CMOS 14-STAGE RIPPLE-CARRY BINARY COUNTER/DIVIDER AND OSCILLATOR

■ Description

TK4060B consists of an oscillator section and 14 ripple-carry binary counter stages. The oscillator configuration allows design of either RC or crystal oscillator circuits. A RESET input is provided which resets the counter to the all-O's state and disables the oscillator. A high level on the RESET line accomplishes the reset function. All counter stages are master-slave flip-flops. The state of the counter is advanced one step in binary order on the negative transition of ΦI and ΦO. All inputs and outputs are fully buffered. Schmitt trigger action on the input-pulse line permits unlimited input-pulse rise and fall times.

■ Features

* 12MHz clock rate at 15V
* Common reset
*Fully static operation
* Buffered inputs and outputs
* Schmitt trigger input-pulse line

■ OSCILLATOR FEATURES

* All active components on chip
* RC or crystal oscillator configuration
* RC oscillator frequency of 690 kHz min. at 15V

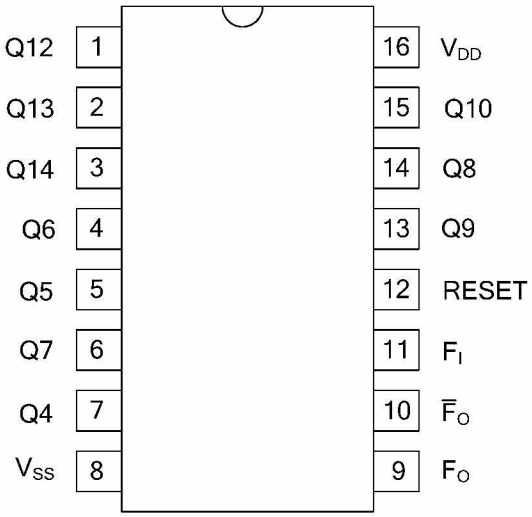
■ Applications

* Control counters
* Timers
* Frequency dividers
* Time-delay circuits

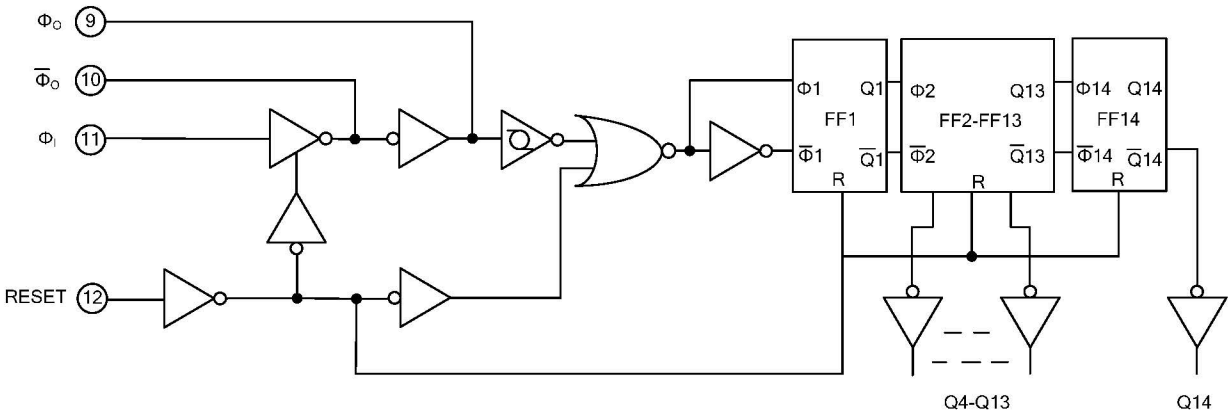
■ Ordering Information

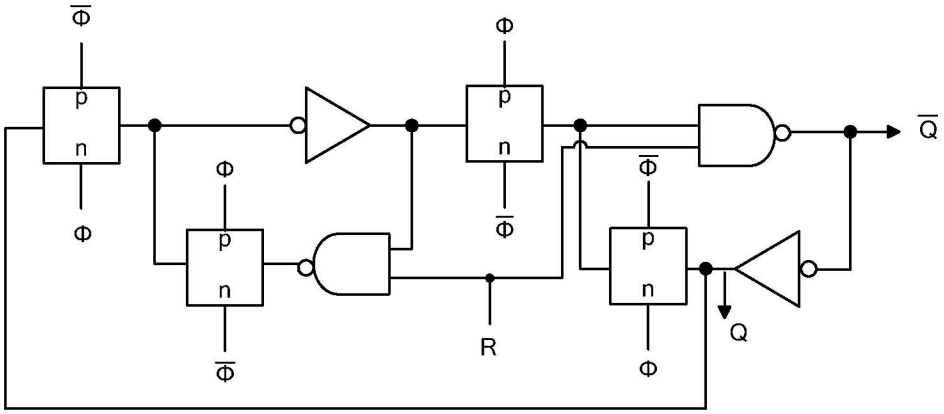
Ordering Number	Package	Packing
TK4060BDT	DIP-16	Tube
TK4060BBR	SOP-16	Tape Reel
TK4060BGR	TSSOP-16	Tape Reel

■ Pin Assignment



■ LOGIC DIAGRAM





