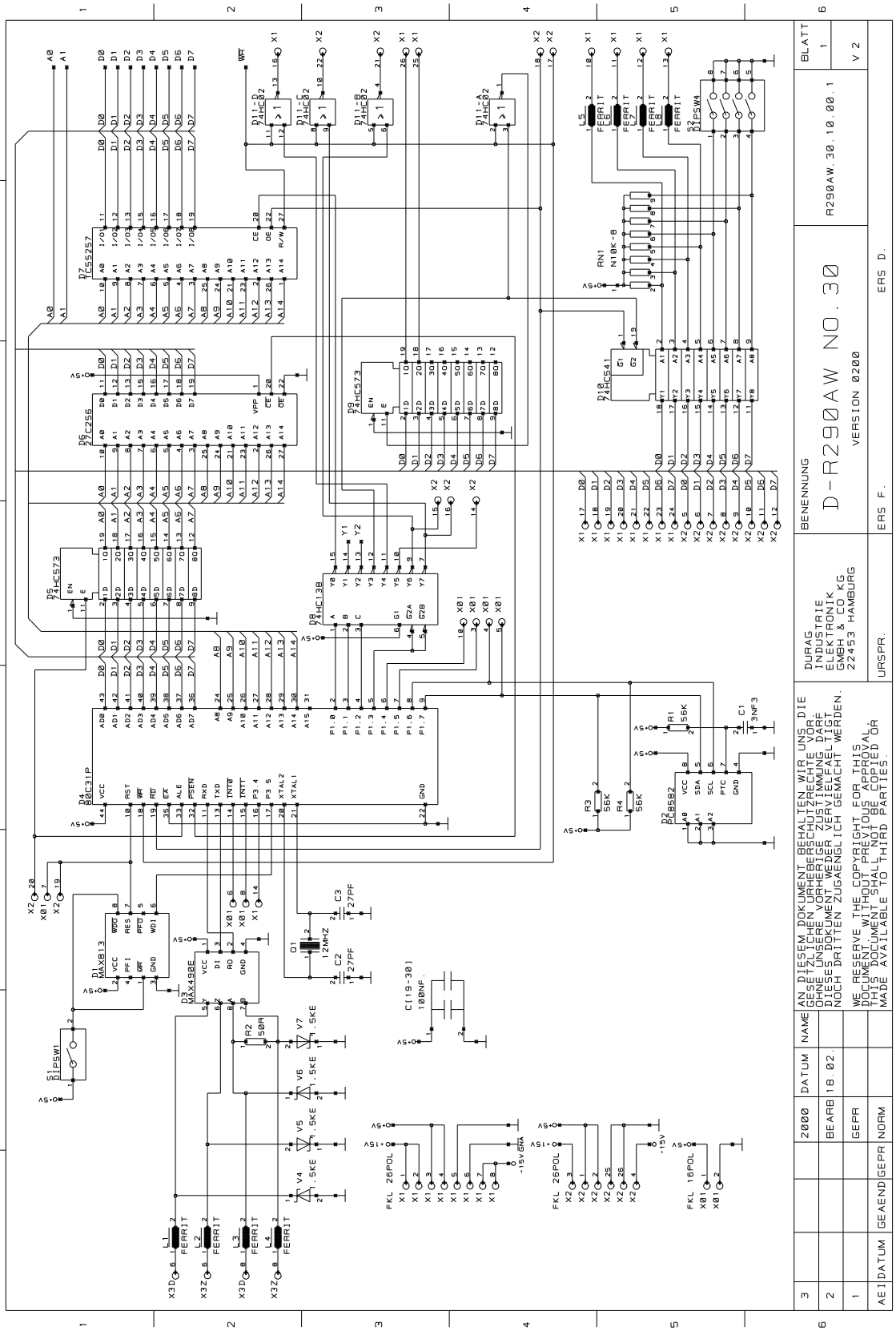
	Zero point Motor	Plug X 4		Comparison Motor	
	yellow	**A 1**	**B 1**	yellow	
	black	**A 2**	**B 2**	black	
	green	**A 3**	**B 3**	green	
	red	**A 4**	**B 4**	red	
	blue	**A 5**	**B 5**	blue	
	white	**A 6**	**B 6**	white	
Light box output	yellow	**A 7**	**B 7**	yellow	Light box output
Light box Ground	black	**A 8**	**B 8**	black	Light box ground
Light box + 15 Volt	red	**A 9**	**B 9**	red	Light box + 15 Volt
Heated exit window	black	**A 10**	**B 10**	black	Heated exit window

