

7.2 DI450

7.2.1 General Information

The DI450 is equipped with the following functions:

- Standard digital inputs
- 4 Counter inputs
- 2 Channels for gate or period measurement

7.2.2 Order Data

Model Number	Short Description	Figure
3DI450.60-9	2005 digital input module, 16 inputs 24 VDC, 1 ms / 10 ms, sink or sink/source, 4 electrically isolated input groups, 4 counter inputs, 100 kHz, gate or period measurement. Order TB170 terminal block separately.	
3TB170.9	2005 terminal block, 20-pin, screw clamps	
3TB170.91	2005 terminal block, 20-pin, cage clamps	
3TB170.90-02	2005 terminal block, 20-pin, 20 pcs., screw clamps	
3TB170.91-02	2005 terminal block, 20-pin, 20 pcs., cage clamps	
Terminal blocks not included in the delivery (see "Accessories").		

Table 95: DI450 order data

7.2.3 Technical Data

Product ID	DI450
C-UL-US Listed	Yes
B&R ID Code	\$08

Table 96: DI450 technical data

Product ID	DI450
Number of Inputs Total in 4 Groups of	16 4
Type of Inputs Channels 1 - 4 Channels 5 - 6 Channels 7 - 16	8-bit counter Gate, period measurement (starting with Rev. 30.00) Digital input
Electrical Isolation Input - PLC Group - Group Input - Input (same group)	Yes (optocoupler) Yes (optocoupler) No
Wiring Groups 1 + 2 (input 1 - 8) Groups 3 + 4 (input 9 - 16)	Sink Sink or source
Input Voltage Nominal Maximum	24 VDC 30 VDC
Input current at 24 VDC at 30 VDC	Approx. 8 mA Approx. 10 mA
Input Resistance	2.8 k Ω
Switching Threshold LOW Range Switching range HIGH Range	< 5 V 5 to 15 V > 15 V
Input Delay for inputs 1 - 8 Typical Max. for inputs 9 - 16 Typical Max.	1 ms 1.2 ms 10 ms 12 ms
Counter Inputs Inputs Counter Size Count Frequency	1 - 4 8-bit (individual) ¹⁾ Max. 100 kHz
Gate Measurement Channels Gate Frequency Gate Pause	5 and 6 Max. 10 kHz > 50 μ s
Period Measurement (Rev. 30.00 and up) Channels Input Frequency	5 and 6 Max. 10 kHz
Maximum Peak Voltage	500 V for 50 μ s max. every 100 ms
Power Consumption 5 V 24 V Total	Max. 2 W --- Max. 2 W
Dimensions	B&R 2005 single-width

Table 96: DI450 technical data (cont.)

1) Counter inputs 1 and 2 as well as 3 and 4 can be linked together as a 16-bit counter.

7.2.4 Status LEDs

Figure	LED	Description
	1 - 16	The status LEDs indicate the logical status of the corresponding inputs. Regardless of the type connection (sink or source connection), the LED is lit if the input is logical 1, i.e. when the current flows through the optocoupler.

Table 97: DI450 status LEDs

7.2.5 Pin Assignments

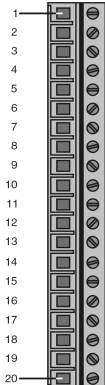
	Connection	Assignment			
 TB170	1	COM (1-4)			Group 1
	2	Input 1	Counter 1: 8-bit		
	3	Input 2	Counter 2: 8-bit	Counter 1 and 2: 16-bit	
	4	Input 3	Counter 3: 8-bit		
	5	Input 4	Counter 4: 8-bit	Counter 3 and 4: 16-bit	
	6	Input 5	Gate/Period Measurement Channel 2: 16-bit		Group 2
	7	Input 6	Gate/Period Measurement Channel 4: 16-bit		
	8	Input 7			
	9	Input 8			
	10	COM (5-8)			Group 3
	11	COM (9-12)			
	12	Input 9			
	13	Input 10			
	14	Input 11			
	15	Input 12			Group 4
	16	Input 13			
	17	Input 14			
	18	Input 15			
	19	Input 16			
	20	COM (13-16)			

Table 98: DI450 pin assignment

7.2.6 Pulse Measurement

Channels 1 to 4 can be used as 8-bit counter inputs (input frequency max. 100 kHz). Channel pairs 1 and 2 as well as 3 and 4 can be linked together as 16-bit counters. In this case, the counter inputs for the channel are 2 or 4.

