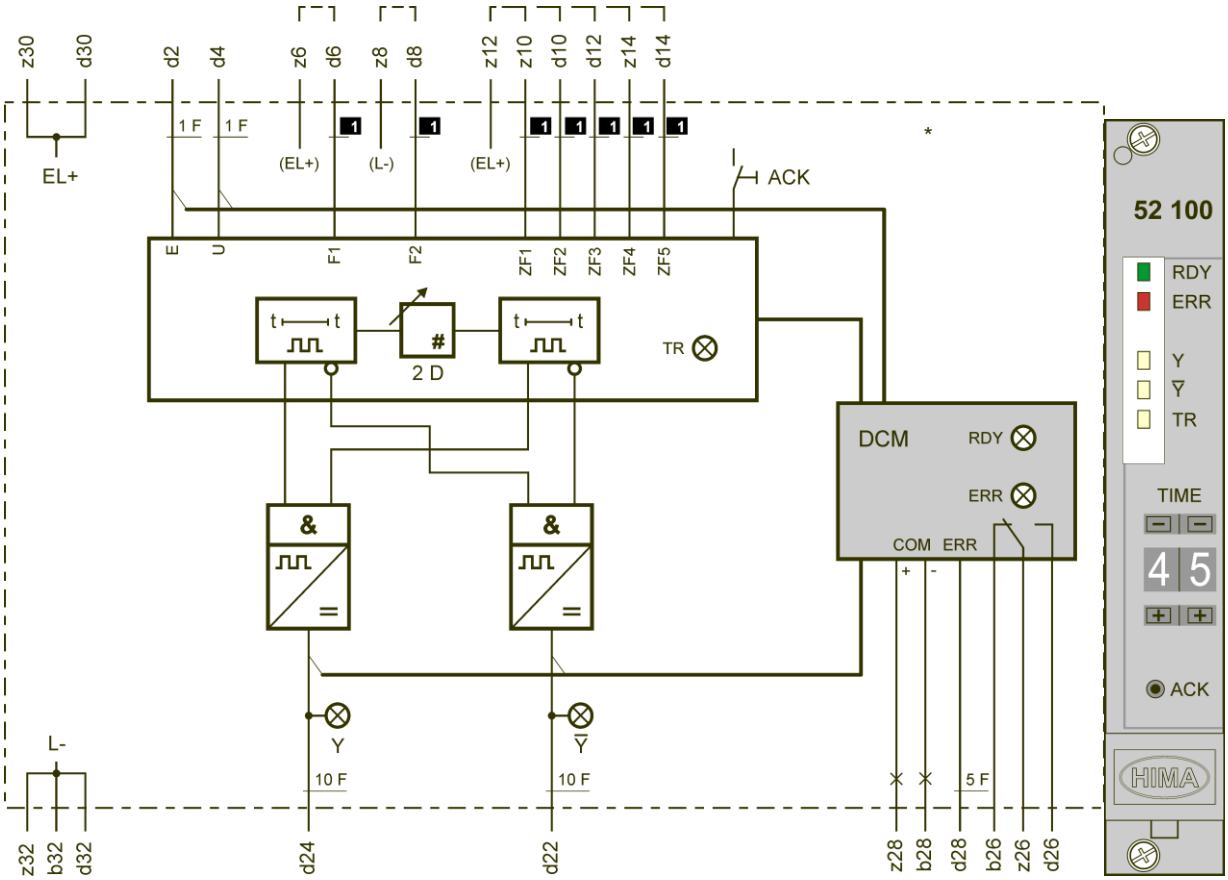
52 100: Time Delay Module

Safety-related

The module can be used for the following applications:

- With 1oo1 wiring in accordance with IEC 61508 for SIL 3 applications.
- With redundant wiring (1oo2 or 2oo3) for SIL 4 applications.



Outputs are short-circuit-proof

1 Connection to EL+ or L-, depending on the function

Figure 1: Block Diagram

The maximum cable length within the control cabinet between the 52 100 time delay module and other modules may not exceed 3 m.

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Selection	Time range	Resolution
ZF1	0.1...9.9 s	0.1 s
ZF2	1...99 s	1 s
ZF3	10...990 s	10 s
ZF4	60...5 940 s	60 s
ZF5	600...59 400 s	600 s

Table 1: Time Range Settings

Time accuracy	< 0.1 % of the setpoint
Fundamental deviation	-10...+90 ms

The 1-signals at the outputs Y and $\bar{Y}$ do not overlap (gap of approx. 20 ms).