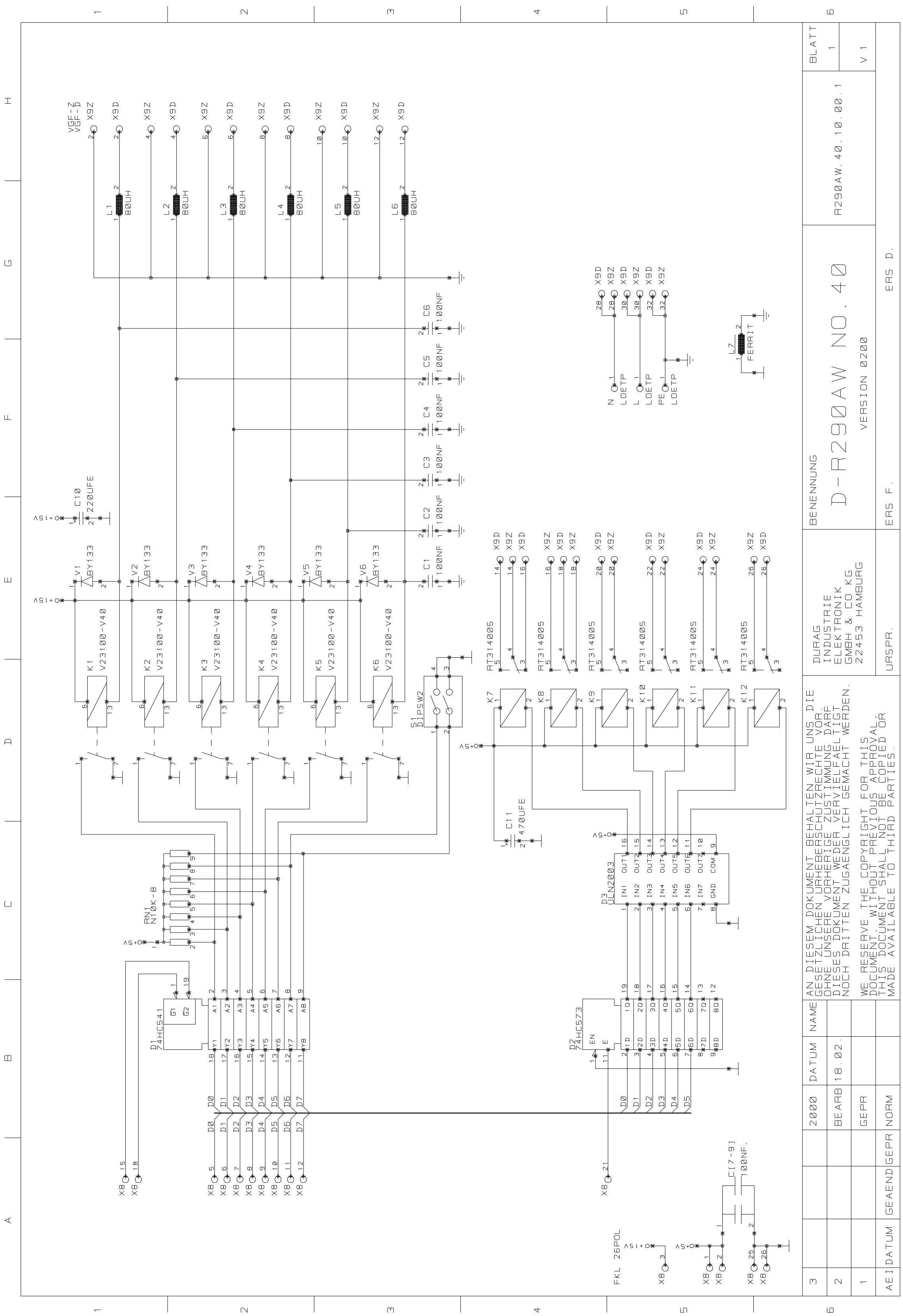
7 Recommended Spare Parts

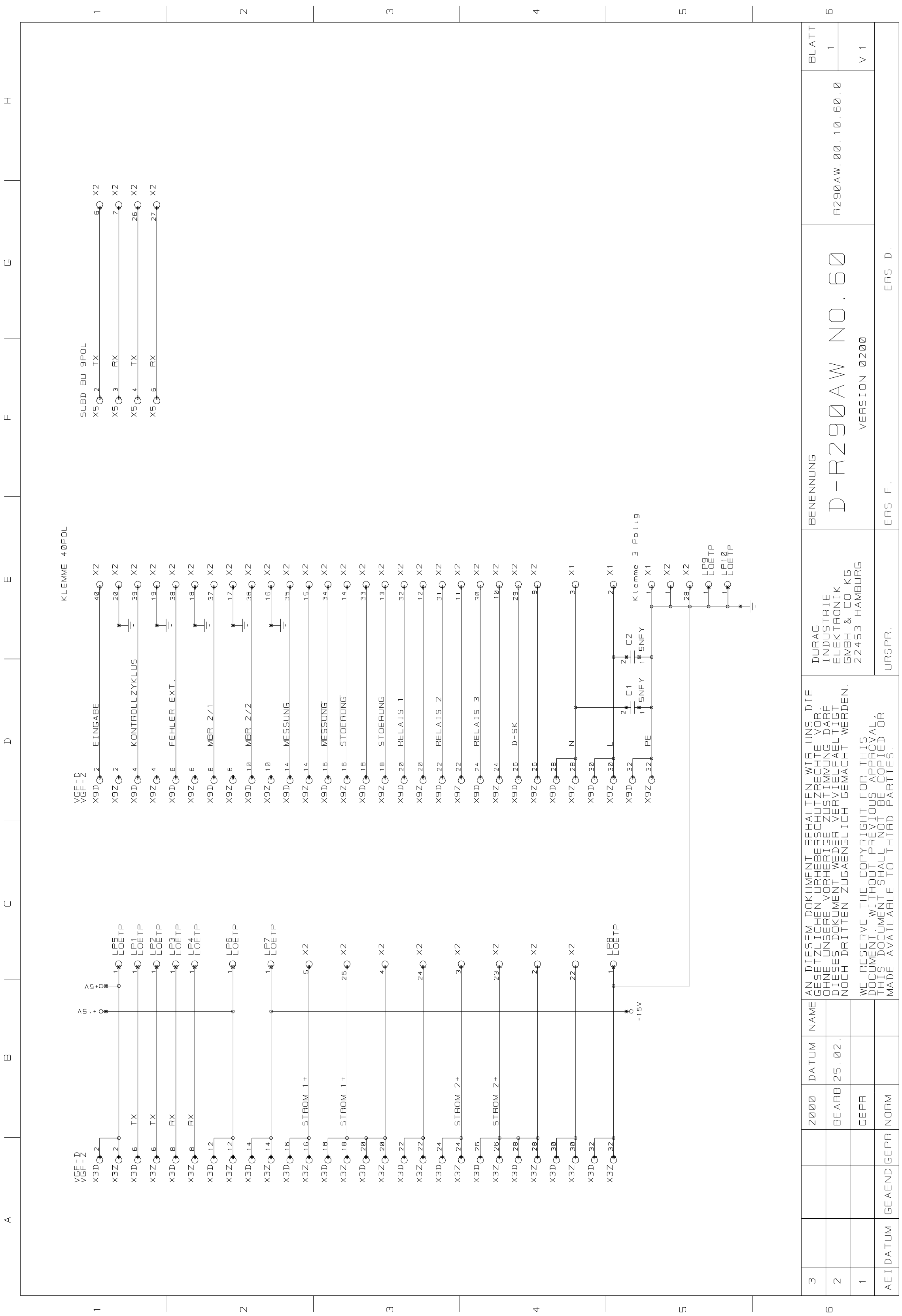
Part Number	Description
	Mounting
	Measuring Head / Reflector
	Super Wide Band Diode
	Main board
	PC board with light barrier
	Photo element with PCB
	Fuse A, per 10 pcs. (mains: 230V)
	Fuse A, per 10 pcs. (mains: 115V)
	Heated Disk
	Internal Zero Point Reflector
	Stepper Motor
	Reflector Insert Type I (1.0 - 2.25 m)
	Reflector Insert Type II (1.75-12.0 m)
	Control Unit
	CPU Board
	Relay Board
	Display / Data Entry
	Internal Back plane
	External Back plane (in wall mount housing)
	Power supply
	Purge Air Unit
	Filter Housing FPG05 7505
	Filter Cartridge P77-5308 for FPG05 7505
wdiluftsch280	Air Hose for blower, price per foot, diam. 50 mm
	Accessories

