Digital Interval Wipe/Wash Control for Rear or Front Wiper

Description

The circuit U840B is designed as interval wipe/ wash timer for automotive applications. The interval pause can be set in a range from 0.8 s to 22 s by an external 30 kΩ potentiometer. All other time periods are determined by the basic frequency of the oscillator. The wipe/ wash (WIWA) mode has priority over the interval mode. The program Pin PP controls, whether the wiper immediately starts to wipe, or with a delay time of 0.8 s. Immunity against glitches by dual edge debounce stages is provided at inputs WASH and INT. The PARK switch keeps the relay energized until the motor end position is reached.

The integrated relay driver is protected against short circuits and is switched to conductive condition in the case of a load-dump. The circuit is protected with the recommended external circuitry against load-dump and RF interference, refer to ISO 7637–1/3 (DIN 40839).

Features

- Interval-switch to GND
- Wipe/ wash push button to V_{Batt}
- Output driver protected against short circuit digital debounced: t_6 = 10 ms
- All time periods determined by RC-oscillator
- Turn-on time of relay t_2 = 375 ms
- Adjustable interval pause, t_3 = 0.8 to 22 s
- Dry wiping time t_5 = 3.7 s
- Program Pin PP determines turn-on delay t_4 during wipe-wash mode
  PP to GND: t_4 = 0.8 s
  PP to V_S: t_4 = 0 s
  Interval mode: t_4 = 0 s
- Inputs WASH and INT digital debounced, t_1 = 100 ms
- All inputs with integrated RF protection
- Load-dump protected and interference protection according to ISO 7637–1/3 (DIN 40839)

Ordering Information

Extended Type Number	Package	Remarks
U840B	DIP8	
U840B-FP	SO8	

Pin Description

Pin	Symbol	Function
1	INT	Interval input
2	CO	C oscillator
3	RO	R oscillator
4	PP	Program pin
5	WASH	Wash signal
6	V_S	Supply voltage
7	GND	Ground
8	OUT	Output

