Digital Wiper Control for Intermittent and Wipe/ Wash Mode

Description

The U846B is a bipolar integrated circuit for automotive use (“Rugged Silicon”) in interval and wipe/ wash control of windshield or backlite wipers.

The interval pause can be set individually within a wide range by using a potentiometer. Wipe / wash mode with dry wiping – activated either for 2 wipes or for a certain time – has priority over the interval mode.

The U846B is used in applications to control wiper motors with or without park-switch signal feedback. The integrated relay driver is protected against short circuits and is switched to conductive condition in the case of a load-dump. By using only a few external components, protection against RF interference and ISO transients can be achieved.

Features

- Interval input: high side
- Wipe/ wash input: high side
- Park input: low side (park position)
- Output driver protected against short circuits
- All time periods determined by an RC-oscillator
- Typical relay activation time of 500 ms
- Adjustable interval pause from 1.2 s to 27 s
- Typical pre-wipe delay of 100 ms
- Dry wiping
- – With park-switch signal: 2 cycles
- – Without park-switch signal typically 5.25 s
- Inputs INT, WASH and PARK digitally debounced
- All inputs with integrated RF protection
- Load-dump protection and interference protection according to ISO 7637–1/4 (DIN 40839)

Application

Digital interval / wipe/ wash control for windshield or backlite wiper motors with a 22-kΩ potentiometer (typical value) for interval pause adjustment.

Recommended oscillator circuitry:
$R_6 = 36\ k\Omega$; $C_2 = 100\ nF$.

Ordering Information

Extended Type Number	Package	Remarks
U846B	DIP8	
U846B–FP	SO8	

Pin Description

Pin	Symbol	Function
1	INT	Interval input
2	C	Oscillator C
3	R	Oscillator R
4	PARK	Park-switch input
5	WASH	Wipe/wash input
6	V_S	Supply voltage
7	GND	Ground
8	OUT	Relay output

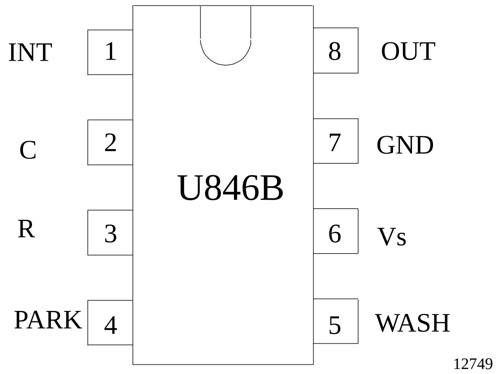


Figure 13. Pinning

Block Diagram

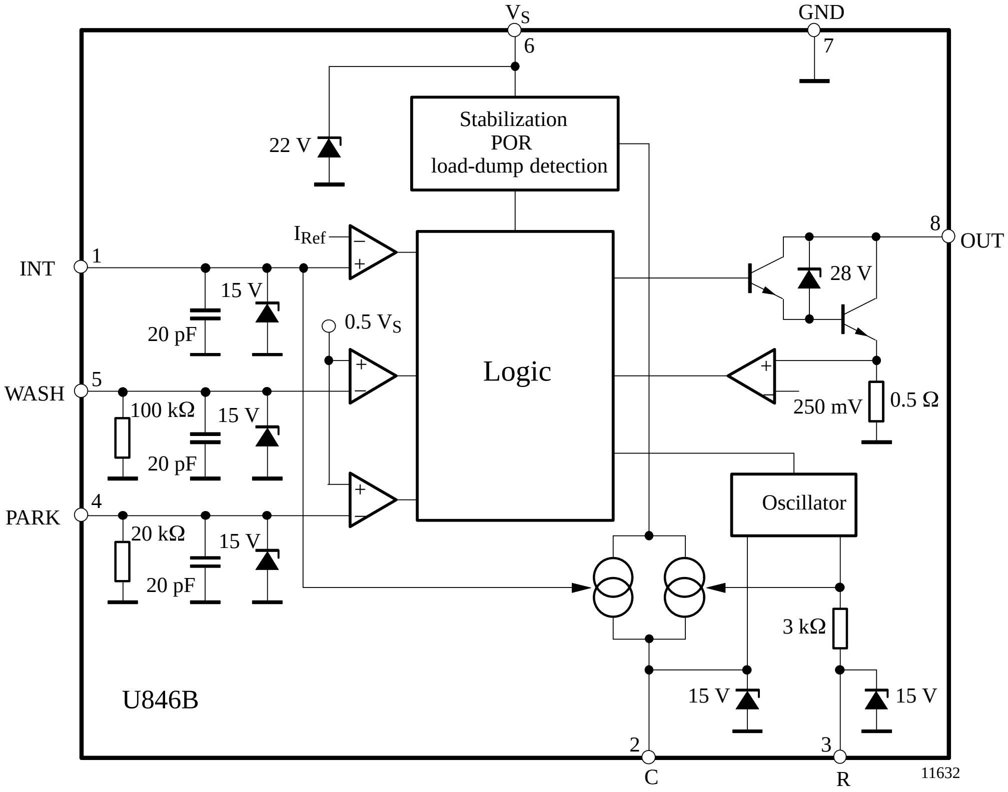


Figure 1.

Basic Circuitry

Power Supply

For reasons of interference protection and surge immunity, an RC circuitry has to be connected to the supply pin. Therefore, current limitation during transients and proper supply in the case of voltage drops is ensured. Recommended values: R_1 = 180 Ω, C_1 = 47 F. In order to protect the IC against reversed battery, a diode has to be added to the supply. With this configuration, the value of the external capacitor can be reduced to typically C_1 = 10 F. The supply (Pin 6) is clamped with a 22-V Zener diode. The operation voltage may range between V_{Batt} = 9 to 16 V.