The counters run continually. This means an overflow is not recognized. The application program can read the counter states and e.g. use the previous cycle value for the differential peak.

Reset / Enable

All counters are automatically reset and then enabled with a hardware reset. The counter status is increased with every negative edge (change from logical 1 to logical 0) of the respective input.

A reset causes one or more counters to be set to zero. Counting begins after the counter is enabled again. Since the status out byte is only written to at the end of a task cycle, the reset and enable must be carried out in two different task cycles.

To avoid pulses from the configuration process, a reset of the effected counter is necessary after counter configuration.

Connection Examples for Pulse Measurement

Example 1: 8-bit counter for inputs 1 - 4

Configuration Register: \$00

Pin Assignments:

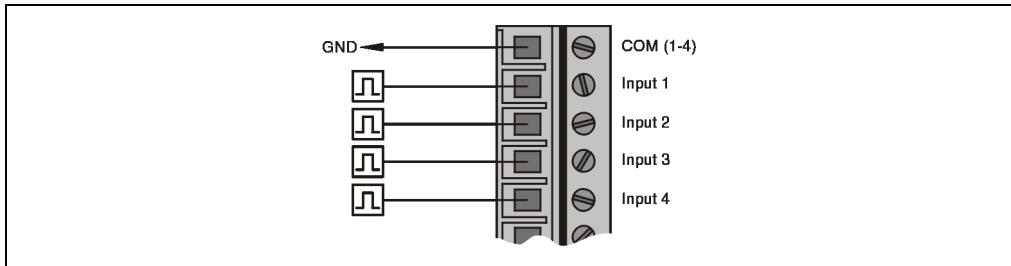


Figure 81: DI450 connection example 1 for pulse measurement

Example 2: 16-bit counter for inputs 2 and 4

Configuration Register: \$03

Pin Assignments:

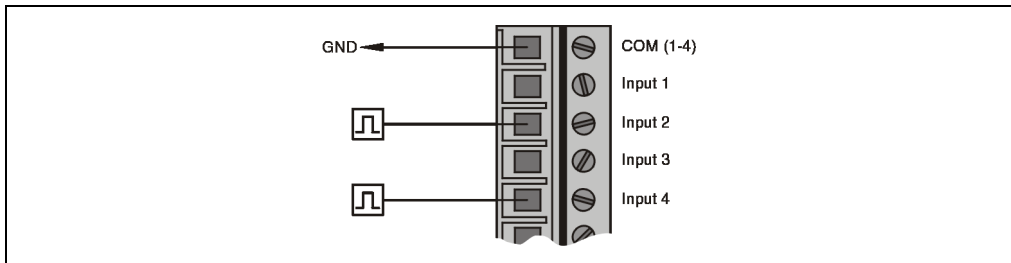


Figure 82: DI450 connection example 2 for pulse measurement

7.2.7 Gate Measurement

A signal connected to channel 5 or 6 can be evaluated using gate measurement. The resolution is 16-bit. The frequency of the signal to be measured can be a maximum of 10 kHz. The signal to be measured is also called the gate frequency. The pause between two gate measurements must be larger than 50 μ s.

An internal or external counter frequency can be selected for the measurement. The setting is made with the configuration register.

- Internal counter frequency (31250 Hz or 4 MHz)
- External counter frequency (max. 100 kHz)

The external counter frequency is connected to inputs 2 (for counters 1/2) and 4 (for counters 3/4).