Switching time	Y approx. 45 ms
	$\bar{Y}$ approx. 25 ms
Reset time	Y approx. 20 ms
	$\bar{Y}$ approx. 40 ms
Operating data	24 VDC / 100 mA
Space requirement	3 RU, 4 HP

The safety-related time delay module is composed of a two-channel safety-related processor system. Each processor system processes the specified time function and performs self-tests and monitoring. The module is initialized after the supply voltage was connected or by pressing the *ACK* key (after a fault). After initialization, the safety-related outputs Y and $\bar{Y}$ are in proper working condition.

To configure the time, connect EL+ to one of the time factor inputs ZF1…ZF5 and set the two-decade pre-selector on the front plate. The delay or pulse time t_d is calculated as follows:

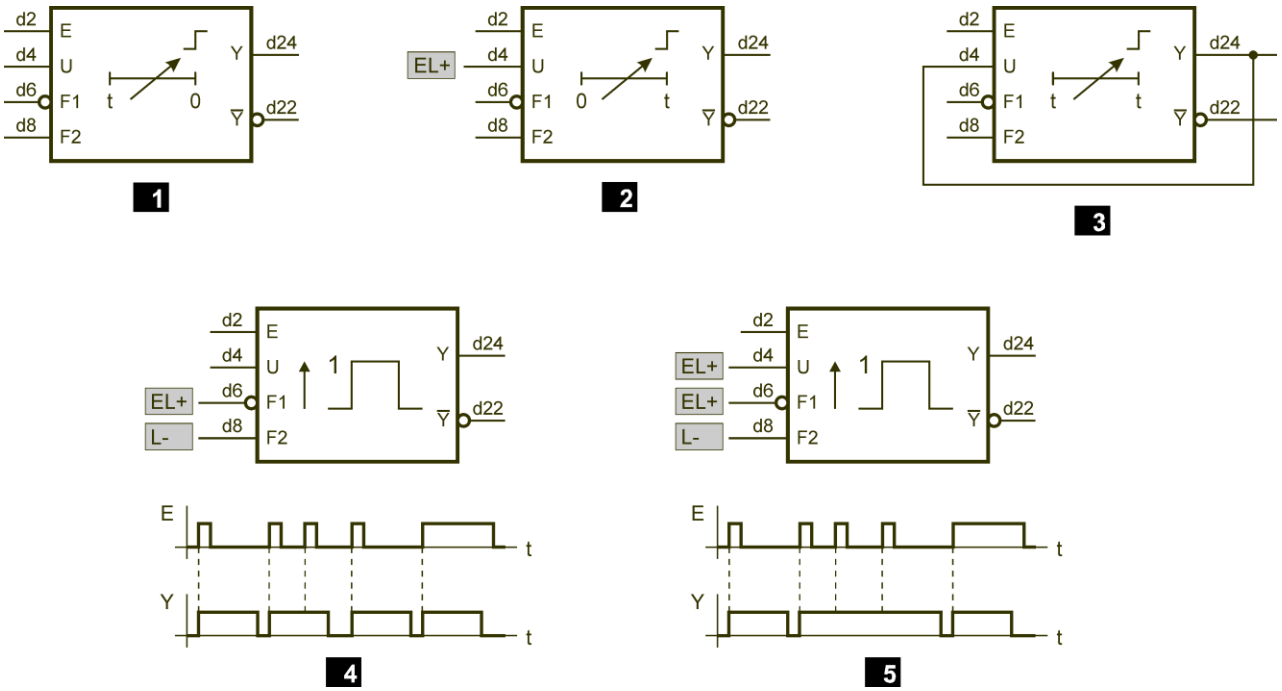
t_d = Resolution x value of the decade selector

During operation, no changes to the switching input (U) with occurring pulses, to the function inputs (F1, F2) or to the time factor inputs (ZF1…ZF5) are permitted. When the settings are changed for the decade selector (LED TR is blinking), press the *ACK* key within 60 s or reset the parameter to its previous value to prevent the module from entering the error state. A time change is only adopted after a new activation.

If an internal error or component fault occurs, the two outputs Y and $\bar{Y}$ are switched to 0 (no output signal), and the ERR output is set to 1. While the time is running, the time can tend to infinity for function 0-1 delay, whereas for function 1-0 delay and for pulsed functions, it can tend to zero.