Oscillator

All time sequences refer to the frequency of the RC oscillator. Its capacitor is charged by integrated current sources and is discharged via a small integrated resistor. The basic frequency, f_0, is determined by the capacitor, C_2, an internal 3 kΩ resistor and the external resistor R_6 according to the formula:

$$f_0 \approx 1 / (0.8 \times C_2 (R_6 + 3\ \text{k}\Omega))$$

The recommended values are C_2 = 100 nF, R_6 = 36 kΩ. The oscillator frequency is approximately $f_0 \approx$ 320 Hz.

The minimum value of R_6 is 21 kΩ.

The precision of the oscillator frequency is determined by the accuracy of the integrated oscillator (approximately ±5%) and the tolerances and temperature coefficients of the external components. A 1% metallic-film resistor and a 5% capacitor with only a small temperature co-efficient are recommended.

Timing

Table 1 shows how to calculate the timing (debouncing and delay times). The recommended timing is based on the oscillator frequency f_0 = 320 Hz. Synchronized times are derived from the oscillator with different numbers of divider stages. Asynchronous times are generated by the internal clock and the randomly applied input signals which result in a “digital uncertainty”.

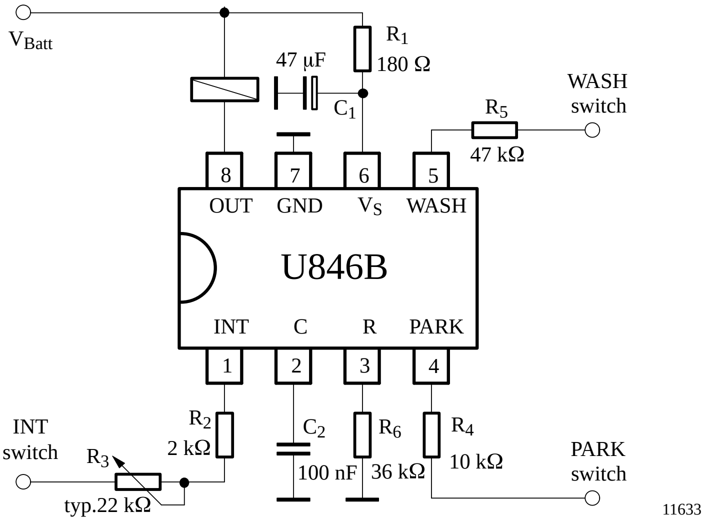


Figure 2. Basic circuitry

Table 1. Times

Synchronized Times		**Typical Values with f_0 = 320 Hz**
Relay activation time	$t_1 = 160 \times 1 / f_0$	t_1 = 500 ms
Interval pause	$t_2 = 440 \times 1 / f_{INT}$	$t_2 = 440 * 1 / f_{INT}$
Dry wiping	$t_3 = 1680 \times 1 / f_0$ or 2 wipes	t_3 = 5.25 s or 2 wipes
POR prolongation	$t_{DPOR} = 8 \times 1 / f_0$	t_{DPOR} = 25 ms
Asynchronous Times		
Debouncing time INT		
● Forward	$t_{DINT} = (32 +/- 4) \times 1 / f_0$	t_{DINT} = 100 ms
● Reverse	$t_{DINR} = (32 +/- 4) \times 1 / f_0$	t_{DINR} = 100 ms
Debouncing time WASH		
● Forward	$t_{DWASH} = (32 +/- 4) \times 1 / f_0$	t_{DWASH} = 100 ms
● Reverse	$t_{DWASHR} = (32 +/- 4) \times 1 / f_0$	t_{DWASHR} = 100 ms
Debouncing time PARK		
● Forward	$t_{DPARK} = (8 + 4) \times 1 / f_0$	t_{DPARK} = 25 ms
● Reverse	$t_{DPARKR} = (8 + 4) \times 1 / f_0$	t_{DPARKR} = 25 ms
Debouncing time SC	$t_{DSC} = (3 +/- 1) \times 1 / f_0$	t_{DSC} = 10 ms

For the calculation of “f_{INT}”: see chapter “Functional Description” on page 4

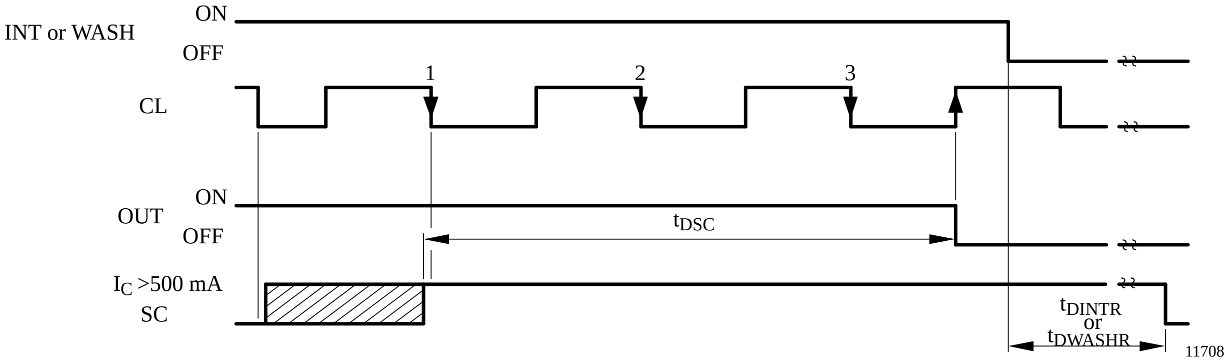


Figure 3. Debouncing of the short circuit detection and reset of the latched short circuit detection

Asynchronous Debouncing Times

Ditigal debouncing by clock count makes all inputs insusceptible to short interference pulses. The switch input stages INT, WASH, PARK are debounced at the positive and negative edge (reverse debouncing).