Gate Measurement Principle

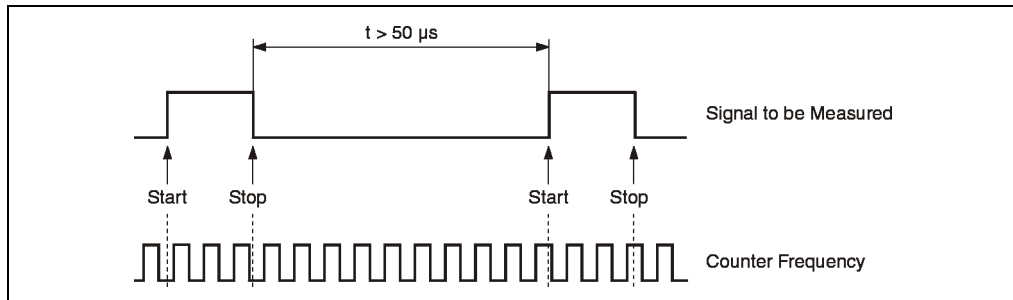


Figure 83: DI450 gate measurement principle

Pulse counting is started by a rising edge on the gate and stopped by a falling edge. The count is placed in a temporary register when the falling edge occurs. The counter is started again by the next rising edge.

During gate measurement, the count stored last (the gate) can be read by the active application program. The value in the temporary register is only updated after at the end of the active measurement (falling edge).

Mixed operation between pulse measurement and gate measurement is possible (see connection example 2).

Connection Example for Gate Measurement

Example 1: Gate measurement on channels 5 and 6.

An external frequency is used for measurement:

Channel 2: 100 kHz

Channel 4: 20 kHz

Configuration Register:

0	0	1	0	1	0	1	1
7							0

 = \$2B

Pin Assignments

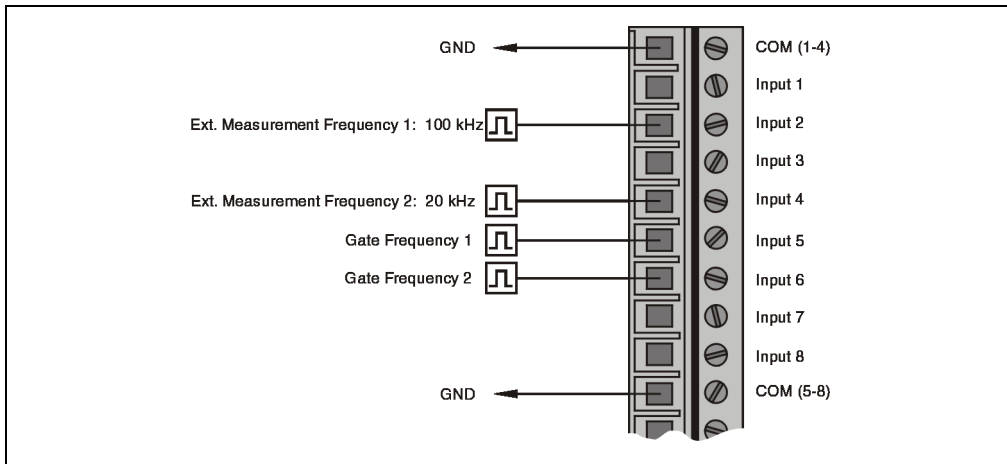


Figure 84: DI450 connection example 1 for gate measurement

Example 2: Pulse measurement with counters 1/2 (16-bit resolution).

Gate measurement on channel 6.