Functions

The following wiring (control signal at input E) can be used to achieve the functions:



1 0-1 delay (VESA)
2 1-0 delay (SEVA)
3 0-1 and 1-0 delay (VEVA)
4 Pulse 0-1
5 Pulse 0-1, retriggable (watchdog function)

Figure 2: Functions

Description of the LEDs

Ȳ, Y (yellow)	Indicators for the Ȳ and Y outputs
TR (yellow)	Time span (continuous light)
	Initialization (continuous light)
	Time change (blinking light)

All the module functions are monitored by a microcontroller.

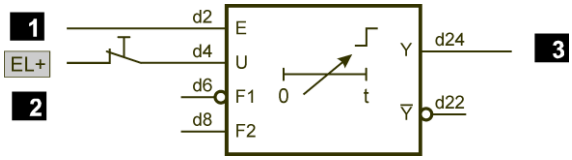
This also applies to functions that are not detected by the safety-related part since failures may cause the module to enter the safe state (e.g., component failure at the control input E)

If a malfunction occurs, the ERR LED is lit, output d28 is on 1-signal and relay contact z26-d26 opens. Output z28-b28 is intended for connecting to the communication module, e.g., for transferring data to a distributed control system (DCS).

RDY (Ready) indicates the applied voltage (≥ 20 V).

Notes

For the function 1-0 delay (SEVA), a running time can be reset to zero (i.e., time expired) via a short interruption of EL+ at the d4 input (e.g., using a key):



1 Control signal

2 1-0 delay (SEVA)

3 Output reset to 0 by pressing a key

Figure 3: 1-0 Delay (SEVA)

Notices

To protect the time settings, the module must be configured such that only authorized users may modify them.

To obtain the safety time, add 75 ms (maximum fault detection and response time) to the selected delay time.

Function Requirements

Name	Function	Reliability
0-1 delay (VESA)	Delayed on, immediately off	For applications in which the configured time may be increased but not decreased.
1-0 delay (SEVA)	Immediately on, delayed off	For applications in which the configured time may be decreased but not increased.
0-1 and 1-0 delay (VEVA)	Delayed on, immediately off	When switching on: For applications in which the configured time may be increased but not decreased. When switching off: For applications in which the configured time may be decreased but not increased.
Pulse	When the input signal changes from 0 to 1	For applications in which the configured time may be decreased but not increased.

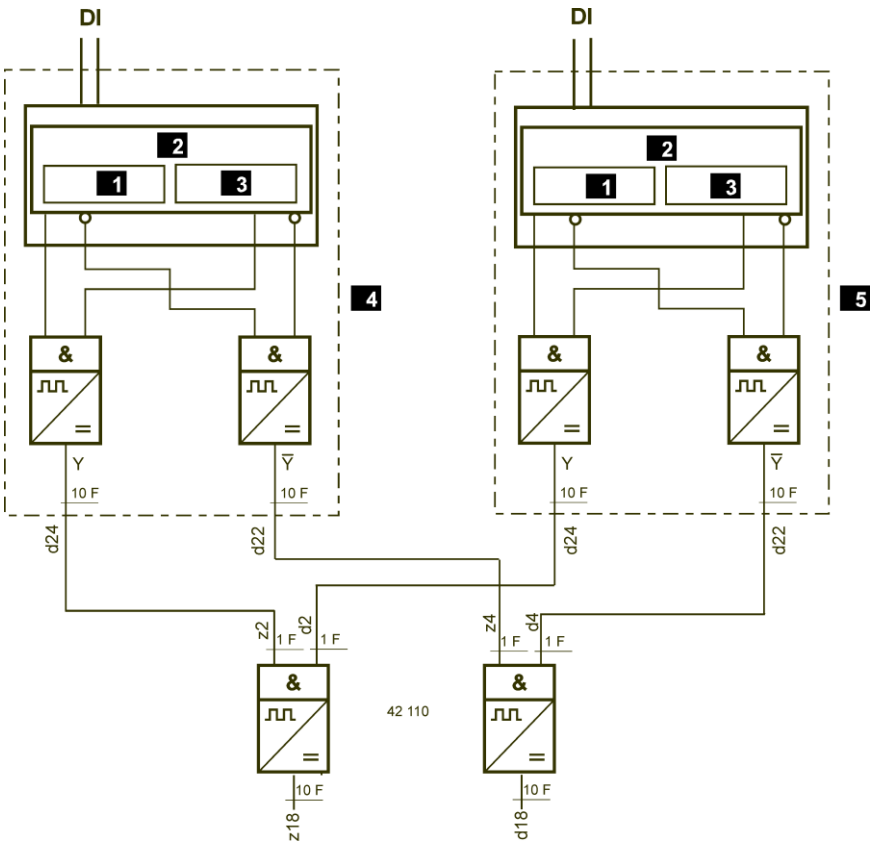
Table 2: Requirements for Using the Functions

Proof Test

The 52 100 module must be subject to a proof test in intervals of 10 years.