■ ABSOLUTE MAXIMUM RATING (T_A=25°C, unless otherwise specified)

PARAMETER	SYMBOL	RATINGS	UNIT
Supply Voltage	V_{DD}	-0.5 ~ 17	V
Input Voltage	V_{IN}	-0.5 ~ V_{CC}+0.5	V
Output Voltage	V_{OUT}	-0.5 ~ V_{CC}+0.5	V
Input Clamp Current (V_{IN}<0, or V_{IN}>V_{DD})	I_K	±10	mA
Power Dissipation (T_A=-40°C~+85°C)	P_D	500	mW
Operating Temprature	T_{OPR}	-40 ~ +85	°C
Storage Temperature	T_{STG}	-65 ~ +150	°C

Notes: 1. Absolute maximum ratings are those values beyond which the device could be permanently damaged. Absolute maximum ratings are stress ratings only and functional device operation is not implied.
2. The input and output voltage ratings may be exceeded if the input and output current ratings are observed.

■ THERMAL DATA

PARAMETER		SYMBOL	RATINGS	UNIT
Junction to Ambient	DIP-16	θ_{JA}		°C/W
	SOP-16			°C/W
	TSSOP-16		110	°

■ RECOMMENDED OPERATING COMDITIONS

PARAMETER	SYMBOL	CONDITIONS	MIN	TPY	MAX	UNIT
Supply Voltage	V_{DD}		3		18	V
Input-Pulse Width	t_W	V_{DD}=5V	100			ns
		V_{DD}=10V	40			ns
		V_{DD}=15V	30			ns
Input-Pulse Frequency	fφI	V_{DD}=5V			3.5	MHz
		V_{DD}=10V			8	MHz
		V_{DD}=15V			12	MHz
Input-Pulse Rise and Fall Time	t_r / t_f	V_{DD}=5V	Unlimited			μs
		V_{DD}=10V				μs
		V_{DD}=15V				μs
Reset Pulse Width	t_W	V_{DD}=5V	120			ns
		V_{DD}=10V	60			ns
		V_{DD}=15V	40			ns

■ ELECTRICAL CHARACTERISTICS (T_A=25°C, unless otherwise specified)