An external frequency is used for measurement (channel 4): 15 kHz

Configuration Register:

0	0	1	0	0	0	1	1
---	---	---	---	---	---	---	---

 = \$23

7
0

Connection Example:

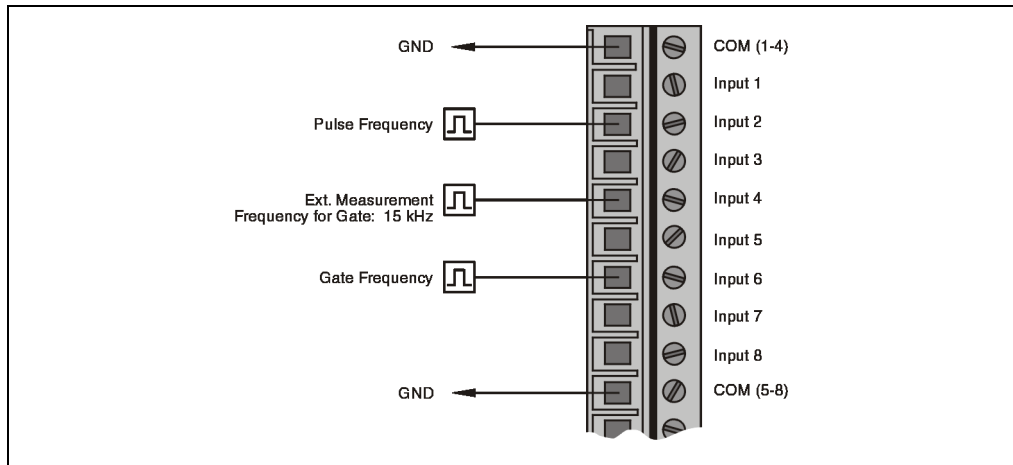


Figure 85: DI450 connection example 2 for gate measurement

7.2.8 Period Measurement

The period can be measured from a signal connected to channel 5, 6 or 7. The resolution is 16-bit. The frequency of the signal to be measured can be a maximum of 10 kHz.

An internal or external counter frequency can be selected for the measurement. The setting is made with the configuration register.

- Internal counter frequency (31250 Hz or 4 MHz)
- External counter frequency (max. 100 kHz)

The external counter frequency is connected to inputs 2 (for counters 1/2) and 4 (for counters 3/4).

Period Measurement Principle

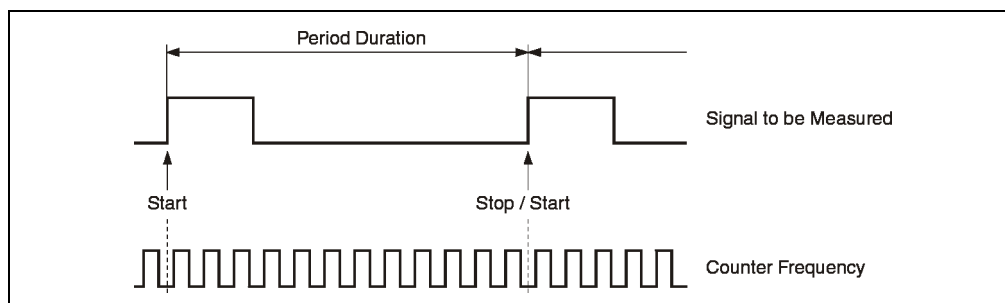


Figure 86: DI450 period measurement principle

Pulse counting is started by a high edge on the input and stopped by the next rising edge. The count is placed in a temporary register. The counter is started again by the same rising edge.

During period measurement, the count stored last (the period) can be read by the active application program. The value in the temporary register is only updated at the end of the active measurement.

Connection Example for Period Measurement

Period measurement on channels 5 and 6.

