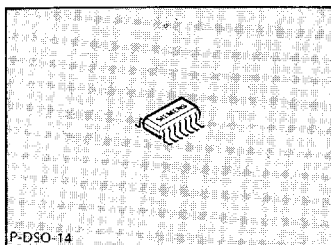
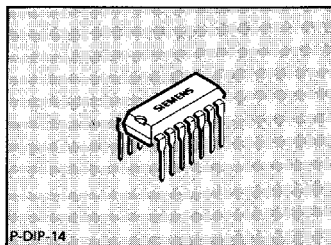


Preliminary Data

Bipolar IC

Features

- Two window settings
 - direct setting of lower and upper edge voltage (window edges)
 - indirect setting by window center voltage and half window width
- Adjustable hysteresis
- Digital outputs with open collectors for currents up to 50 mA
- Adjustable reference voltage V_{Stab}



Type	Ordering Code	Package
▼ □ TCA 965 A	Q67000-A8227	P-DIP-14
▼ □ TCA 965 G	Q67000-A2368	P-DSO-14 (SMD)

▼ New type

The window discriminator compares an input voltage to a defined voltage window. The digital outputs show whether the input voltage is below, within or above this window.

The TCA 965A window discriminator is especially suitable as a tracking or compensating controller with a dead band in control engineering and for the selection of DC voltages within a certain tolerance of the required setpoint value in measurement engineering. When it is used as a Schmitt trigger, switching frequencies up to a typical value of 200 kHz are possible.

Functional Description

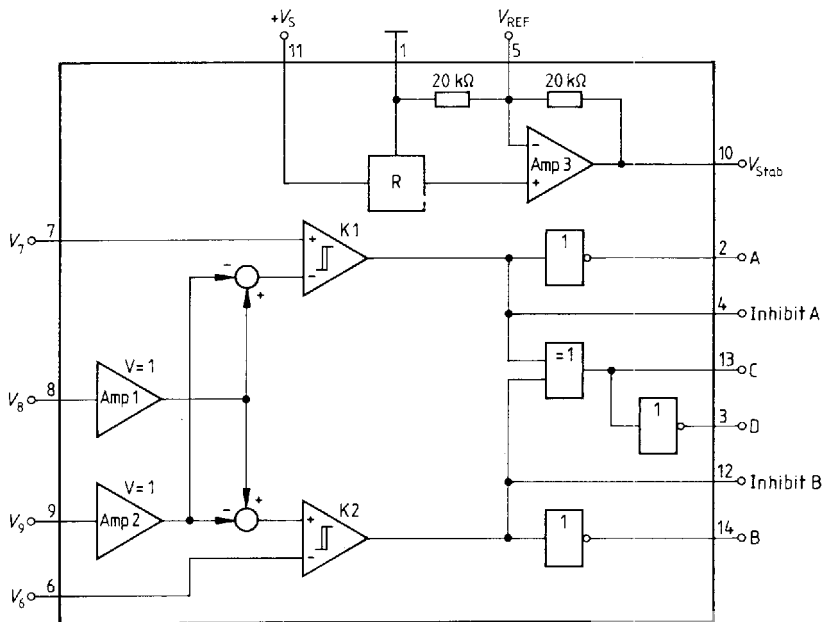
Amplifier Amp 3 increases the voltage of the reference source R to $V_{Stab} = 2 \times V_{REF}$. The amplification factor can be altered by external wiring. With direct setting of the window, the input voltage appears on amplifier Amp 1 (V_8), the upper edge voltage on comparator K2 (V_6) and the lower edge voltage on comparator K1 (V_7).

With indirect setting of the window, the input voltage appears on inputs V_6 and V_7 , while the center voltage is connected to amplifier A1 (V_8).

The voltage applied to the input (V_9) of amplifier Amp 2 is subtracted symmetrically from the output voltage of amplifier Amp 1 and added. The comparators switch with hysteresis. The logic gates have open collectors.