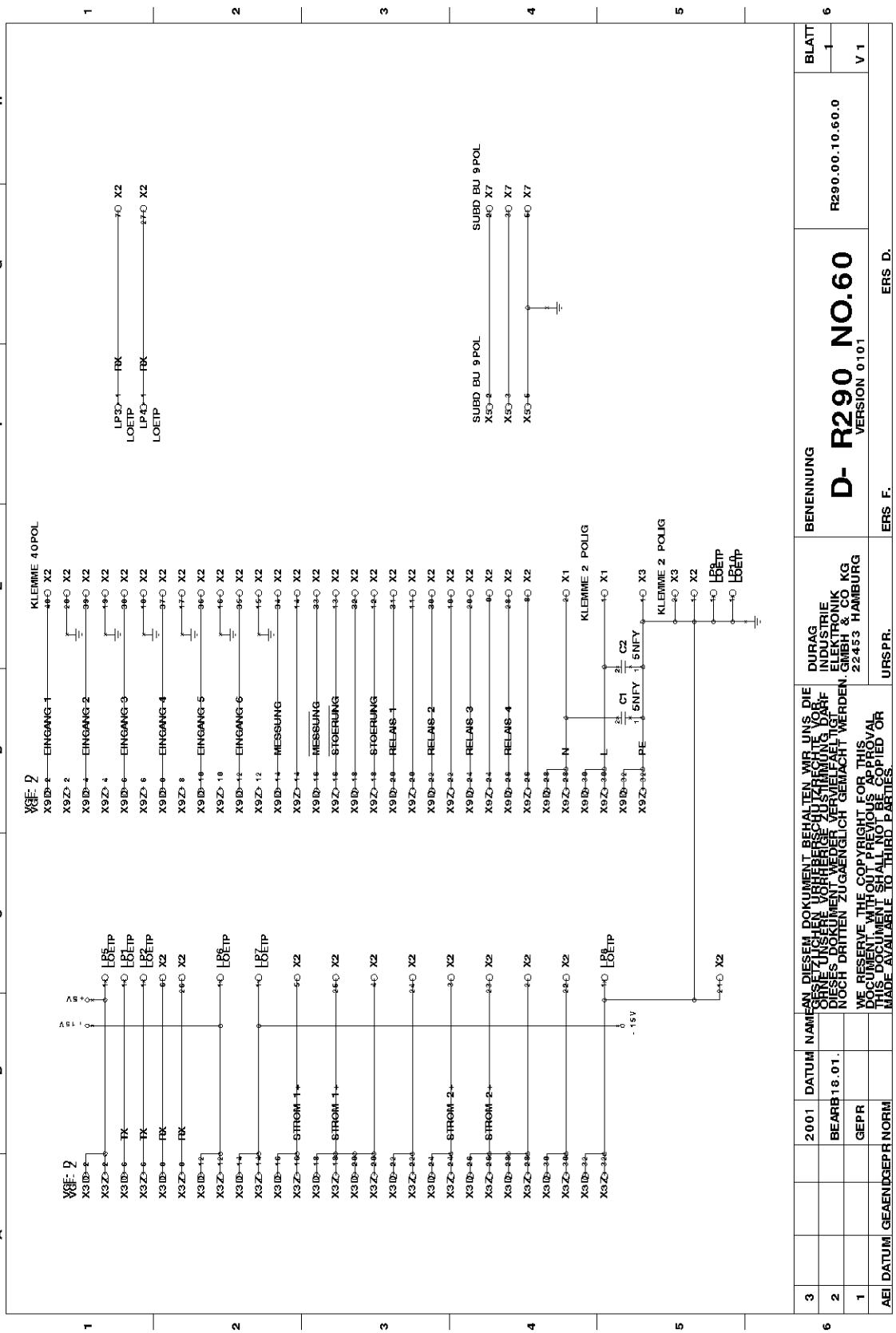
8 Schematics

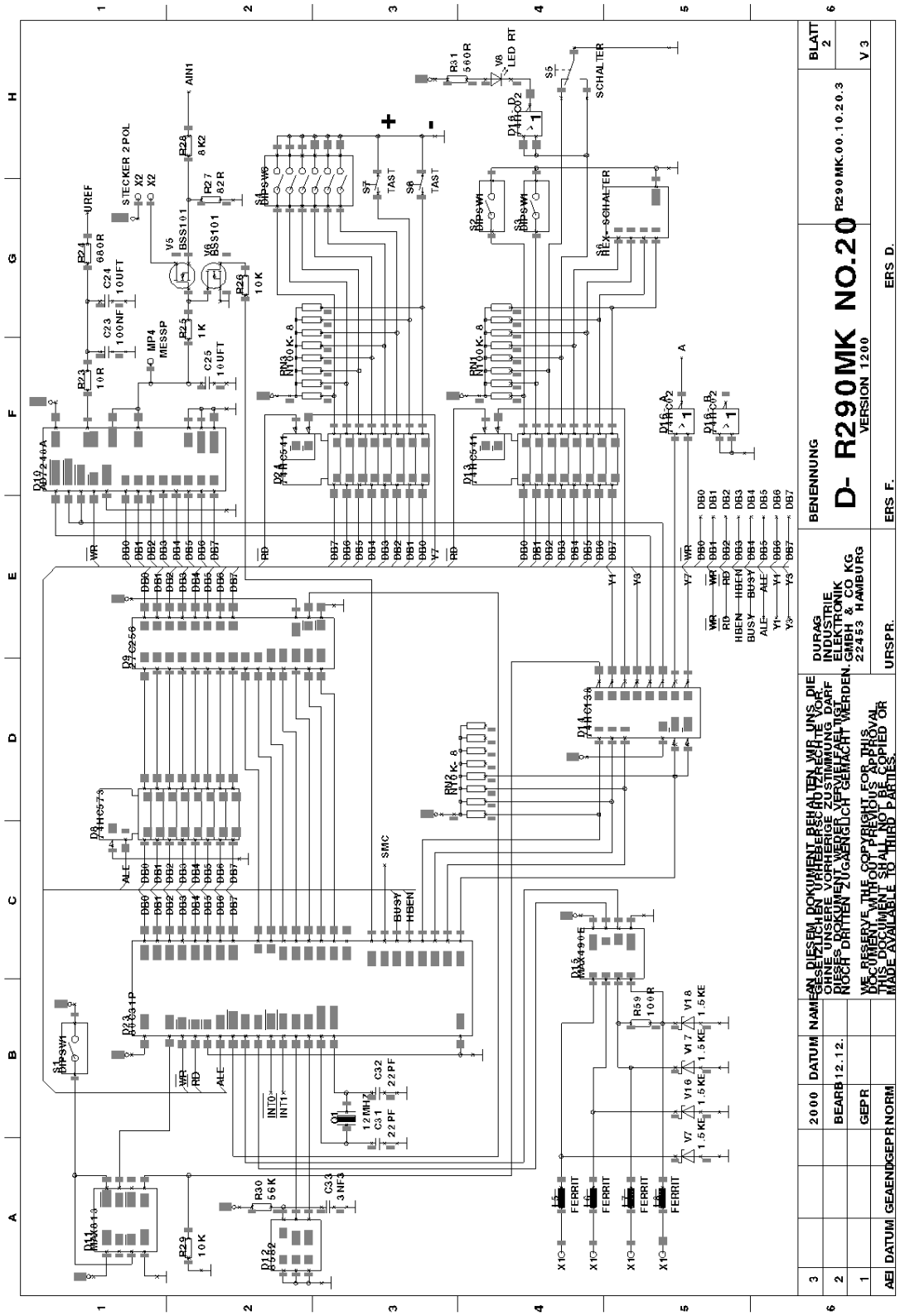


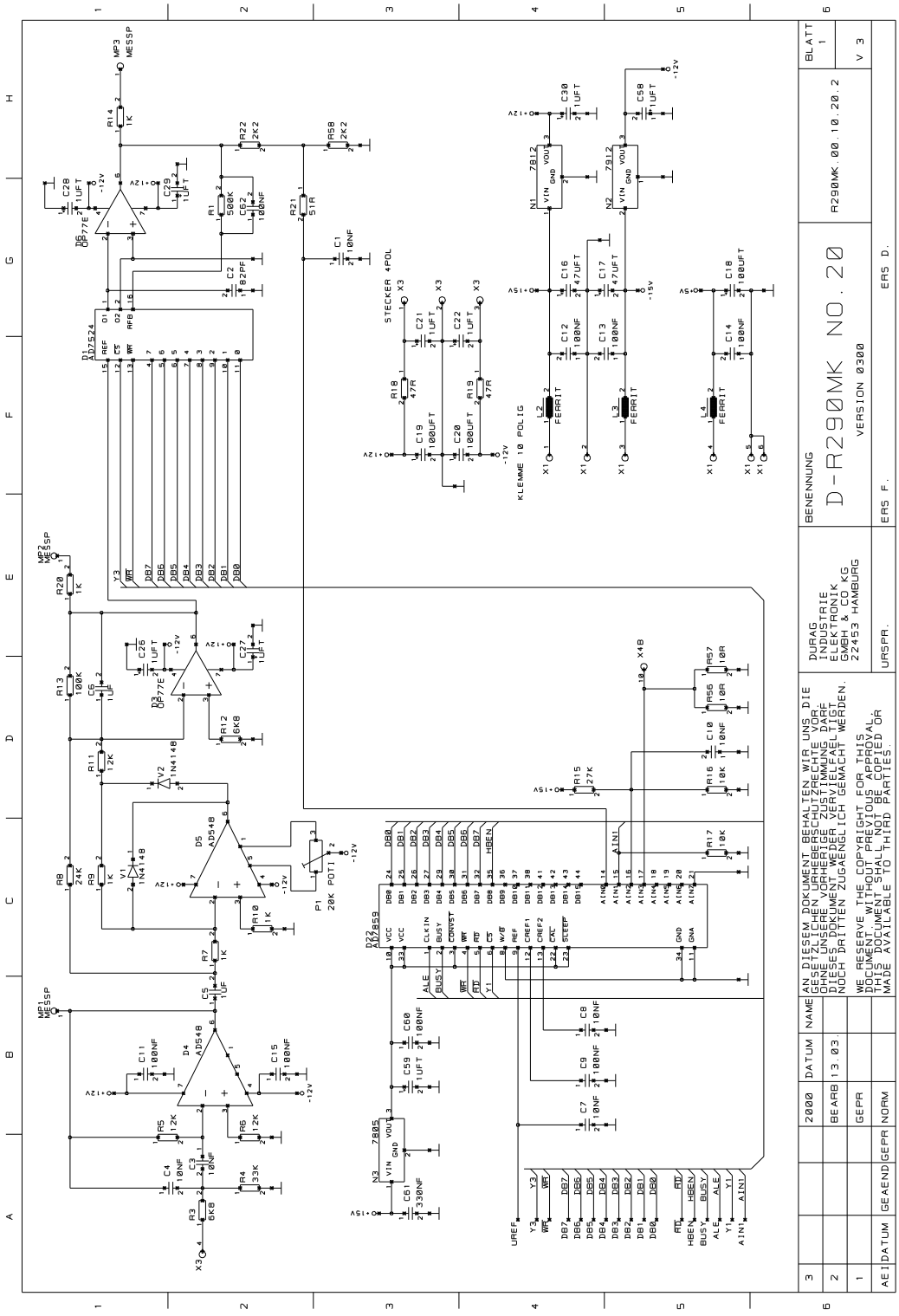

DURAG
INDUSTRIE
ELEKTRONIK
GMBH & CO KG
22453 HAMBURG
BENENNUNG
D-R290AW NO. 30
VERSION 0200
R290AW.30.10 00.1
BLATT 1
V 2
ERS F.
ERS D.
URSPR.
DATUM
NAME
2000
BEARB 18.02.
GEPR
NORM
GEAEND
GEPR
AN DIESEM DOKUMENT BEHALTEN WIR UNS DIE
GESETZLICHEN URHEBERRECHTE VOR.
OHNE UNSERE AUSDRUECKLICHE ZUSTIMMUNG DARF
DIESES DOKUMENT WEDER VERVIELFAELTIGT
NOCH DRITTEN ZUGAENGLICH GEMACHT WERDEN.
WE RESERVE THE COPYRIGHT FOR THIS
DOCUMENT. WITHOUT PREVIOUS APPROVAL
THIS DOCUMENT MUST NOT BE COPIED OR
MADE AVAILABLE TO THIRD PARTIES.