The debouncing times vary (digital uncertainty). This is caused by the asynchronism between the random input signal and the IC clock CL.

Short circuit debouncing is shown in figure 3.

During the relay activation time, the output current is monitored at each positive edge of the clock. In the case of a detected short, a 3-stage shift register counts 3 negative edges.

The output stage is disabled with the following positive edge. Depending on when the short circuit occurs, there is a variation of 1 clock: the delay time may last from 2 to 4 clock cycles. In the case of the other times, (e.g., debouncimg input INT) the digital uncertainty adds up to ± 4 cycles.

Relay Output

The relay output is an open collector Darlington transistor stage with an integrated 28-V Zener diode which limits the relay coil‘s inductive cut–out pulse. The maximum static collector current must not exceed 300 mA and the saturation voltage is typically Vsat = 1.2 V@ 200 mA.

An integrated shunt resistor measures the collector current constantly. If a typical value of I_8 = 500 mA is exceeded, the short circuit detection buffer is set.

The output stage is switched off and is kept disabled even if an input switch is still on. When an input switch is opened, the short circuit buffer is reset after the debouncing delay and the output can be activated again.

If − after closing an input switch again − a persistant short is detected, the short circuit buffer is set again and the output is disabled. If no short circuit condition is detected normal operation continues.

In order to avoid short term disabling caused by current pulses of transients, a typical debounce period (t_{DSC} = 10 ms) is provided (see figure 3).

During a load-dump pulse (V_{Batt} > 30 V), the output transistor is switched to conductive condition to prevent it from being destroyed. The output transistor absorbs the current during the load-dump pulse (1A, short term). Short circuit detection is disabled during the load-dump.

Power-on Reset

When the supply voltage is switched on, an internal power-on reset pulse (POR) with a prolongation time of t_{DPOR} = 25 ms is generated to set and hold the integrated logic at the condition which is defined initially.

During t_{DPOR} the relay output stage is kept disabled and the short circuit buffer is reset.

Functional Description

All timing periods refers to f_0 = 320 Hz with R_6 = 36 kΩ and C_2 = 100 nF

Interval Function

The interval mode is activated with the high side input switch INT. After the debouncing time t_{DINT} the relay is activated and the wiper motor performs one turn. The beginning of the interval pause depends on the application “with or without the park-switch” (see figures 5, 6, 7 and 8). If the INT switch is opened the wiper performs a full turn as long as the relay is energized.

Contact Current and Leakage Resistance

As the current into Pin 1 (INT) only ranges from 200 µA to 800 µA (depending on the potentiometer value), an external pull-down resistor helps to increase the contact current of the interval switch INT.

The input is detected “open” and the intermittent function is not activated if the input resistance of Pin 1 exceeds 45 kΩ.

Timing of the Interval Pause t_2

During the interval pause the oscillator frequency is switched from f_0 to f_{INT}. Thus the frequency-determing resistor is now (R_2 + R_3). The frequency is calculated approximately by using the following formulas:

$f_{INT} \approx 4.4/\,(57 \times C_2 \times (R_2 + R_3))$

$t_2 \approx 5700 \times C_2 \times (R_2 + R_3)$

Correct operation is ensured, with

$2\ k\Omega < (R_2 + R_3) < 40\ k\Omega$

With the recommended value of C_2 = 100 nF, the pause time can be adjusted to 1 s < t_2 < 27 s (see figure 4).

When the interval pause has been completed the oscillator is switched to its basic frequency f_0.

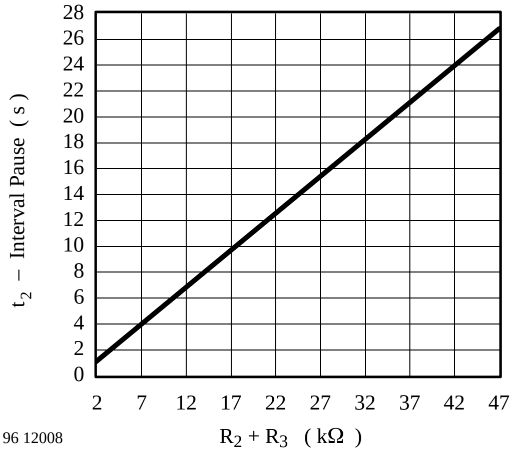


Figure 4. Pause time t_2/ s versus resistor (R_2 + R_3)/ kΩ

Interval Function with Park-Switch Feedback

During the relay activation time, t_1, the wiper motor‘s park-switch leaves its park position and changes its potential from GND to V_{Batt}. The output is kept active as long as the park-switch stays at high potential, even if the relay activation time has expired in the meantime. If the park-switch is connected to the PARK input (Pin 4), the interval pause t_2 starts after the 25 ms debounce time t_{DPARK} (see figures 5 and 6).

If the INT switch is opened while the relay is still energized, the wiper motor turns on until it reaches its park position. The motor current can flow only via the relay contact.