If the inhibit input A or B is connected to ground, output A or B will always be high. If output A or B is not to be inhibited, the inhibit inputs can be connected to V_8 or left open-circuit. It is advisable to connect the inhibit inputs to V_8 for an improved signal-to-noise ratio.

Block Diagram



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Outputs A, B, C, D are open-collector

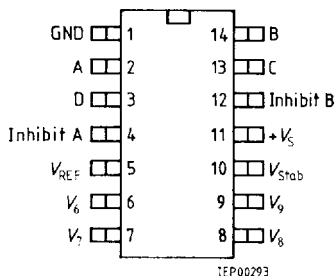
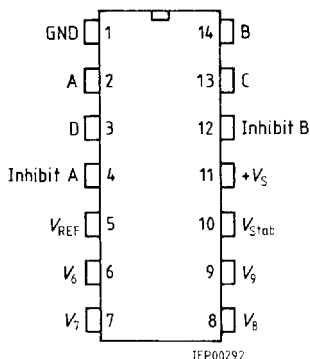
Pin Configuration

(top view)

P-DIP-14

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P-DSO-14



Pin Definitions and Functions

Pin	Symbol	Pin Function in	
		direct setting	indirect setting
1	GND	GND	
2	A	Logic output A	
3	D	Logic output D = A \oplus B EXNOR	
4	Inhibit A	Connected to GND: logic output A = HIGH	
5	V _{REF}	Internal V _{REF} = 3 V	
6	V ₆	Upper edge voltage	Input voltage V _{6/7}
7	V ₇	Lower edge voltage	Input voltage V _{6/7}
8	V ₈	Input voltage	Center voltage
9	V ₉	GND	Half window width
10	V _{Stat}	Internal V _{Stat} = 6 V	
11	+V _S	Supply voltage	
12	Inhibit B	Connected to GND: logic output B = HIGH	
13	C	Logic output C = www.DataSheet4U.com	
14	B	Logic output B	

Absolute Maximum Ratings

Maximum ratings for ambient temperature T_A –25 to 85 °C

Parameter	Symbol	Limit Values		Unit
		min.	max.	
Supply voltage (pin 11)	V_S		30	V
Difference in input voltage between pins 6, 7, 8	V_I		15	V
Input voltage (pins 6, 7, 8, 9)	V_I		30	V
Output current (pins 2, 3, 13, 14)	I_Q		50	mA
Output voltage (pins 2, 3, 13, 14) independent of V_S	V_Q		30	V
Voltage on V_{REF} (pin 5)	V_R		8	V
Output current of stabilized voltage (pin 10)	I_{10}		10	mA
Inhibit input voltage (pins 4, 12)	V_{IH}		30	V
Junction temperature	T_J		150	°C
Storage temperature	T_{Stg}	--55	125	°C
Thermal resistance system-air P-DIP-14	$R_{th SA}$		80	K/W
P-DSO-14	$R_{th SA}$		125	K/W