An external frequency is used for measurement:

Channel 2: 100 kHz

Channel 4: 20 kHz

Configuration Register:

$\begin{array}{|c|c|c|c|c|c|c|c|} \hline 1 & 0 & 1 & 1 & 0 & 1 & 0 & 1 & 1 \\ \hline 7 & & & & & & & & 0 \\ \hline \end{array} = \AB

Pin Assignments:

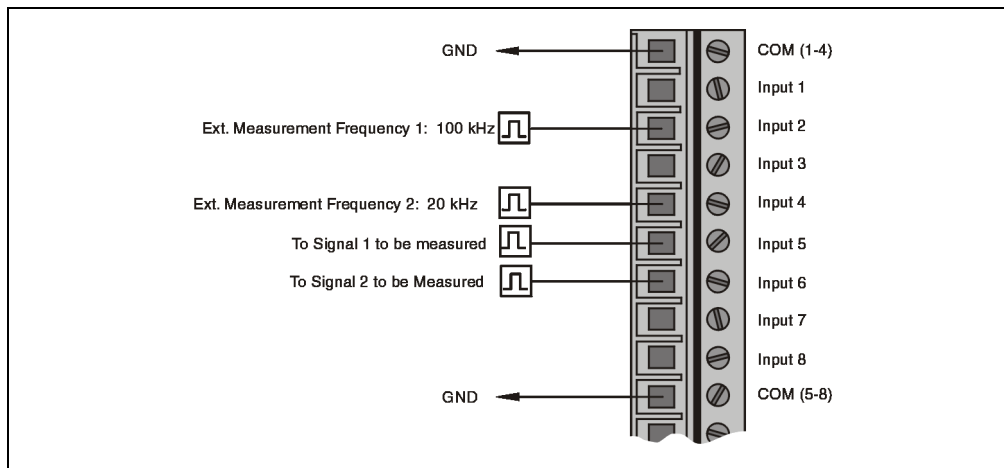


Figure 87: DI450 connection example for period measurement

7.2.9 Input Circuit Diagram

Inputs 1 - 6 (counter and gate inputs)

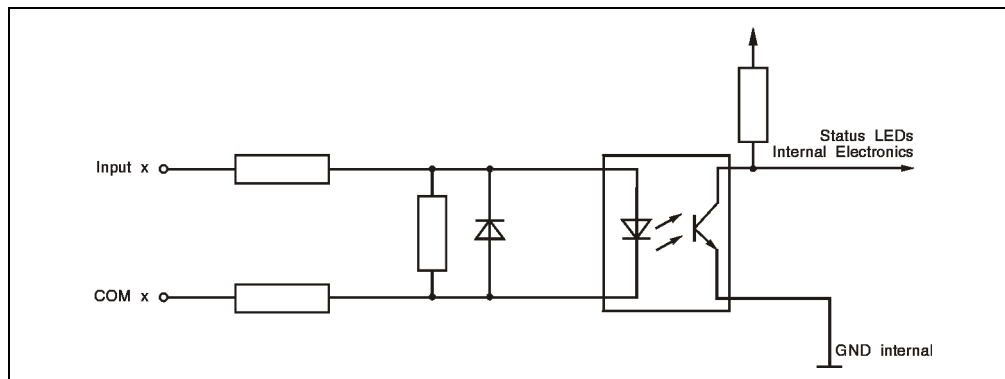


Figure 88: DI450 input circuit diagram for inputs 1 - 6 (counter and gate inputs)