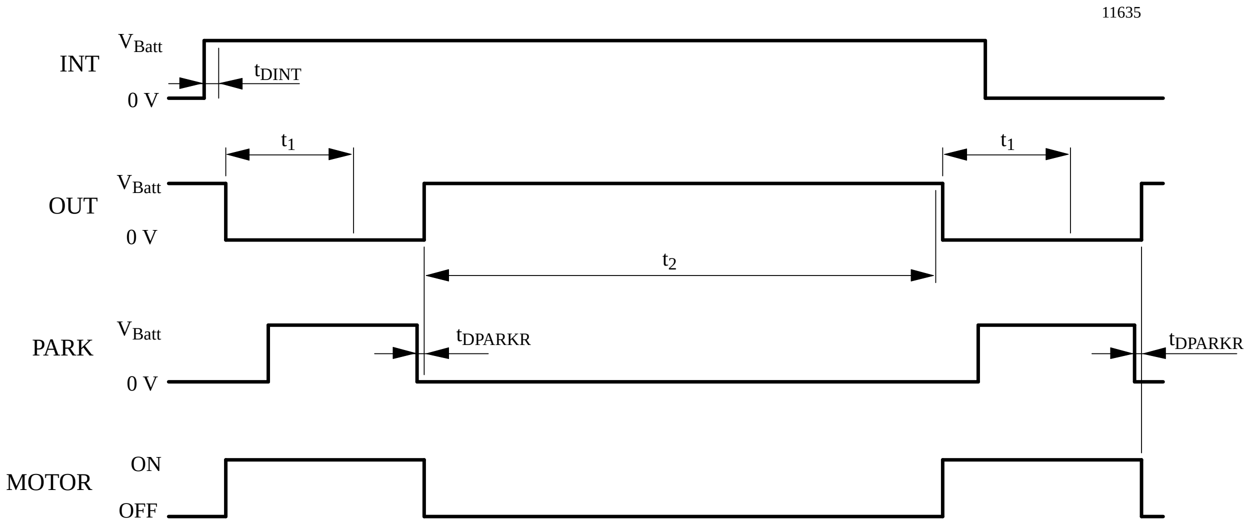


Figure 5. Intermittent circuit function with park-position feedback

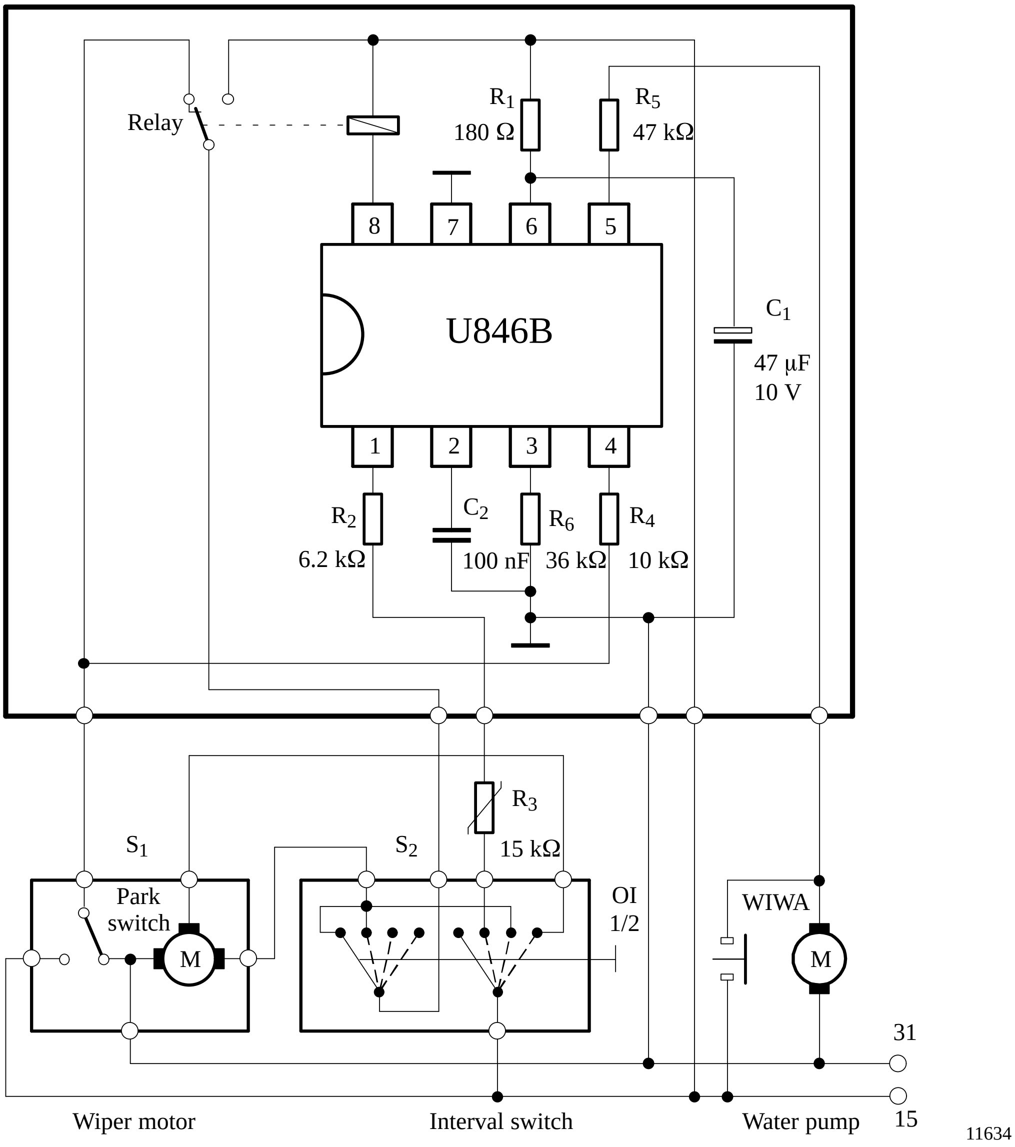


Figure 6. Application circuit with park-switch feedback

Interval Function without Park-Switch Feedback

This configuration is used mainly if the relay is mounted directly to the wiper motor. The PARK input (Pin 4) can be left open (internal pull-down resistor). During the relay activation time, the motor current flows via the relay contact. When the relay is switched off, the park-switch takes over the current (see figure 7). The interval pause starts at the end of the activation time of the relay (see figure 8). If the INT switch is opened while the relay is still energized, the wiper motor turns on until it reaches its park position. The motor current flows via the park-switch contact.