Operating Range

Supply voltage	V_S	4.5	30	V
Ambient temperature	T_A	www.DataSheet4U.com		

Electrical Characteristics

$$V_S = 10 \text{ V}; T_A = 25^\circ \text{C}$$

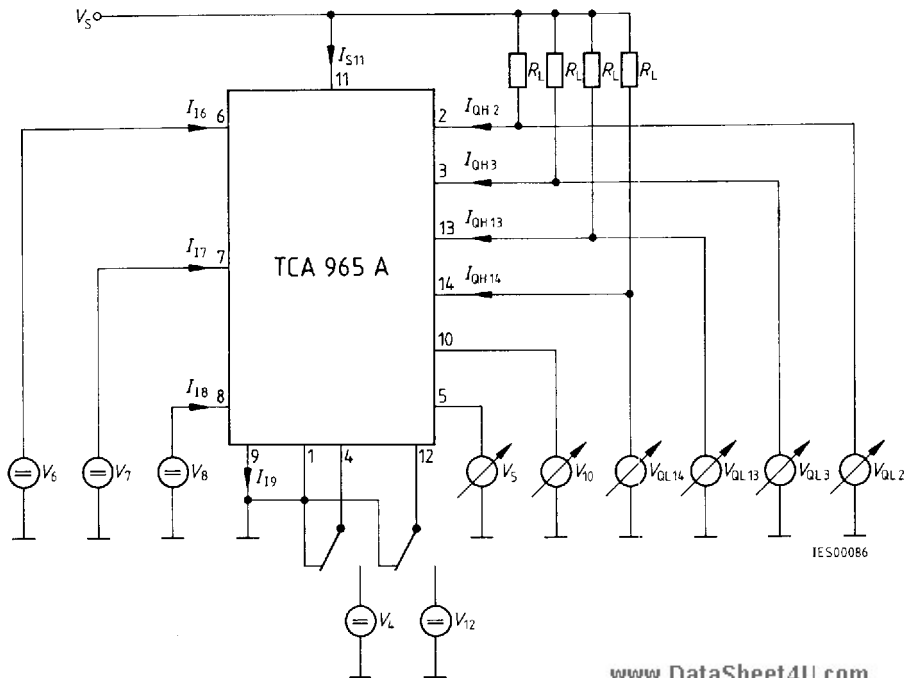
Parameter	Symbol	Limit Values			Unit	Test Conditions	Test Circuit
		min.	typ.	max.			
Current consumption	I_S		5	7	mA	$V_2, V_{13} = V_{QH}$	1
Input current (pins 6, 7, 8)	I_1		20	50	nA		1
Input current, pin 9	$-I_1$		400	3000	nA		1
Input offset voltage in direct setting of window	V_{IO}	-20		20	mV	$\Delta V_1 < 13 \text{ V}$	1
Input offset voltage in indirect setting of window	V_{IO}	-50		50	mV		2
Input-voltage range on pins 6, 7, 8	V_1	1.5		$V_S - 1$	V		1
Input-voltage range on pin 9	V_1	50		$V_S/2$	mV		2
Differential input voltage	$V_6 - (V_8 - V_9)$ $(V_8 + V_9) - V_7$			13	V		
Reference voltage ¹⁾	V_5	2.8	3	3.2	V		$I_{ref} = 0$ $V_S > 7.9 \text{ V}$
Stabilized voltage on pin 10 ²⁾	V_{10}	5.5	6	6.5	V		
TC of reference voltage	αV_5		0.3		mV/K		
Sensitivity of reference voltage to supply-voltage variation	$\Delta V_5 / \Delta V_S$		2		mV/V		
Output reverse current	I_{QH}			10	μA		
Output saturation voltage	V_{QL}		100	200	mV	$I_Q = 10 \text{ mA}$ $I_Q = 50 \text{ mA}$	1
Hysteresis of window edges	$V_U - V_L$	18	22	35	mV		
Inhibit threshold	$V_{4, 12}$	1		1.8	V		
Inhibit current	$I_{4, 12}$		-100		μA		
Switching frequency	f_{dir}	50	80		kHz		1
	f_{ind}	150	200		kHz		2