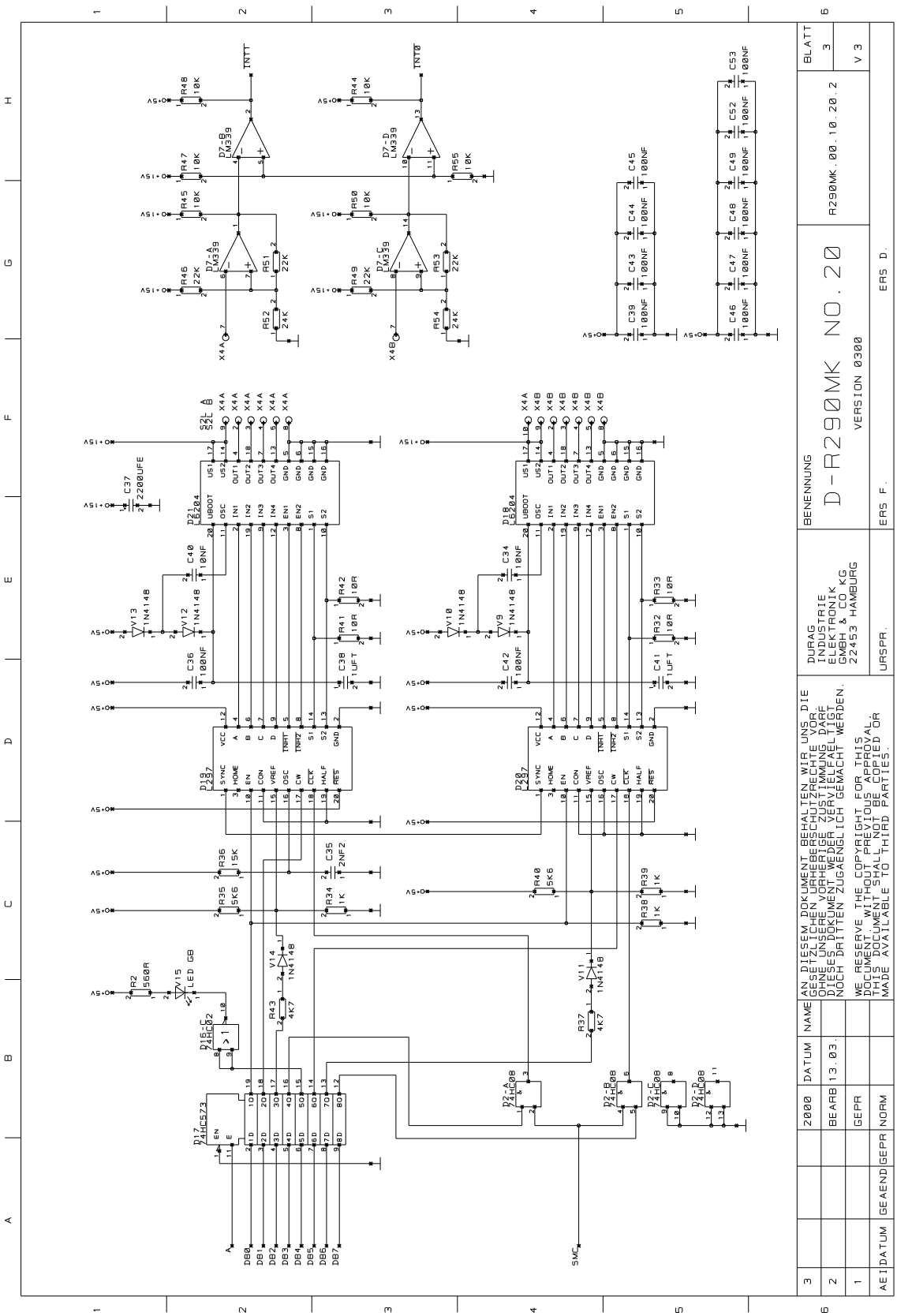

D-R290AW NO. 40
VERSION 0200
R290AW.40.10.00.1
DURAG INDUSTRIE ELEKTRONIK GMBH & CO KG 22453 HAMBURG
BENENNUNG
BLATT