PARAMETER	SYMBOL	CONDITIONS	MIN	TPY	MAX	UNIT
Quiescent Supply Current	I_{CC}	V_{IN}=0, 5V, V_{DD}=5V		0.04	5	μA
		V_{IN}=0, 10V, V_{DD}=10V		0.04	10	
		V_{IN}=0, 15V, V_{DD}=15V		0.04	20	
		V_{IN}=0, 20V, V_{DD}=20V		0.08	100	
Output Low (Sink) Current	I_{OL}	V_{OUT}=0.4V, V_{IN}=0, 5V, V_{DD}=5V	0.51	1		mA
		V_{OUT}=0.5V, V_{IN}=0, 10V, V_{DD}=10V	1.3	2.6		
		V_{OUT}=1.5V, V_{IN}=0, 15V, V_{DD}=15V	3.4	6.8		
Output High (Source) Current	I_{OH}	V_{OUT}=4.6V, V_{IN}=0, 5V, V_{DD}=5V	-0.51	-1		mA
		V_{OUT}=2.5V, V_{IN}=0, 5V, V_{DD}=5V	-1.6	-3.2		
		V_{OUT}=9.5V, V_{IN}=0, 10V, V_{DD}=10V	-1.3	-2.6		
		V_{OUT}=13.5V, V_{IN}=0, 15V, V_{DD}=15V	-3.4	-6.8		
Output Voltage: Low-Level	V_{OL}	V_{IN}= 0, 5V, V_{DD}=5V		0	0.05	V
		V_{IN}= 0, 10V, V_{DD}=10V		0	0.05	
		V_{IN}= 0, 15V, V_{DD}=15V		0	0.05	
Output Voltage: High-Level	V_{OH}	V_{IN}= 0, 5V, V_{DD}=5V	4.95	5		V
		V_{IN}= 0, 10V, V_{DD}=10V	9.95	10		
		V_{IN}= 0, 15V, V_{DD}=15V	14.95	15		
Input Low Voltage	V_{IL}	V_{OUT}=0.5, 4.5V, V_{DD}=5V			1.5	V
		V_{OUT}=1, 9V, V_{DD}=10V			3	
		V_{OUT}=1.5, 13.5V, V_{DD}=15V			4	
Input High Voltage	V_{IH}	V_{OUT}=0.5, 4.5V, V_{DD}=5V	3.5			V
		V_{OUT}=1, 9V, V_{DD}=10V	7			
		V_{OUT}=1.5, 13.5V, V_{DD}=15V	11			
Input Leakage Current	$I_{I(LEAK)}$	V_{IN}=0, 18V, V_{DD}=18V		$\pm10^{-5}$	±0.1	μA

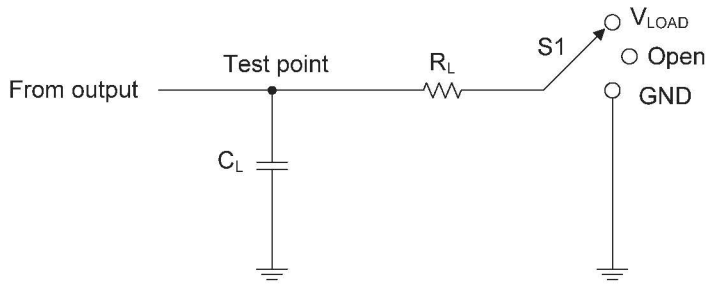
■ SWITCHING CHARACTERISTICS (T_A =25°C, Input t_r / t_f =20ns, C_L =50pF, R_L = 200kΩ)

PARAMETER	SYMBOL	CONDITIONS	MIN	TPY	MAX	UNIT
CLOCKED OPERATION						
Propagation Delay Time, ΦI to Q4	t_{PLH} / t_{PHL}	V_{DD}=5V		370	740	ns
		V_{DD}=10V		150	300	
		V_{DD}=15V		100	200	
Propagation Delay Time, Qn to Qn+1	t_{PLH} / t_{PHL}	V_{DD}=5V		100	200	ns
		V_{DD}=10V		50	100	
		V_{DD}=15V		40	80	

■ SWITCHING CHARACTERISTICS(Cont.)