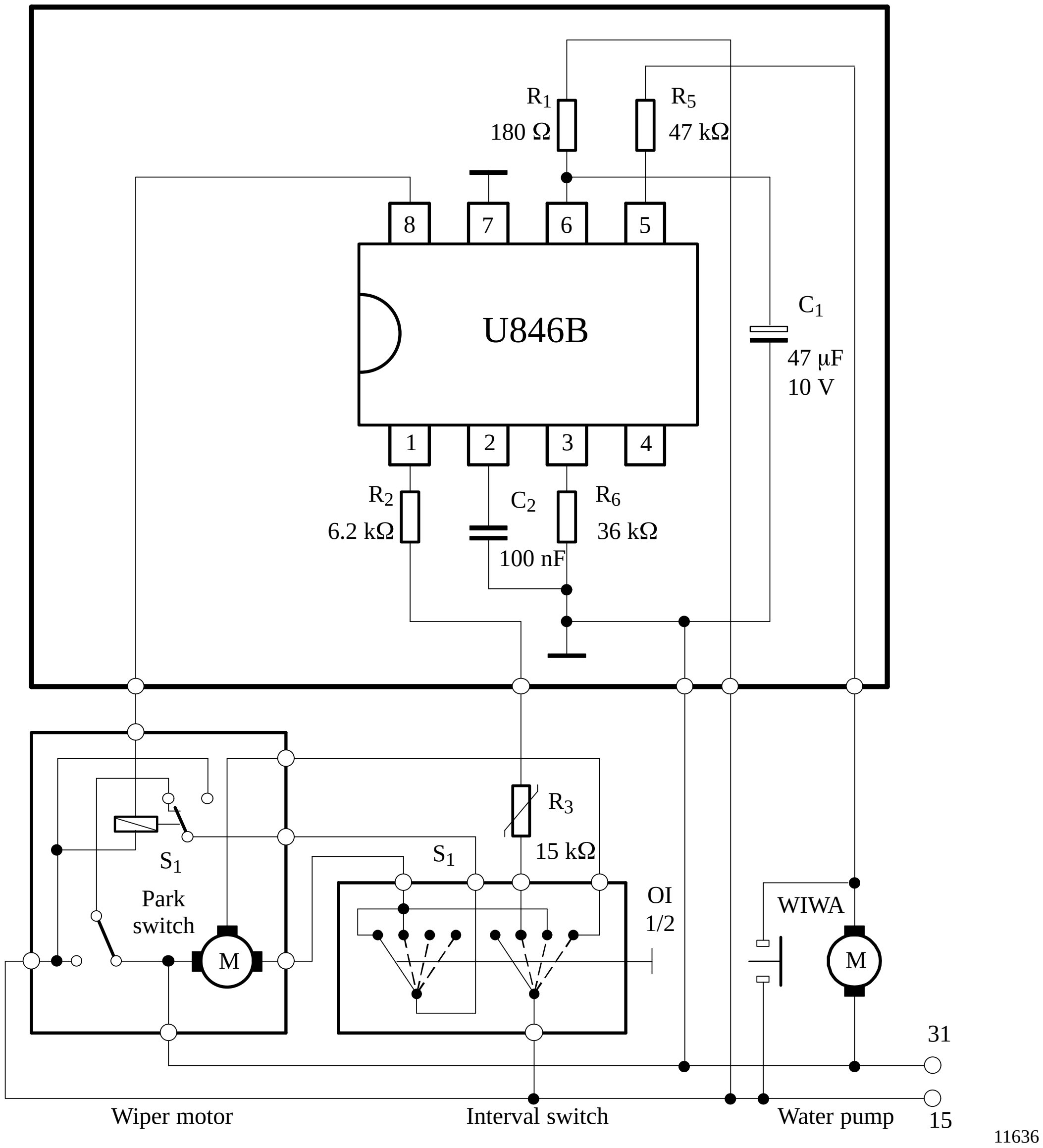


Figure 7. Application circuit without park-position feedback

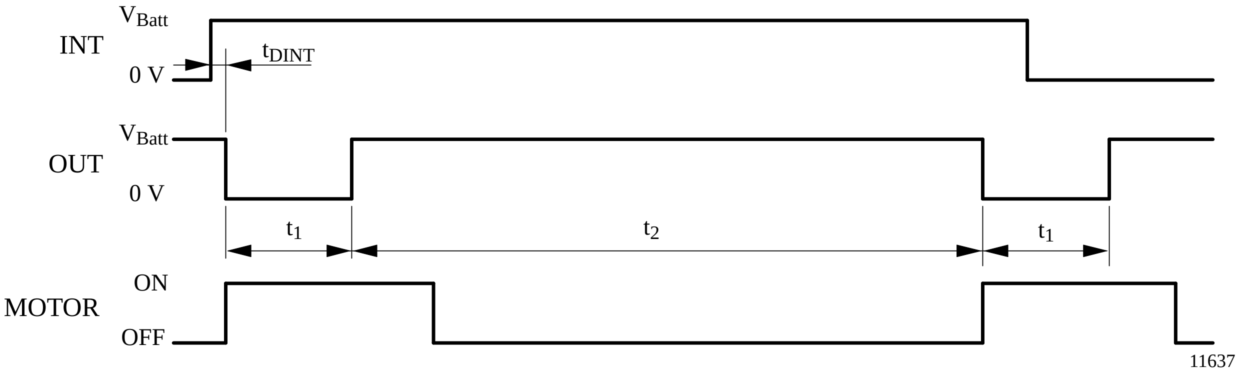


Figure 8. Intermittent circuit function without park-position feedback

Wipe/ Wash Operation

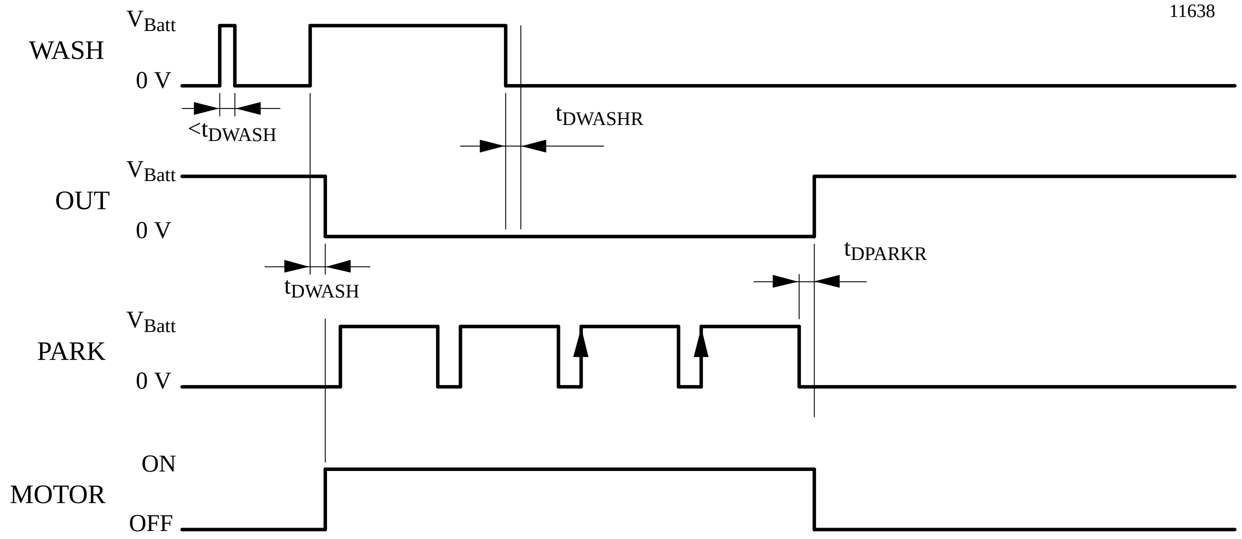


Figure 9. Wash operation with park-switch signal

When the WASH switch is closed, the relay is activated after the debounce time, t_{DWASH}. As long as the switch is pushed, the wash pump sprays water on the windscreen. When the WASH switch is released, the dry wiping starts after the “reverse” debouncing time t_{DWASHR} = 100 ms

Wipe/ Wash Mode with Park-Position Feedback

With the park input of the circuit connected to the wiper motor‘s park-switch, the output stays active until an internal counter counts 2 positive edges of the park-switch i.e., 2 full cycles for dry wiping (see figure 9).