1) Range aimed at is 2.85 to 3.15 V

2) Range aimed at is 5.6 to 6.4 V

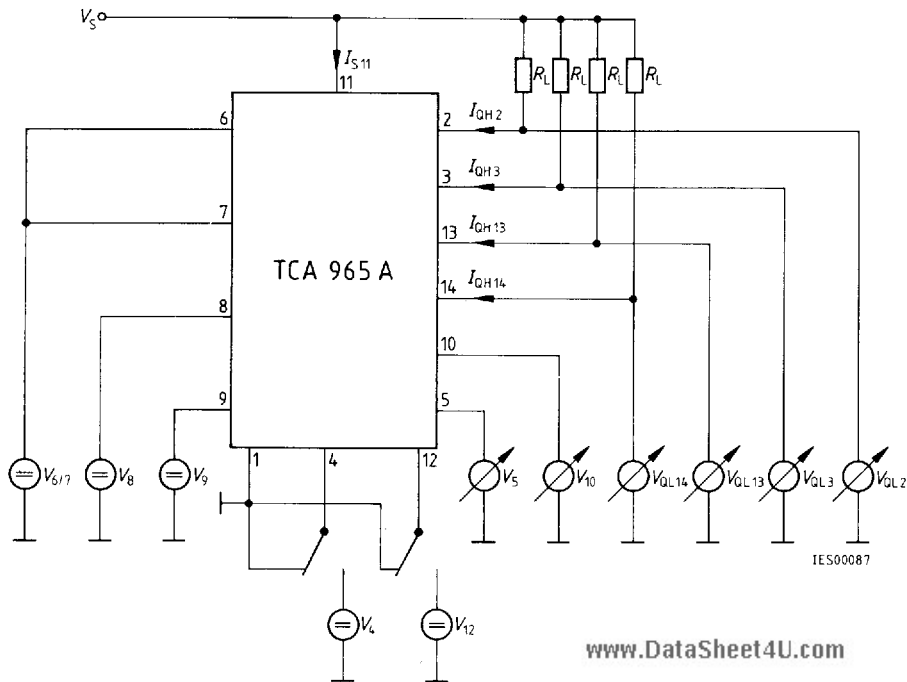
Test Circuit 1

Direct Setting of Window

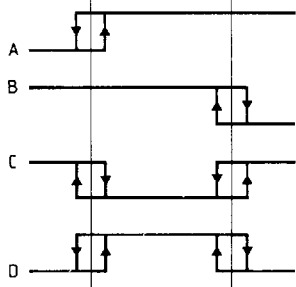
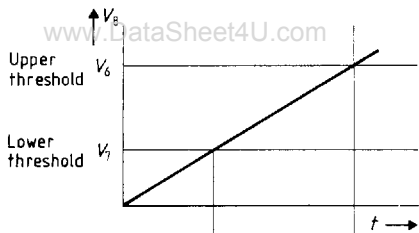


Test Circuit 2

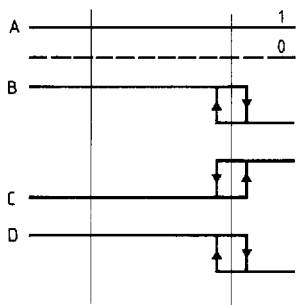
Indirect Setting of Window by Center Voltage and Half Window Width



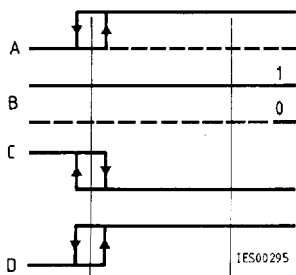
Application Circuit 1: Direct Setting of Window Assignment of Logic Outputs A, B, C, D

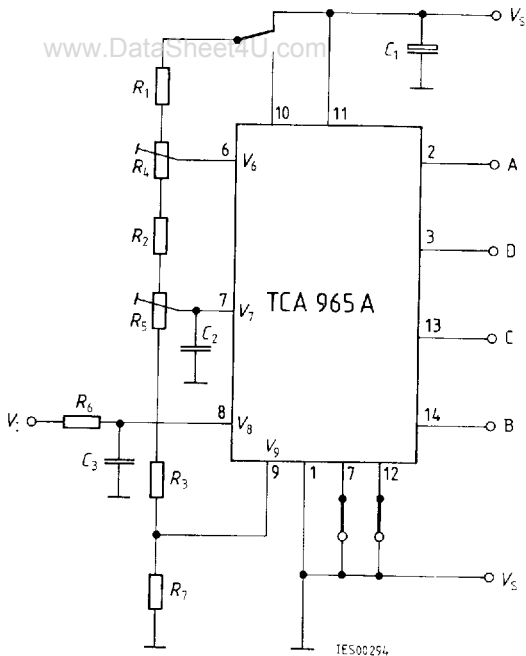


Inhibit A (pin 4 on GND)