PARAMETER	SYMBOL	CONDITIONS		MIN	TPY	MAX	UNIT
Transition Time	t_{THL}/ t_{TLH}	V_{DD}=5V			100	200	ns
		V_{DD}=10V			50	100	
		V_{DD}=15V			40	80	
Maximum Input-Pulse Frequency	f ΦI	V_{DD}=5V		3.5	7		MHz
		V_{DD}=10V		8	16		
		V_{DD}=15V		12	24		
Minimum Input-Pulse Width	t_W	V_{DD}=5V			50	100	ns
		V_{DD}=10V			20	40	
		V_{DD}=15			15	30	
Input-Pulse Rise and Fall Time	t_r Φ/ t_f Φ	V_{DD}=5V		Unlimited			
		V_{DD}=10V					
		V_{DD}=15V					
Average Input Capacitance	C_I	Any Input			5	7.5	pF
RESET OPERATION							
Propagation Delay Time	t_{PLH} / t_{PHL}	V_{DD}=5V			180	360	ns
		V_{DD}=10V			80	160	ns
		V_{DD}=15V			50	100	ns
Minimum Reset Pulse Width	t_{WR}	V_{DD}=5V			60	120	ns
		V_{DD}=10V			30	60	ns
		V_{DD}=15			20	40	ns
RC OPERATION							
Variation of Frequency		C_X=200pF, R_S=560kΩ, R_X=50kΩ	V_{DD}=5V		23±10%		kHz
			V_{DD}=10V		24±10%		kHz
			V_{DD}=15V		25±10%		kHz
Variation of Frequency with voltage change		C_X=200pF, R_S=560kΩ, R_X=50kΩ	V_{DD}=5V~10V		1.5		kHz
			V_{DD}=10V~15V		0.5		kHz
R_X max		C_X=10Mf, V_{DD}=5V				20	MΩ
		C_X=50μF, V_{DD}=10V				20	MΩ
		C_X=10μF, V_{DD}=15V				10	MΩ
C_X max		R_X=500kΩ, V_{DD}=5V				1000	μF
		R_X=300kΩ, V_{DD}=10V				50	
		R_X=300kΩ, V_{DD}=15V				50	
Maximum Oscillator Frequency		C_X=15pF, R_S=30kΩ, R_X=5kΩ	V_{DD}=10V	530	650	810	kHz
			V_{DD}=15	690	800	940	kHz
Drive Current at Pin 9	I_{OL}	V_O=0.4V, V_{DD}=5V		0.16	0.35		mA
		V_O=0.5V, V_{DD}=10V		0.42	0.8		mA
		V_O=1.5V, V_{DD}=15		1	2		mA
	I_{OH}	V_O=4.6V, V_{DD}=5V		-0.16	-0.35		mA
		V_O=9.5V, V_{DD}=10V		-0.42	-0.8		mA
		V_O=13.5V, V_{DD}=15		-1	-2		mA

■ TEST CIRCUIT AND WAVEFORMS



TEST	S1
t_{PLH}/t_{PHL}	GND

Fig. 1 Test Circuit

Inputs		V_M	V_{LOAD}	C_L	R_L
V_{IN}	t_r, t_f				
V_{CC}	20 ns	$V_{CC}/2$	V_{CC}	50 pF	200 KΩ

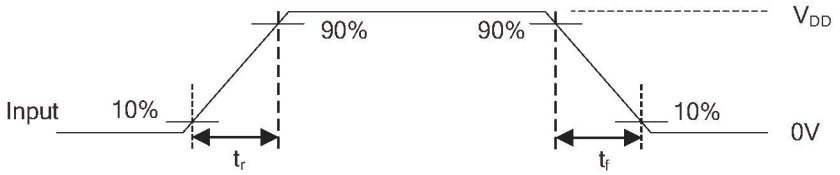


Fig. 2 Voltage Waveforms Input Rise And Fall Times

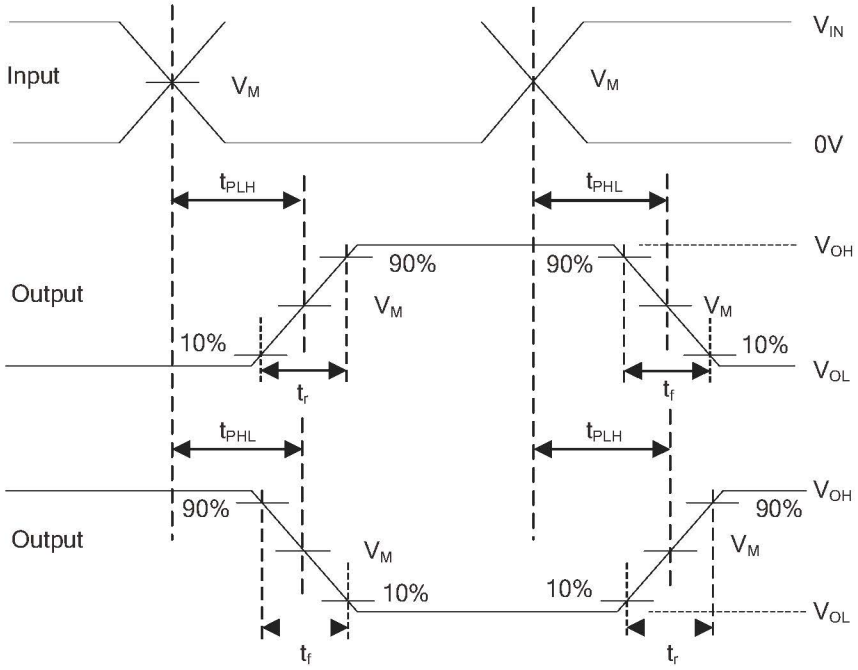


Fig. 3 Voltage Waveforms
Propagation Delay Aad Output Transition Times

Notes: 1. C_L includes probe and jig capacitance.
2. All input pulses are supplied by generators having the following characteristics: PRR ≤1MHz, Z_O = 50Ω.