Wipe/ Wash Mode without Park-Position Feedback

If the U846B is used without the wiper motor’s park-switch, Pin 4 is fixed to low potential (integrated pull-down resistor). Therefore, the driver stage is switched off after the dry wiping time t_3 is finished, but the wiper motor is supplied via its park-switch until the park position is reached.

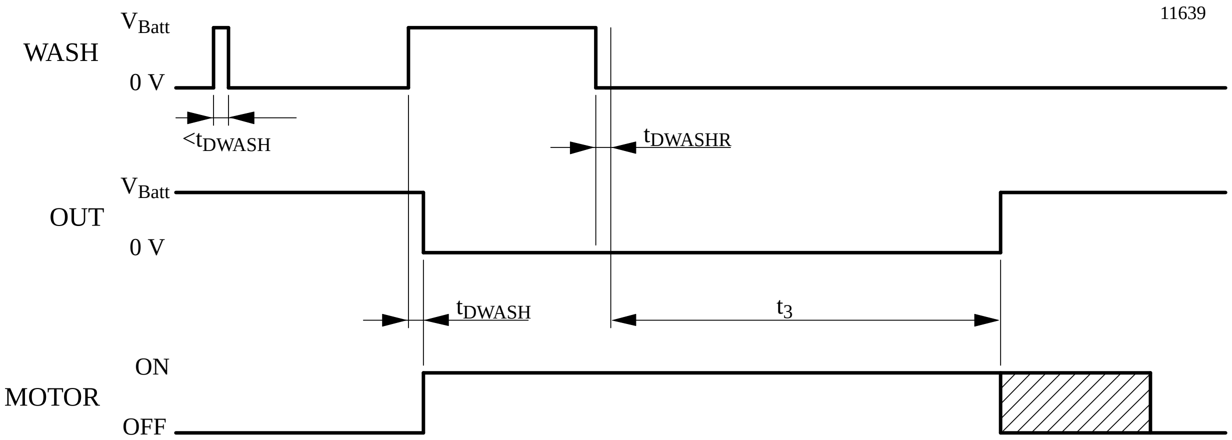


Figure 10. Wash operation without park-signal feedback

Wipe/ Wash Mode Priority

With built-in priority for the wipe / wash mode, the interval function is interrupted as soon as the WASH switch is operated longer than the debounce time t_{DWASH}. The interval mode continues with a relay activation time t_1 (see figures 11 and 12) either with or without park-switch feedback, after the relay activation time is finished (no park-switch feedback) or after the second wipe (park-switch fedback). In this case, 3 wipes are performed.