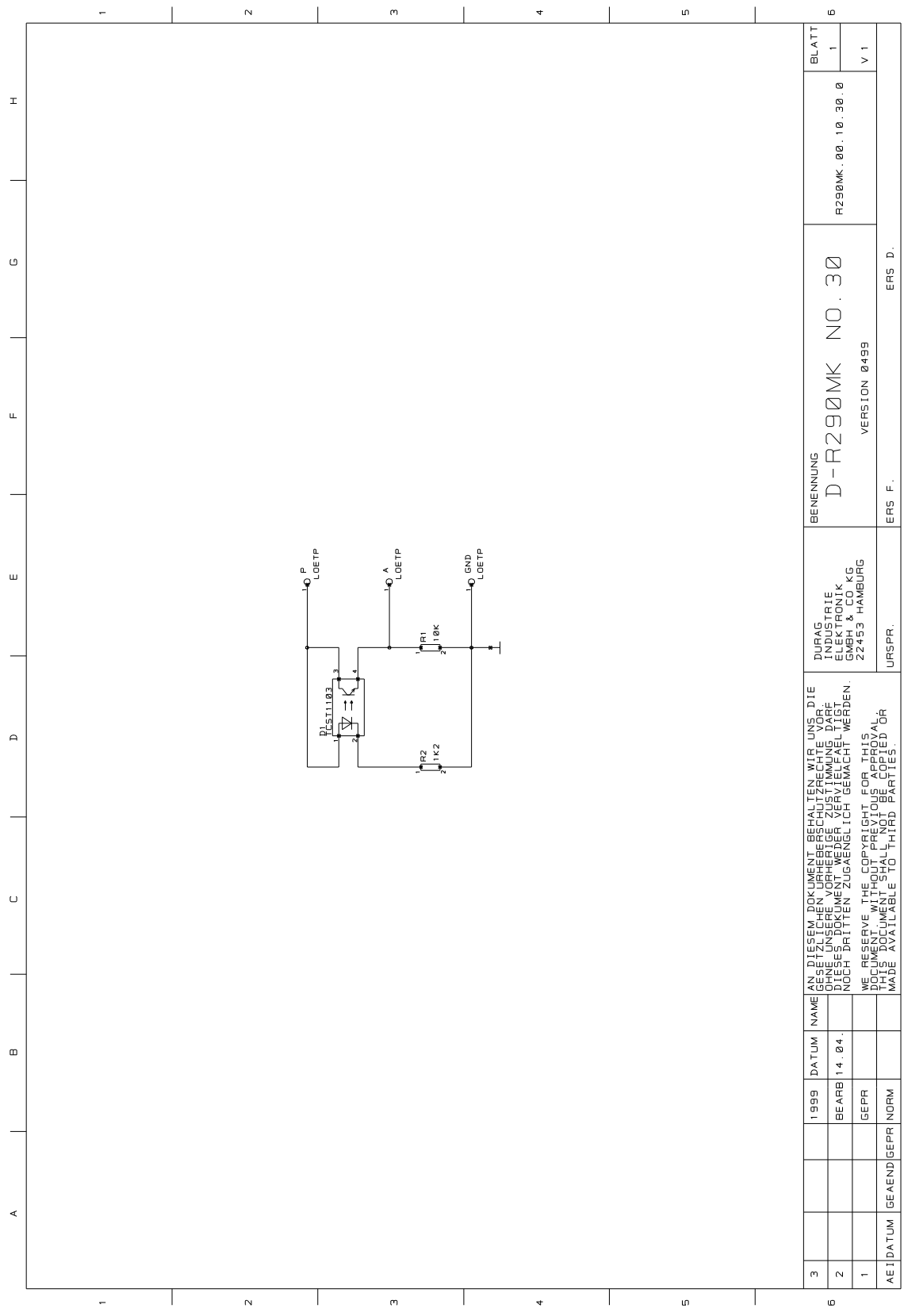

BENENNUNG
D-R290AW NO.60
VERSION 0200
R290AW.00.10.60.0
BLATT
1
V 1
DURAG
INDUSTRIE
ELEKTRONIK
GMBH & CO KG
22453 HAMBURG
KLEMME 40POL
SUBD BU 9POL