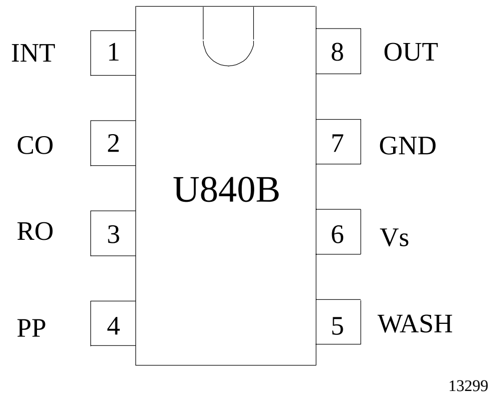


Figure 1. Pinning

Block Diagram

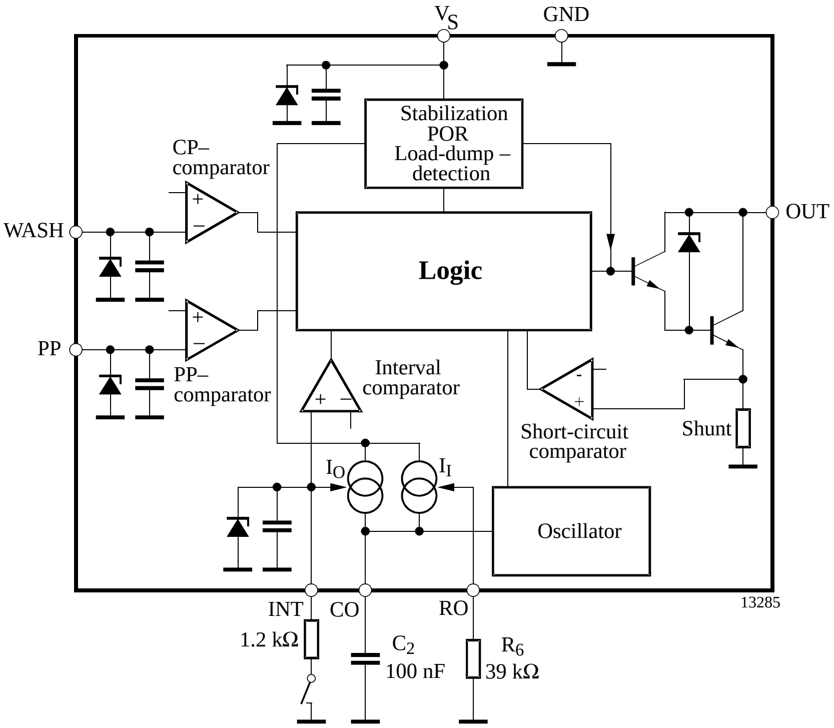


Figure 2. Block Diagram

Circuit Description

Power Supply

The operation voltage is between V_{Batt} = 9 to 16 V. For reasons of interference protection and surge immunity, the V_S-Pin must be provided with an RC-circuit for current limitation in the event of overvoltages and for buffering in the event of voltage dips.

Suggested dimensioning:
R_4 = l80 Ω C_1 = 47 µF, refer to figure 4.

A smaller capacitance (10 µF) is sufficient if a diode against reversed battery is used.

Oscillator

In the circuit all timing sequences are derived from an RC oscillator which is charged by an internal current source and discharged by an integrated 500-Ω resistor. The basic frequency f_0 is determined by the resistor R_6 between Pin RO and GND and by the capacitance C_2 between Pin CO and GND. The basic frequency is adjusted to f_0 = 320 Hz (3.125 ms) by R_6 = 39 kΩ and C_2 = l00 nF.

The tolerances and the temperature coefficients of the external devices determine the precision of the oscillator frequency. A ±l%-metallic-film resistor and a ±5%-capacitance with a TC of a MKT or MKS2 capacitance is suggested.

The debouncing time t_1, the turn-on time of the relay t_2, the delay time t_4, the dry wiping time t_5 and the debouncing time t_6 (short circuit detection) depend on the oscillator frequency f_0 as follows:

Debouncing time INT, WASH	$t_1 = 24 \text{ to } 32 \times 1/f_0$
Turn-on time relay	$t_2 = 120 \times 1/f_0$
Interval pause	$t_3 = 296 \times 1/f_{int}$
Delay time wipe/wash mode	$t_4 = 256 \times 1/f_0$
Dry wiping time	$t_5 = 1184 \times 1/f_0$
Debouncing time SC	$t_6 = 2 \text{ to } 3 \times 1/f_0$

SC (short circuit) = collector current of relay driver I_C > 500 mA.

The clock counts of the debouncing times are not fixed because the switching of the signals and the system clock are asynchronous. The cause of the clock count variation is shown by the example of the short circuit debouncing (figure 3).

The relay output is activated. The internal logic of the IC queries the short-circuit detection SC during the positive slope of the system clock CL. A 3-stage shift register is loaded by the positive slope of clock 1, 2 and 3 and the relay output is switched off. A short circuit signal which happened after the positive slope of clock 0 is just recognized by the positive slope of clock l. Therefore the debouncing of the short signal continues two to three clock periods.

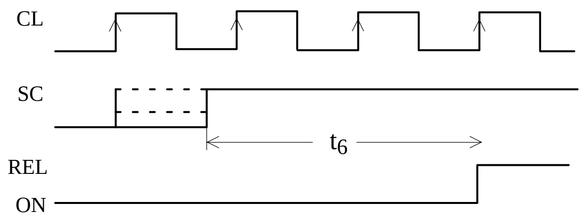


Figure 3. The debouncing of the short circuit detection

These times can be adjusted (except t_3) by variation of the external frequency determined devices. The oscillator frequency is calculated approximately with the following formula:

$$f_0 \approx 1/(0.832 \times C_2 \times (300 + R_6))$$

The resistor between the interval switch and Pin INT determines the interval pause. During the interval pause the oscillator current source is switched to I_I, the frequency is determined by the interval resistors R_1, R_2 and R_3. After the end of the interval pause, the oscillator switches again to the basic frequency f_0. This procedure allows analog interval pause times between 0.8 s to 22 s.