Inputs 7 -16

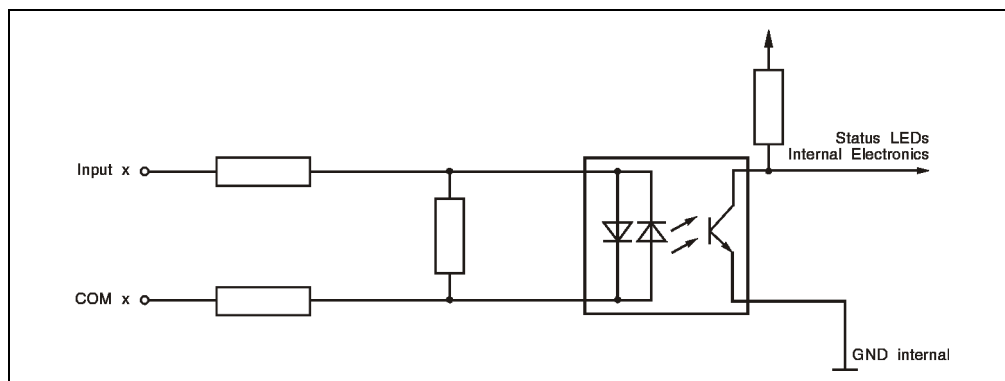


Figure 89: DI450 input circuit diagram for inputs 7 - 16

7.2.10 Variable Declarations

The variable declaration is made in B&R Automation Studio™:

Function		Variable Declarations				
		Scope	Data Type	Length	Module Type	Chan.
Read single digital input (channel x)		tc_global	BOOL	1	Digit. In	1 ... 16
Read 8-bit counter (input 1 to 4):	Input 1	tc_global	USINT	1	Transp. In	4
	Input 2	tc_global	USINT	1	Transp. In	5
	Input 3	tc_global	USINT	1	Transp. In	6
	Input 4	tc_global	USINT	1	Transp. In	7
Read 16-bit counter (input 2 and 4):	Input 2 ¹⁾	tc_global	UINT	1	Transp. In	4
	Input 4 ¹⁾	tc_global	UINT	1	Transp. In	6
Resetting one or more counters by writing with \$7F:	All counters	tc_global	USINT	1	Status Out	1
	Counters 1 and 2	tc_global	USINT	1	Status Out	2
	Counters 3 and 4	tc_global	USINT	1	Status Out	3
	Counter 1	tc_global	USINT	1	Status Out	4
	Counter 2	tc_global	USINT	1	Status Out	5
	Counter 3	tc_global	USINT	1	Status Out	6
	Counter 4	tc_global	USINT	1	Status Out	7
Enabling one or more counters by writing with \$FF:	All counters	tc_global	USINT	1	Status Out	1
	Counters 1 and 2	tc_global	USINT	1	Status Out	2
	Counters 3 and 4	tc_global	USINT	1	Status Out	3
	Counter 1	tc_global	USINT	1	Status Out	4
	Counter 2	tc_global	USINT	1	Status Out	5
	Counter 3	tc_global	USINT	1	Status Out	6
	Counter 4	tc_global	USINT	1	Status Out	7
Counter configuration (see section "Configuration Register")		tc_global	USINT	1	Status Out	0

Table 99: DI450 variable declaration

1) If input 2/4 is used as a 16-bit counter, it is not possible to simultaneously use input 1/3 as an 8-bit counter.



All digital inputs can be read at any time regardless if an input is used as a counter.

Configuration Register

Configuration Reg.	Bit	Description
	7	Period - Period measurement
	6	Int C4 - Internal frequency for channel 4
	5	Gate C4 - Gate measurement for channel 4
	4	Int C2 - Internal frequency for channel 2
	3	Gate C2 - Gate measurement for channel 2
	2	4 MHz - Internal 4 MHz
	1	Z1/2 16-bit - Counter 1 and counter 2 16-bit resolution
	0	Z1/4 16-bit - Counter 3 and counter 4 16-bit resolution
7	0	

Period 0 Pulse measurement and gate measurement
1 Period measurement

Int C4 0 External frequency for channel 4
1 Internal frequency for channel 4

Gate C4 0 Pulse measurement for channel 4
1 Gate measurement or period measurement for channel 4

Int C2 0 External frequency for channel 2
1 Internal frequency for channel 2

Gate C2 0 Pulse measurement for channel 2
1 Gate measurement or period measurement for channel 2

4 MHz 0 Internal 31250 Hz
1 Internal 4 MHz

Z1/2 16-bit 0 counter 1 and 2: 8-bit
1 counter 1 and 2: 16-bit

Z3/4 16-bit 0 counter 3 and 4: 8-bit
1 counter 3 and 4: 16-bit