■ TEST CIRCUIT AND WAVEFORMS (Cont.)

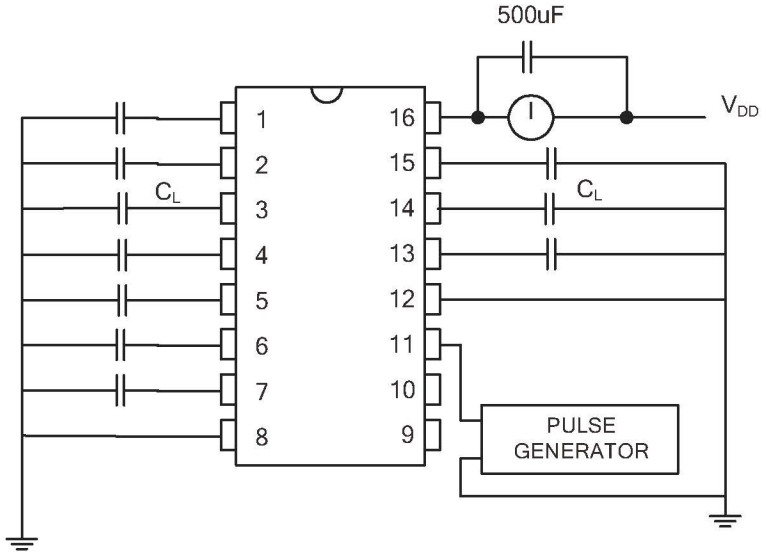


Fig. 4 Dynamic Power Dissipation Test Circuit

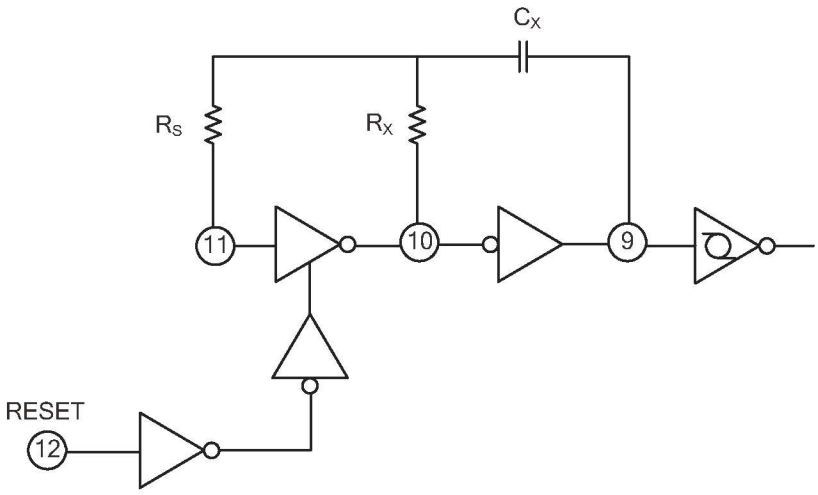
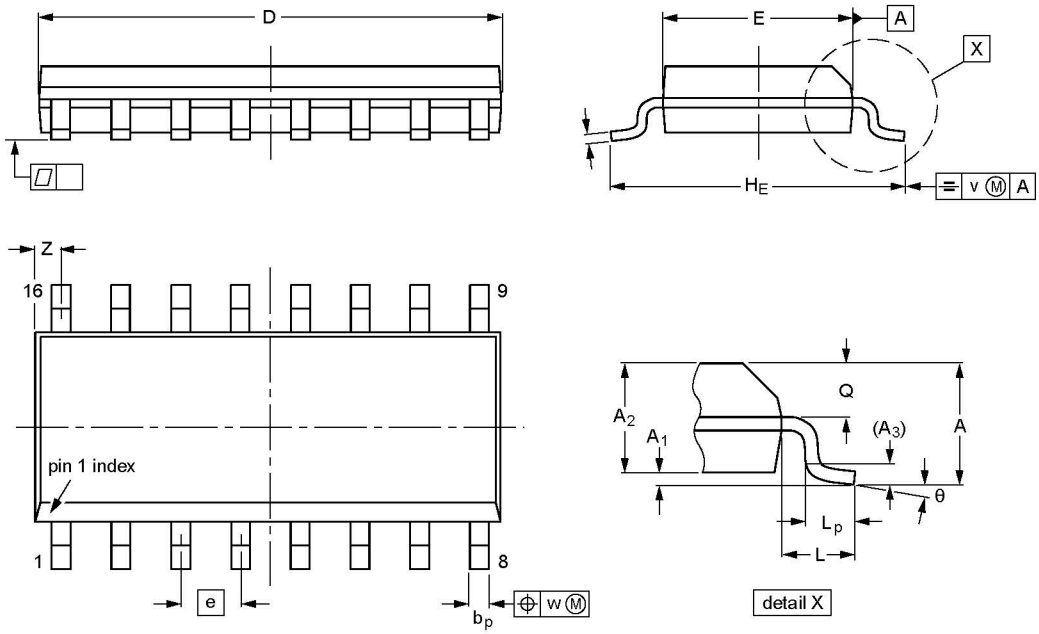