The dependence of the interval pause t_3 from the interval resistor and therefore from the position of the switch A and B is shown in table 1.

Table 1. Function table

WASH	B	A	INT	C	OUT	Note
L	1	1	OFF	1	OFF	
X	X	X	X	2	ON	Continuous
L	2	1	R_1+R_2	1	INT_1	11 cycles/min
L	3	1	R_1	1	INT_2	27 cycles/min
L	X	2	GND	1	INT_3	44 cycles/min
H	X	X	X	1	WIWA	WASH

Relay Output

The relay output is an open-collector Darlington transistor with integrated 28-V Z-diode for limitation of the inductive cut-out pulse of the relais coil. The maximum static collector current must not exceed 300 mA and saturation voltage is typically 1.2 V for a current of 200 mA.

The collector current is permanently measured by an integrated shunt and in the case of a short-circuit (I_C > 500 mA) to $V_{Batt,}$ the relay output is disabled and latched in this status.

The reset of the short-circuit buffer is possible if the switches interval and wipe/ wash are opened. A new attempt to switch on from INT or WASH cause again a switch off of the relay output, if the short-circuit still exists, otherwise the normal function is possible.

The short-circuit detection is digital debounced about a period of l0 ms, so that shorter interference peaks at the power supply do not disable the output transistor because the interference peaks cause a higher current and pretend a short-circuit.

During a load-dump impulse the output transistor is switched to conductive condition to prevent destruction. The short circuit detection is suppressed during the load-dump.

Interference Voltages and Load Dump

The IC supply is protected by R_4, C_1 and an integrated Z-diode, the inputs are protected by a series resistor, integrated 14-V Z-diode and RF capacitor.

The RC-configuration stabilizes the supply of the circuit during negative interference voltages so that the power-on reset (POR) does not arise and reset the function of the circuit.

The relay output is protected against short interference peaks by an intergrated 28-V Z-diode, and during load-dump the relais output is switched to conductive condition for a battery voltage of greater than approximately 30 V. The output transistor is dimensioned so that it can absorb the current, produced by the load-dump pulse.

Power-on Reset

When the operating voltage is switched on, an internal power-on reset pulse (POR) is generated which sets the logic of the circuits to defined intinial condition. The relay output is disabled, the short circuit buffer is reset.

Functional Description

Interval Function

By closing the interval switch A and/or B to GND (refer to function table l) for a time longer than the debouncing time t_1 = l00 ms the relay is activated for a time of t_2 = 375 ms, whereafter the interval pause begins. The park switch causes the wiper motor to move to its end position. The oscillator switches to a frequency which is determined by R_1 to R_3. At the end of the interval pause, t_3, the relay is activated for a time t_2.

If, during the turn-on time of the relay, the switches A and B are opened (also the opening is debounced), then the time t_2 runs off, one turn of the wiper arm is finished.

Afterwards it the interval mode can be immediatly activated.

The resistor between the interval switch and Pin INT determines the interval pause. The circuit U840B is so dimensioned, that a linear resistor-time-characteristic is used. Therefore, a doubling of the resistor evokes a doubling ot the interval pause. With the help of the resistor R_3 the characteristic can be shifted parallel to its axis. The resistors R_1 and R_2 keep their values.

An increasing of R_3 shifts the characteristic to longer interval pauses. With it the interval pause can be adjusted to the demanded values by the dimensioning of R_3 (see time diagram figure 5). The resistor R_3 must not be smaller than 1 kΩ, otherwise the linearity of the resistor-time-characteristic cannot be guaranteed and too great a current flows from the input INT to GND.