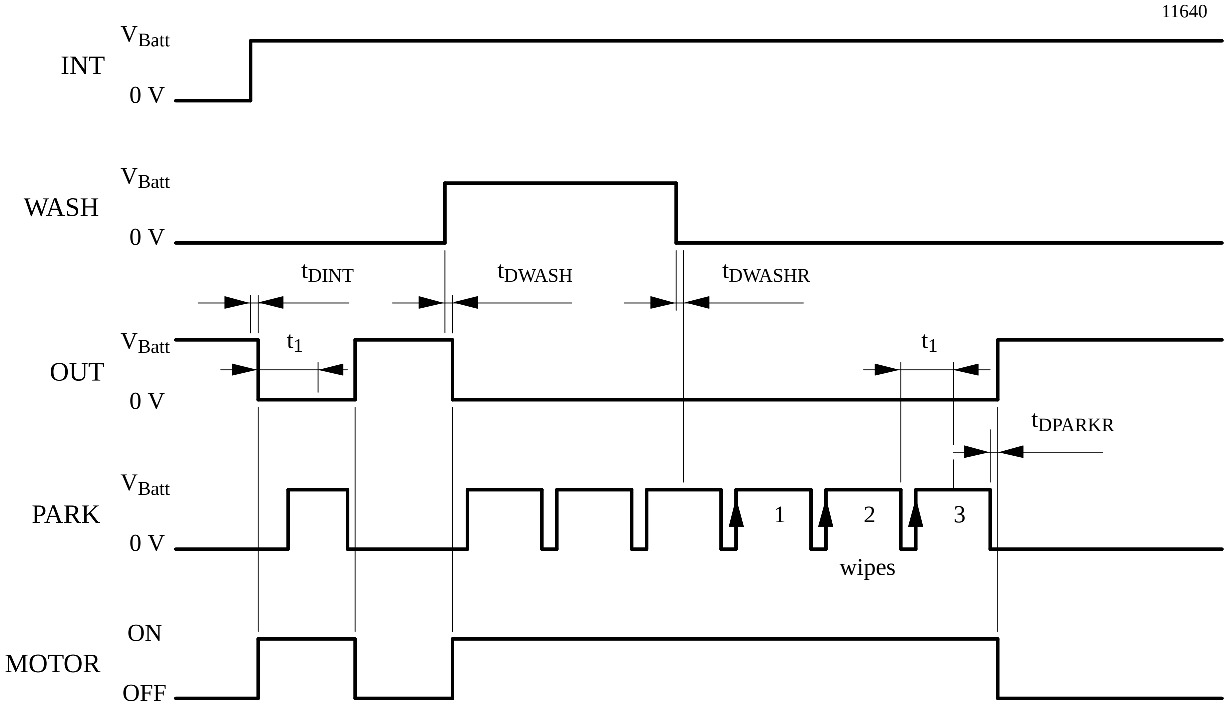


Figure 11. Wipe/ wash priority with park-position feedback

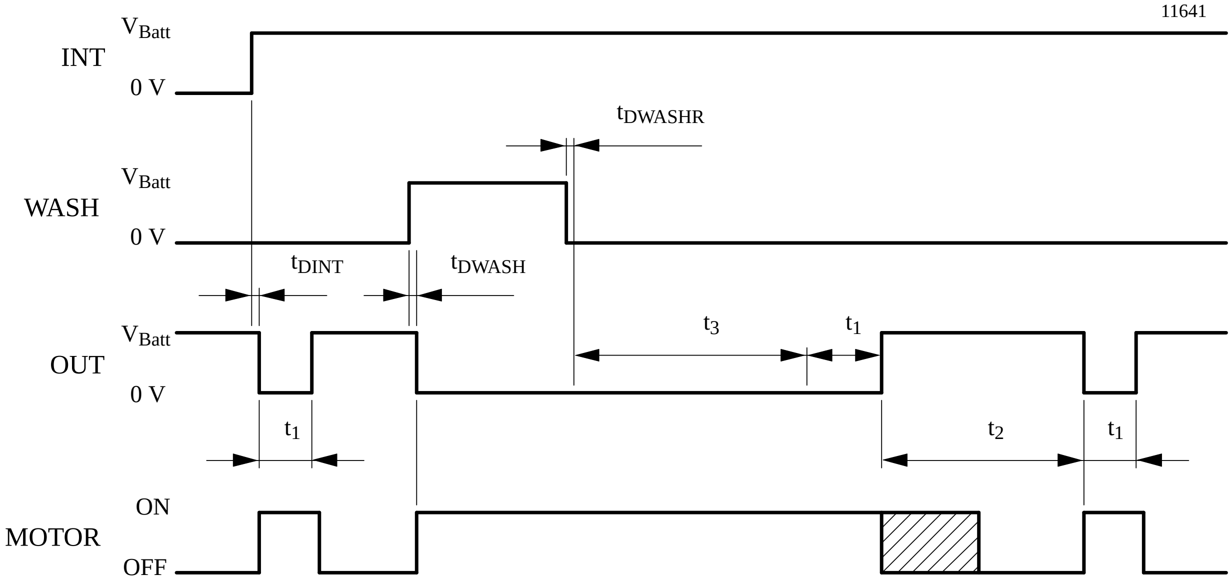


Figure 12. Wash/ wipe priority without park-position feedback

Absolute Maximum Ratings

Parameters		Symbol	Value	Unit
Supply voltage	t = 60 s t = 600 s	V_{Batt} V_{Batt}	24 18	V
Ambient temperature range		T_{amb}	-40 to +100	°C
Storage temperature range		T_{stg}	-55 to +125	°C
Maximum junction temperature		T_j	150	°C

Thermal Resistance

Parameters		Symbol	Maximum	Unit
Junction ambient	DIP8 SO8	R_{thJA} R_{thJA}	110 160	K/W

Electrical Characteristics

V_{Batt} = 13.5 V, T_{amb} = 25°C, reference point ground (Pin 7), unless otherwise specified
Circuit with recommended external circuitry (see figure 2)