KLEMME 40POL
SUBD BU 9POL
SUBD BU 9POL
KLEMME 2 POLIG
KLEMME 2 POLIG
D- R290 NO.60
VERSION 0101
R290.00.10.60.0
DURAG INDUSTRIE ELEKTRONIK GMBH & CO KG 22453 HAMBURG
BENENNUNG
BLATT 1
V 1
2001
BEARB 18.01.
GEPR
DATUM
NAME
URSPR.
ERS F.
ERS D.
AEI DATUM GEAEND GEPR NORM
WE RESERVE THE COPYRIGHT FOR THIS DOCUMENT, WITHOUT PREVIOUS APPROVAL THIS DOCUMENT SHALL NOT BE COPIED OR MADE AVAILABLE TO THIRD PARTIES.
AN DIESEM DOKUMENT BEHALTEN WIR UNS DIE GESETZLICHEN URHEBERRECHTE VOR. OHNE UNSERE VORHERIGE ZUSTIMMUNG DARF DIESES DOKUMENT WEDER VERVIELFAELTIGT NOCH DRITTEN ZUGAENGLICH GEMACHT WERDEN.


D- R290MK NO.20
VERSION 1200
P290MK.00.10.20.3
DURAG INDUSTRIE ELEKTRONIK GMBH & CO KG 22453 HAMBURG
BENENNUNG
BLATT 2
V 3
ERS F.
ERS D.
URSPR.
DATUM NAME
2000
BEARB 12.12.
GEPR
NORM
DATUM GEAEND GEPR
AEI


DURAG INDUSTRIE ELEKTRONIK GMBH & CO KG 22453 HAMBURG
BENENNUNG
D-R290MK NO. 20
VERSION 0300
R290MK.00.10.20.2
BLATT 1
V 3
ERS F.
ERS D.
URSPR.
DATUM
NAME
2000
BEARB 13.03
GEPR
NORM
GEAEND
GEPR
AENDERUNG
DATUM
AN DIESEM DOKUMENT BEHALTEN WIR UNS DIE GESETZLICHEN URHEBERSCHUTZRECHTE VOR. DIESES DOKUMENT DARF WEDER VERVIELFAELTIGT NOCH DRITTEN ZUGAENGLICH GEMACHT WERDEN.
WE RESERVE THE COPYRIGHT FOR THIS DOCUMENT. WITHOUT PREVIOUS APPROVAL, THIS DOCUMENT SHALL NOT BE COPIED OR MADE AVAILABLE TO THIRD PARTIES.


D-R290MK NO. 20
VERSION 0300
R290MK.00.10.20.2
DURAG INDUSTRIE ELEKTRONIK GMBH & CO KG 22453 HAMBURG
AN DIESEM DOKUMENT BEHALTEN WIR UNS DIE GESETZLICHEN URHEBERSCHUTZRECHTE VOR. DIESES DOKUMENT WEDER VERVIELFAELTIGT NOCH DRITTEN ZUGAENGLICH GEMACHT WERDEN.
WE RESERVE THE COPYRIGHT FOR THIS DOCUMENT. WITHOUT OUR APPROVAL THIS DOCUMENT SHALL NOT BE COPIED OR MADE AVAILABLE TO THIRD PARTIES.


P
LOETP
A
LOETP
GND
LOETP
R1
10K
R2
1K2
DURAG
INDUSTRIE
ELEKTRONIK
GMBH & CO KG
22453 HAMBURG
BENENNUNG
D-R290MK NO.30
VERSION 0499
R290MK.00.10.30.0
BLATT
1
V 1
URSPR.
ERS F.
ERS D.
AN DIESEM DOKUMENT BEHALTEN WIR UNS DIE
GESETZLICHEN URHEBERRECHTE VOR.
OHNE UNSERE VORHERIGE ZUSTIMMUNG DARF
DIESES DOKUMENT WEDER VERVIELFAELTIGT
NOCH DRITTEN ZUGAENGLICH GEMACHT WERDEN.
WE RESERVE THE COPYRIGHT FOR THIS
DOCUMENT WITHOUT PREVIOUS APPROVAL.
THIS DOCUMENT SHALL NOT BE COPIED OR
MADE AVAILABLE TO THIRD PARTIES.
NAME
DATUM
1999
BEARB 14.04.
GEPR
NORM
GEAEND
GEPR
DATUM

9 Notes