Wipe/ Wash Releasing and Program Pin PP

When the wash button is activated, the relay is energized after the debouncing (Pin PP connects to V_S). As long as the button is pushed, water is sprayed on the windscreen by the water pump. After releasing the wash button and after 100 ms reverse debouncing, the dry-wiping time t_5 starts. At the end of the dry-wiping time, the relay output is disabled and the wiper motor is supplied via the park switch until park position is reached.

If the input PP is connected to ground, the debouncing time of the WIWA mode is extended to 800 ms. The water is sprayed on the windscreen before the wiper begins its job.

PP to GND: 0.8 s delay time

PP to V_S: 0.1 s delay time

Interval Wipe/Wash Mode

The interval function is interrupted when the wash button is operated. In this case, the 0.8 s delay time t_4 is reduced to the 100 ms debouncing time. Interval function begins after the wipe/ wash function is finished.

Switch Contact Currents

The contact current of the interval switch is 0.6 to 3 mA. Of course the current depends on the position of the interval switches. The contact current of the wash button is fixed by the internal resistance of the water pump. A pull-down resistor is integrated at the input WASH. Therefore, the input is connected to ground in the case of an open wash push button and a pump which is not connected.

Input Leakage Resistance

With a resistor of more than 40 kΩ between INT to GND, the interval function is not activated.

The wipe/ wash function is not activated by a leakage resistance > 10 kΩ and recommended external circuitry.

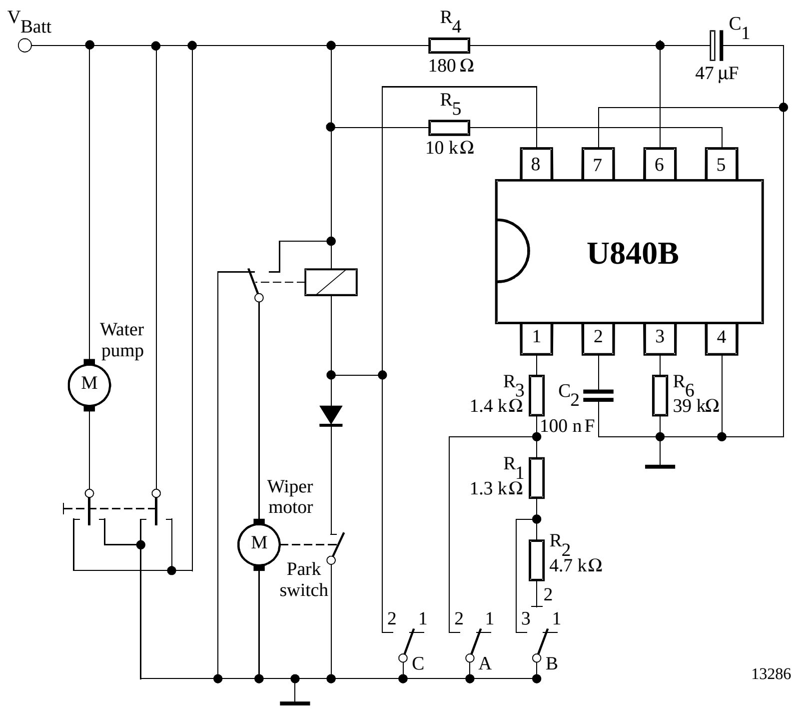


Figure 4. Application circuit with interval and WIWA operation

Absolute Maximum Ratings

Parameters		Symbol	Value	Unit
Supply voltage	t = 60 s t = 1 h	V_{Batt} V_{Batt}	24 18	V V
Ambient temperature range		T_{amb}	–40 to +100	°C
Storage temperature range		T_{stg}	–55 to +125	°C
max. junction temperature		T_J	150	°C

Thermal Resistance

Parameters		Symbol	Value	Unit
Junction ambient	DIP8 SO8	R_{thJA} R_{thJA}	120 160	K/W K/W

Electrical Characteristics

V_{Batt} = 13.5 V, T_{amb} = 25°C, reference point ground (Pin 7) circuit with recommended external circuitry