Inhibit B (pin 12 on GND)



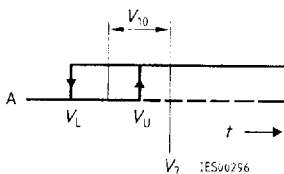


To increase switching frequency, pin 9 is grounded via R_7 (V_9 approx. 10 mV) and not directly

$V_6 - V_9 =$ Upper edge voltage

$V_7 + V_9 =$ Lower edge voltage

$V_8 =$ Input voltage

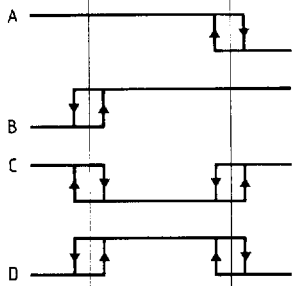
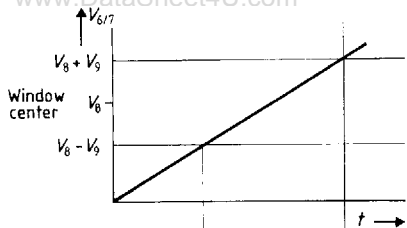


$$V_{10} = \frac{V_L + V_U}{2} - V_7$$

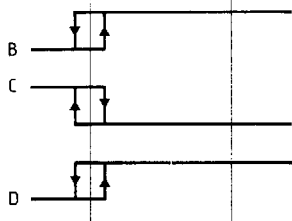
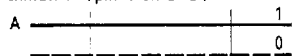
Application Circuit 2: Indirect Setting of Window by Center Voltage and Half-Window Width V

Assignment of Logic Outputs A, B, C, D

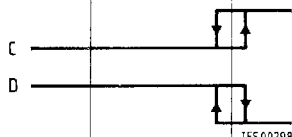
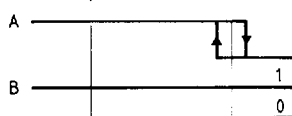
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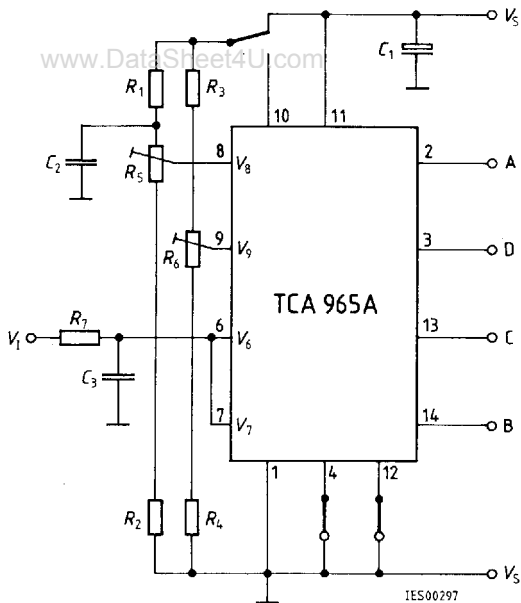
Inhibit A (pin 4 on GND)



Inhibit B (pin 12 on GND)



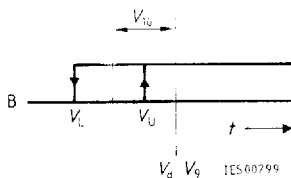
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$V_6 = V_7 =$ Input voltage

$V_8 =$ Center voltage

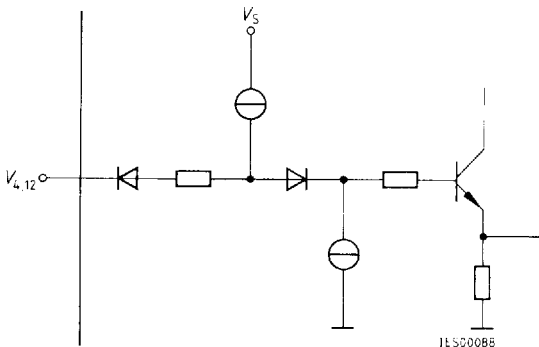
$V_9 =$ Half window width



$$V_{10} = \frac{V_L + V_U}{2} - (V_8 - V_9)$$

Schematic Circuit Diagram

Inhibit-Inputs 4,12



TCA 965 A

$V_{4,12}$	Output A, B
GND	HIGH
V_S	Normal funct.
Open	Normal funct.