Redundant 1oo2 Wiring for SIL 4 Applications

Two 52 100 time delay modules are redundantly connected via their digital inputs. Both modules use the same delay setting and their outputs are connected via AND gate (42 110 module). If one of the two 52 100 time delay modules fails, the outputs are set to the safe state.

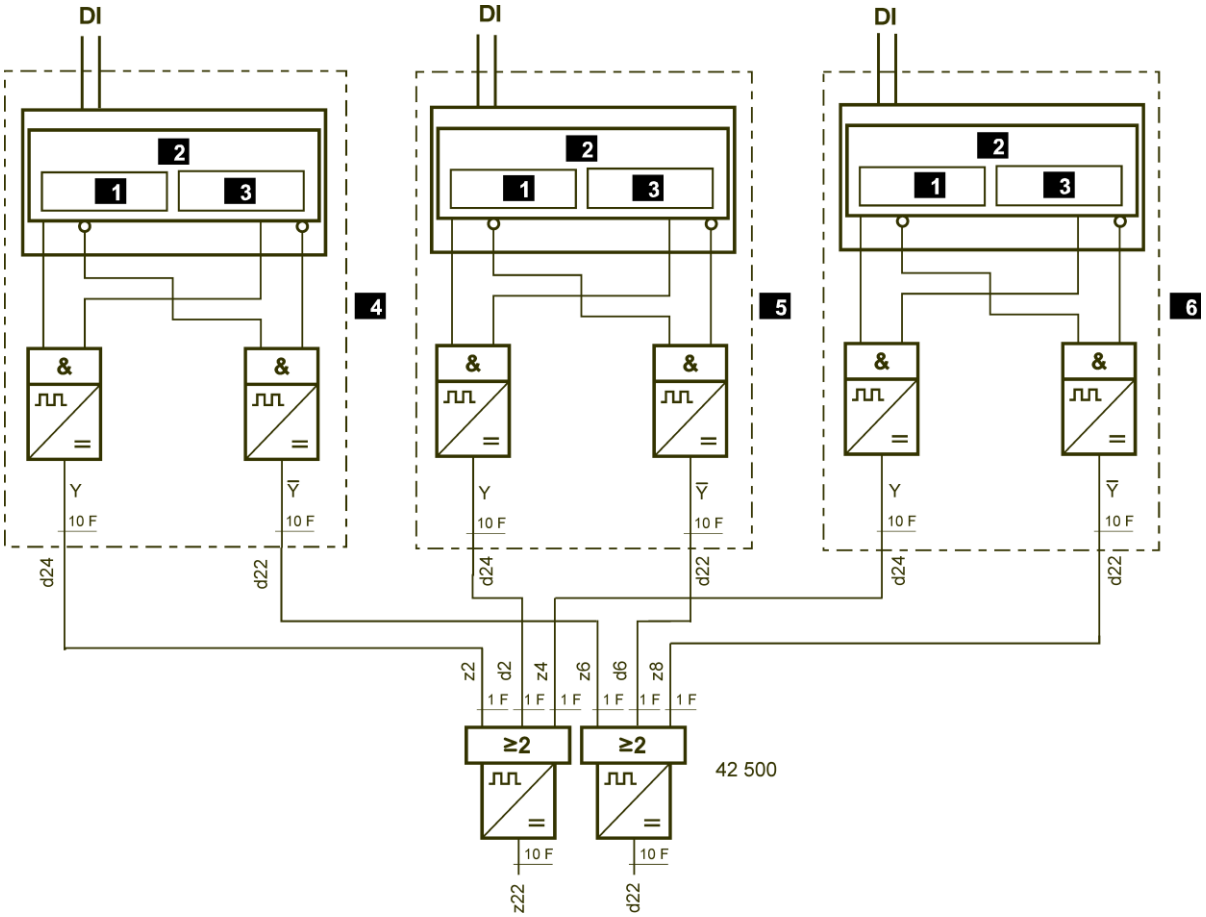


1 Processing unit 1
2 1oo2 system
3 Processing unit 2
4 Module 1
5 Module 2

Figure 4: Redundant 1oo2 Wiring for SIL 4 Applications

Redundant 2oo3 Wiring for SIL 4 Applications

Three 52 100 time delay modules are redundantly connected via their digital inputs. The three modules use the same limit value setting and their outputs are connected through a 2oo3 voting element (e.g., the 42 500 module). If two of the 52 100 modules fail, the outputs are set to the safe state.