Parameters	Test Conditions / Pin	Symbol	Min.	Typ.	Max.	Unit
Supply						
Supply voltage range		V_{Batt}	9		16	V
Supply current, all push-buttons open		I_6			3	mA
Undervoltage threshold POR		V_6		4		V
Series resistance		R_4		180		Ω
Filter capacitance		C_1		47		µF
Internal Z-diode	I_6 = 10 mA	V_6		14		V
INT input (Pin 1)						
Protective diode	I_1 = 10 mA	V_1		14		V
Internal capacitance		C_{INT}		25		pF
External resistance		R_3	1			kΩ
Leakage resistance	No interval function	R_L	40		60	kΩ
PP input (Pin 4)						
Protective diode	I_4 = 10 mA	V_4		14		V
Internal capacitance		C_4		13		pF
Threshold		V_4		$0.5 \times V_S$		V
Pull-down resistance		R_4		120		kΩ
WASH-input (Pin 5)						
Protective diode	I_5 = 10 mA	V_5		14		V
Internal capacitance		C_{INT}		25		pF
Threshold		V_5		$0.5 \times V_S$		V
Leakage resistance	No Wash function	R_L		10		kΩ
Pull-down resistance		R_{pd}		20		kΩ
Relay output with limitation of short circuit current (Pin 8)						
Saturation voltage	I_8 = 100 mA	V_8		1.0		V
Saturation voltage	I_8 = 200 mA	V_8		1.2		V
Relay coil resistance		R_{REL}	60			Ω
Leakage current	V_8 = 22 V	I_8			10	µA

Parameters	Test Conditions / Pin	Symbol	Min.	Typ.	Max.	Unit
Output current Normal operation		I_8			300	mA
Output pulse current Load dump		I_8			1.5	A
Internal Z-diode	I_8 = 10 mA	V_8		28		V
Short circuit current limitation		I_8	500			mA
Oscillator input						
Oscillator capacitance, Pin 2 (± 5%, TC MKT, MKS2)		C_2		100		nF
Oscillator resistance, Pin 3 (± 1% TC)		R_6		39		kΩ
Oscillator frequency		f_0		320		Hz
Upper switching point		V_2		3		V
Lower switching point		V_2		1		V
Internal discharge resistance		R_2		500		Ω
Times (external circuitry see oscillator input)						
Debouncing time WASH, INT		t_1	67		110	ms
Interval turn-on time		t_2	300		450	ms
Interval pause	Depends on R_1, R_2 and R_3	t_3	0.8		22	s
Turn-on delay Wipe/ wash mode, PP to GND		$t_4 + t_D$	800		1000	ms
Dry wiping time		$t_5 + t_D$	3.4		4.2	s
Debouncing time short circuit		t_6	6		11	ms
1. Interval cycle time		$t_2 + t_{3,1}$	1.2		1.5	s
2. Interval cycle time		$t_2 + t_{3,2}$	1.98		2.45	s
1. Interval cycle time		$t_2 + t_{3,3}$	4.9		6.1	s