Fig. 5 Typical RC Circuit

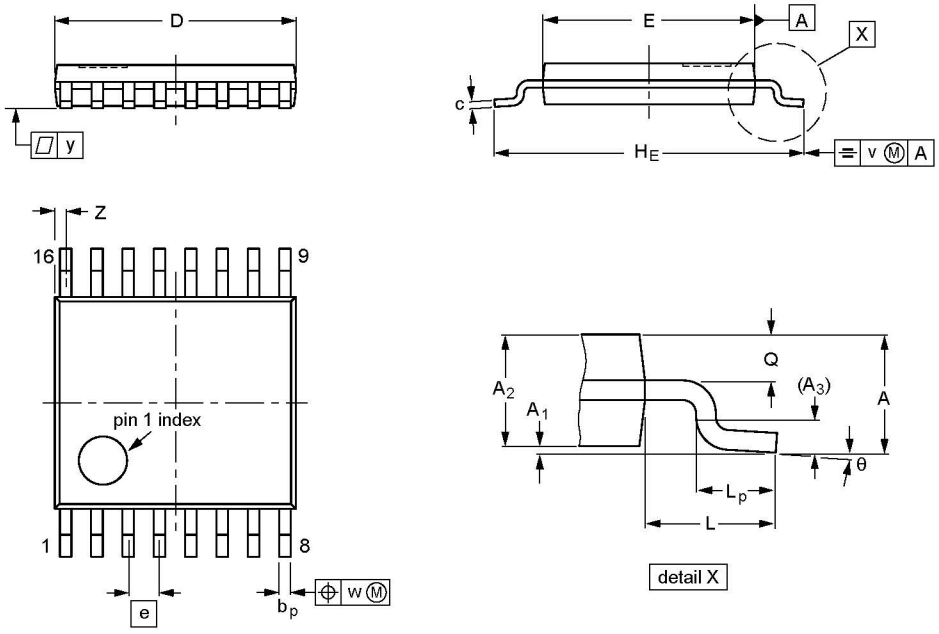
SOIC16: plastic small outline package; 16 leads; body width 3.9 mm



DIMENSIONS (mm are the original dimensions)

UNIT	A max.	A_1	A_2	A_3	b_p	c	$D^{(1)}$	$E^{(1)}$	e	H_E	L	L_p	Q	v	w	y	$Z^{(1)}$	θ
mm	1.75	0.25 0.10	1.45 1.25	0.25	0.49 0.36	0.25 0.19	10.0 9.8	4.0 3.8	1.27	6.2 5.8	1.05	1.0 0.4	0.7 0.6	0.25	0.25	0.1	0.7 0.3	8° 0

TSSOP16: plastic thin shrink small outline package; 16 leads; body width 4.4 mm



DIMENSIONS (mm are the original dimensions)

UNIT	A max.	A_1	A_2	A_3	b_p	c	$D^{(1)}$	$E^{(2)}$	e	H_E	L	L_p	Q	v	w	y	$Z^{(1)}$	θ
mm	1.1	0.15 0.05	0.95 0.80	0.25	0.30 0.19	0.2 0.1	5.1 4.9	4.5 4.3	0.65	6.6 6.2	1	0.75 0.50	0.4 0.3	0.2	0.13	0.1	0.40 0.06	8° 0°