1 Processing unit 1
2 1oo2 system
3 Processing unit 2
4 Module 1
5 Module 2
6 Module 3

Figure 5: Redundant 2oo3 Wiring for SIL 4 Applications

Communication via Modbus

Read Variables

Type BOOL: Function code 1
Type WORD: Function code 3
Events: Function codes 65, 66, 67

Relative address	Data type	Value	Description	Relative event no.
0	WORD	E1 H	Module type 52 100	
1	BOOL	0	None	
2	BOOL	1	Module removed	
3	BOOL	1	Communication with module not ok	
4	BOOL	1	Module in slot, communication ok	
5	BOOL	1	Operating voltage too low, no RDY	
6	BOOL	1	Module fault, ERR	
7...8	BOOL	0	None	
9	BOOL	1	1-signal on control input d2	0
10	BOOL	1	1-signal on switching input d4	1
11...24	BOOL	0	None	
25	WORD	0...65 535	Residual time in seconds	
26	BOOL	1	1-signal at output d22 $\bar{Y}$	24
27	BOOL	1	1-signal at output d24 Y	25
28...33	BOOL	0	None	

Table 3: All Specifications of the 52 100 Module

Value: 0 always has the opposite meaning
H: Hexadecimal value
Absolute address: A = p * 256 + relative address
Absolute event no.: E = (p - 1) * 32 + relative event no.
p = Slot no. in the subrack

Reading of All Variables

Function code 3, 84 WORDS

Starting with address 2000 H, 3000 H or 4000 H

	WORD 0 (16-bit)		WORD 1 (16-bit)		WORD 2 (16-bit)	WORD 3 (16-bit)	
Relative address	0	8…1	24…17	16…9	25		33…26
Data	Module type	Module status	None	None	Residual time in s	None	Outputs

For error-free data transfer, all 84 WORDS must be read. This ensures that the variables of all the modules within a subrack are transferred. 0 is transferred for unused module slots.

Communication via PROFIBUS DP

Read Variables

Relative addresses of WORD and BYTE type

Module state, signals at the outputs

WORD	Bit	BYTE	Bit	Value	Description
0	0...7	0	0...7	E1 H	Module type 52 100
	8	1	0	0	None
	9		1	1	Module removed
	10		2	1	Communication with module not ok
	11		3	1	Module in slot, communication ok
	12		4	1	Operating voltage too low, no RDY
	13		5	1	Module fault, ERR
	14		6	0	None
	15		7	0	None
1	0	2	0	1	1-signal on control input d2
	1		1	1	1-signal on switching input d4
	2...7		2...7	0	None
	8...15	3	0...7	0	None
2	8...15	4	0...7	0...127	Residual time (high byte) in seconds
	0...7	5	0...7	0...127	Residual time (low byte) in seconds
3	0	6	0	1	1-signal at output d24 $\bar{Y}$
	1		1	1	1-signal at output d22 Y
	2...7		2...7	0	None
	8...15	7	0...7	0	None

Table 4: Module State, Signals at the Outputs

Value: 0 always has the opposite meaning
H: Hexadecimal value

Absolute address WORD: W = 4 * (p - 1) + relative address

Absolute address BYTE: B = 8 * (p - 1) + relative address
p = Slot no. in the subrack

Safety Parameters

The following table specifies the PFD, PFH and SFF values for a mono 52 100 module (1oo1) and for the redundant wiring variants (1oo2 and 2oo3).

Parameter	1oo1	1oo2	2oo3
PFD	$8.333359*10^{-6}$ /h	$6.627255*10^{-7}$ /h	$6.656553*10^{-7}$ /h
PFH	$7.546215*10^{-10}$ /h	$7.198501*10^{-10}$ /h	$7.290996*10^{-10}$ /h
SFF	99.764 %	99.7647 %	99.7647 %
Proof test interval	10 years		