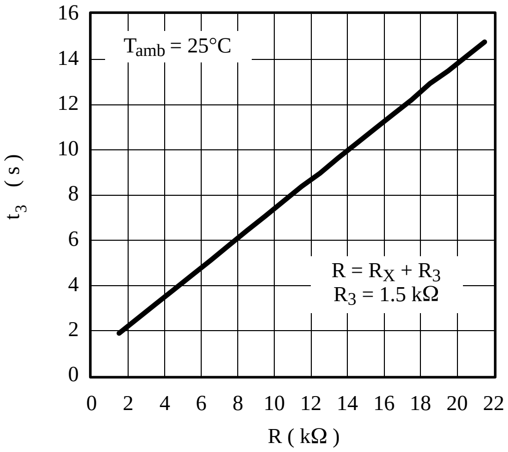
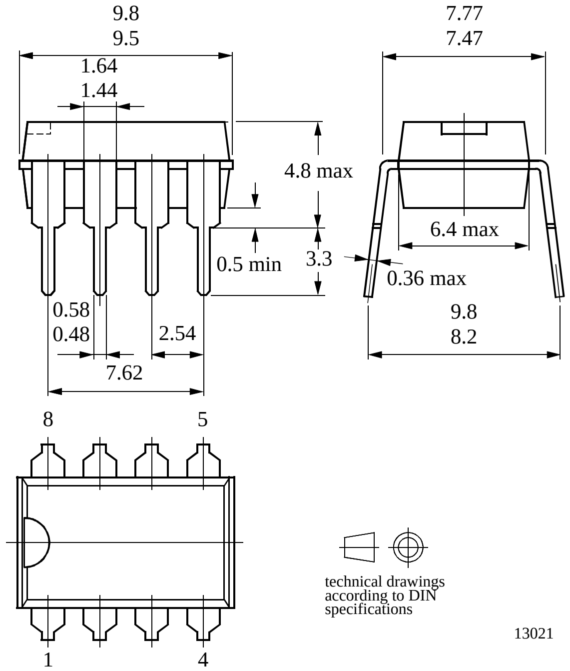


Figure 5. Interval pause time vs. R_{Pin1}
C_2 = 100 nF NP0, R_6 = 39 kΩ metal film resistor

Package Information

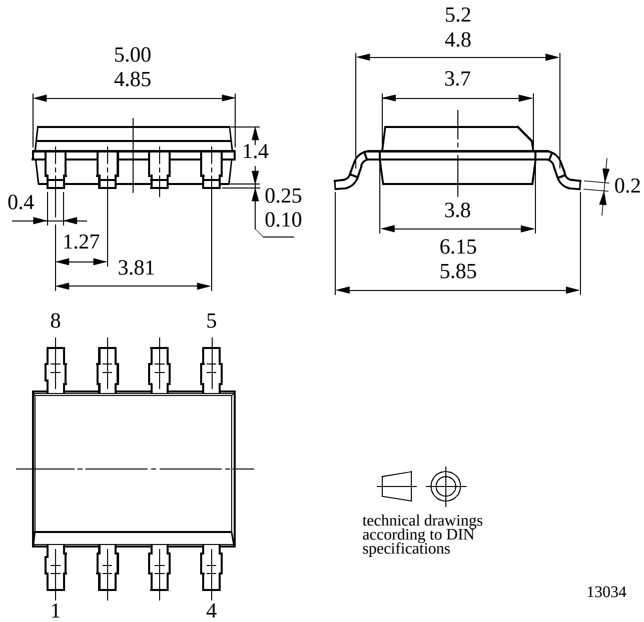
Package DIP8

Dimensions in mm



Package SO8

Dimensions in mm



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1. Meet all present and future national and international statutory requirements.

2. Regularly and continuously improve the performance of our products, processes, distribution and operating systems with respect to their impact on the health and safety of our employees and the public, as well as their impact on the environment.

It is particular concern to control or eliminate releases of those substances into the atmosphere which are known as ozone depleting substances (ODSs).

The Montreal Protocol (1987) and its London Amendments (1990) intend to severely restrict the use of ODSs and forbid their use within the next ten years. Various national and international initiatives are pressing for an earlier ban on these substances.

TEMIC Semiconductor GmbH has been able to use its policy of continuous improvements to eliminate the use of ODSs listed in the following documents.

1. Annex A, B and list of transitional substances of the Montreal Protocol and the London Amendments respectively

2. Class I and II ozone depleting substances in the Clean Air Act Amendments of 1990 by the Environmental Protection Agency (EPA) in the USA

3. Council Decision 88/540/EEC and 91/690/EEC Annex A, B and C (transitional substances) respectively.

TEMIC Semiconductor GmbH can certify that our semiconductors are not manufactured with ozone depleting substances and do not contain such substances.

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