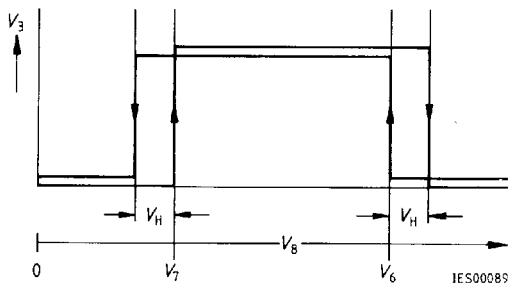
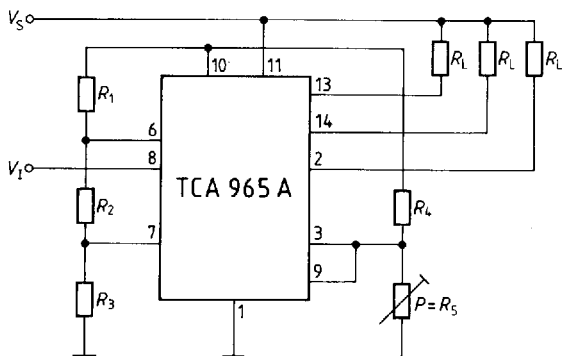
TCA 965 for comparison

$V_{4,12}$	Output A, B
GND	HIGH
V_S	Impermissible
Open	Normal funct.
< 6 V	Low

Application Circuit 3

Symmetrically enlarged edge hysteresis in direct setting of window

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Calculation of hysteresis V_H

$$V_H = V_{I0} \frac{R_5}{R_4 + R_5}$$

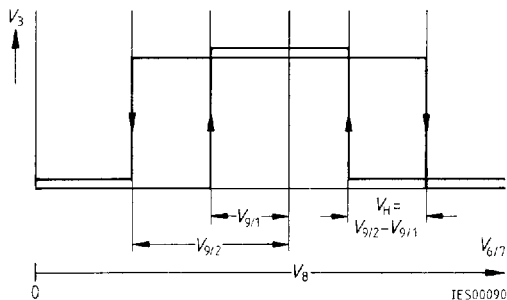
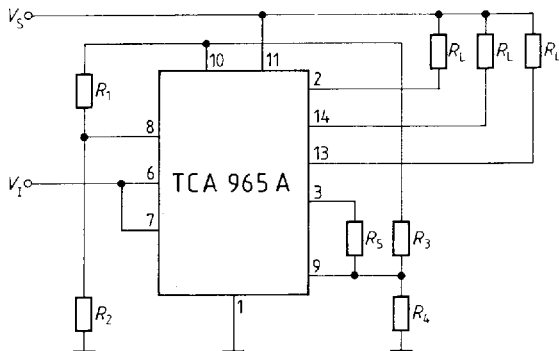
$$\frac{V_{I0}}{R_4 + R_5} + \frac{V_{I0}}{R_1 + R_2 + R_3} \leq 10 \text{ mA}$$

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Application Circuit 4

Symmetrically enlarged edge hysteresis in indirect setting of window

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Calculation of hysteresis V_H

$$V_H = V_{9/2} - V_{9/1}$$

$$V_{9/1} = V_{10} \frac{R_4 \parallel R_5}{R_3 + R_4 \parallel R_5}$$

$$V_{9/2} = V_{10} \frac{R_4}{R_3 + R_4}$$