Parameters	Test Conditions/ Pin	Symbol	Min.	Typ.	Max.	Unit
Supply						
Supply voltage range		V_{Batt}	9		16	V
Supply current	All switches open	I_6		1.6		mA
Undervoltage threshold POR		V_6		4		V
Series reistor		R_1		180		Ω
Filter capacior		C_1		47		F
Internal Z–diode		V_6		22.5		V
INT input Pin 1						
Protective diode		V_1		15		V
Internal capacitance		C_1		20		pF
Leakage resistance		R		45		kΩ
External series resistance		R_S	2		40	kΩ
PARK input Pin 4						
Protective diode		V_4		15		V
Internal capacitance		C_4		20		pF
Threshold		V_4		$0.5 \times V_6$		V
Pull-down resistance		R_4		20		kΩ
External series resistance		R_{S4}		10		kΩ
WASH input Pin 5						
Protective diode		V_5		15		V
Internal capacitance		C_5		20		pF
Threshold		V_5		$0.5 \times V_6$		V
Pull-down resistance		R_5		100		kΩ
External series resistance		R_{S5}			$0.5 \times$ R5	kΩ

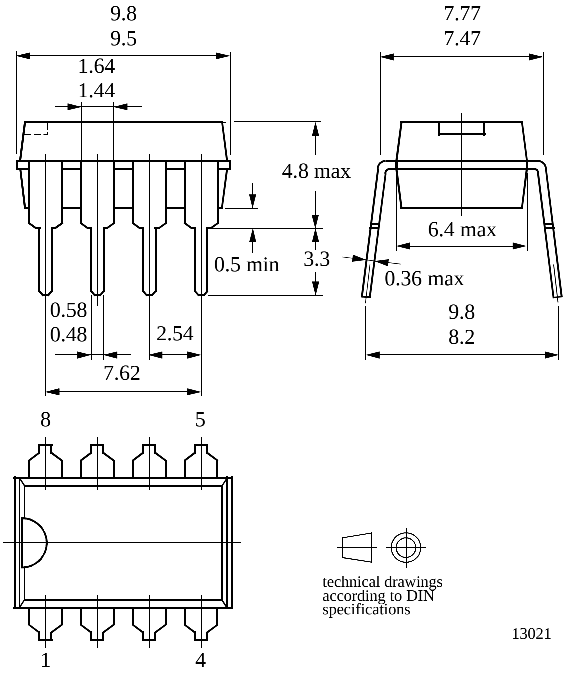
Electrical Characteristics (continued)

Parameters	Test Conditions/ Pin	Symbol	Min.	Typ.	Max.	Unit
Relay output 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
Output current	Normal operation	I_8			300	mA
Output pulse current	Load-dump	I_8			1.5	A
Internal Z-diode		V_8		28.5		V
Short circuit threshold		I_8		500		mA
Reverse current		I_8			100	A
Oscillator input C Pin 2						
Oscillator capacitor	Pin 2	C_2		100		nF
Basic frequency	C_2 = 100 nF, R_3 = 36 kΩ	f_0		320		Hz
Lower switching point		V_2		1		V
Upper switching point		V_2		2.75		V
Internal discharge resistance		R_2		500		Ω
Protective diode	I = 10 mA	V_2		15		V
Oscillator input R Pin 3						
Oscillator resistor		R_{3E}	18	36		kΩ
Integrated resistor		R_{3i}		3		kΩ
Integrated Z–diode		V_3		14		V
Times External circuitry - see oscillator input (figure 2)						
Debouncing Times						
● INT input		t_{DINT}	50	100	125	ms
		t_{DINTR}	50	100	125	ms
● WASH input		t_{DWASH}		100		ms
		t_{DWASHR}		100		ms
● PARK input		t_{DPARK}		25		ms
		t_{DPARKR}		25		ms
● Short circuit detection		t_{DSC}		10		ms
Relay activation time		t_1	400		625	ms
Tolerances of min. pause time	V_{Batt} = 12 V, T_{amb} = 28 ±10°C R_1 = 0 to 15 kΩ, R_3 = 6.2 kΩ	t_{2min}	2.6	3.48	4.35	s
Tolerances of max. pause time	V_{Batt} = 12 V, T_{amb} = 28 ±10°C R_1 = 0 to 15 kΩ, R_3 = 6.2 kΩ	t_{2max}	8.85	11.8	14.75	s
Dry wiping						
Without park-switch feedback		t_3	4.5	5.25	6	s
With park-switch feedback				2		turns

Package Information

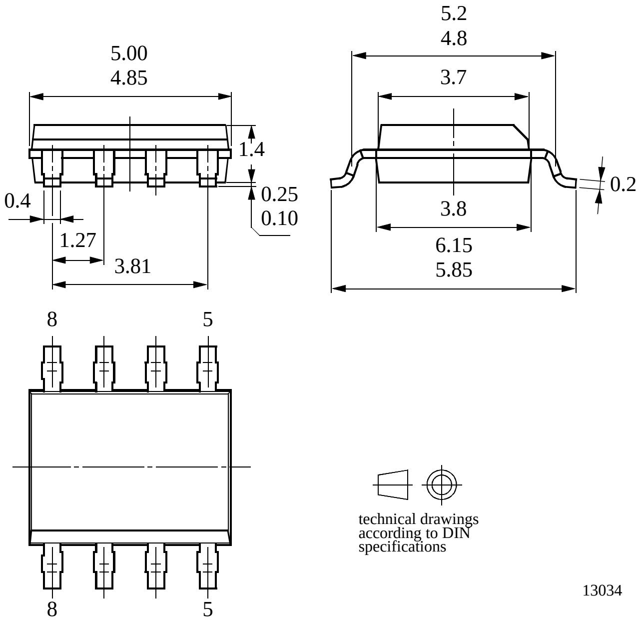
Package DIP8

Dimensions in mm



Package SO8

Dimensions in mm



Ozone Depleting Substances Policy Statement

It is the policy of **TEMIC TELEFUNKEN microelectronic GmbH** to

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 TELEFUNKEN microelectronic GmbH semiconductor division 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 can certify that our semiconductors are not manufactured with ozone depleting substances and do not contain such substances.

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