钍地半导体
Tudi Semiconductor

Product Specification

TUDI-LM393, LM393E, LM293, LM2903, LM2903E, LM2903V, NCV2903

Low Offset Voltage Dual Comparators

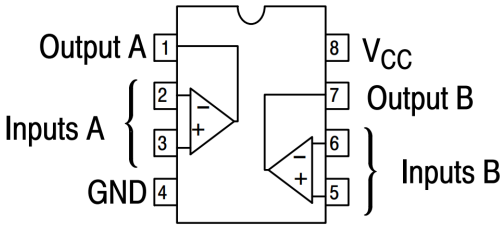
网址 www.sztdbdt.com

用芯智造·卓越品质

semiconductor device manufacturer

- Design
- research and development
- production
- and sales

Features



- Wide Single?Supply Range: 2.0 Vdc to 36 Vdc
- Split-Supply Range: ±1.0 Vdc to ±18 Vdc
- Very Low Current Drain Independent of Supply Voltage: 0.4 mA
- Low Input Bias Current: 25 nA
- Low Input Offset Current: 5.0 nA
- Low Input Offset Voltage: 5.0 mV (max) LM293/393
- Input Common Mode Range to Ground Level
- Differential Input Voltage Range Equal to Power Supply Voltage
- Output Voltage Compatible with DTL, ECL, TTL, MOS, and CMOS Logic Levels
- ESD Clamps on the Inputs Increase the Ruggedness of the Device without Affecting Performance
- NCV Prefix for Automotive and Other Applications Requiring Unique Site and Control Change Requirements; AEC-Q100 Qualified and PPAP Capable
- These Devices are Pb-Free, Halogen Free/BFR Free and are RoHS Compliant

Description

The LM393 series are dual independent precision voltage comparators capable of single or split supply operation. These devices are designed to permit a common mode range-to-ground level with single supply operation. Input offset voltage specifications as low as 2.0 mV make this device an excellent selection for many applications in consumer, automotive, and industrial electronics.

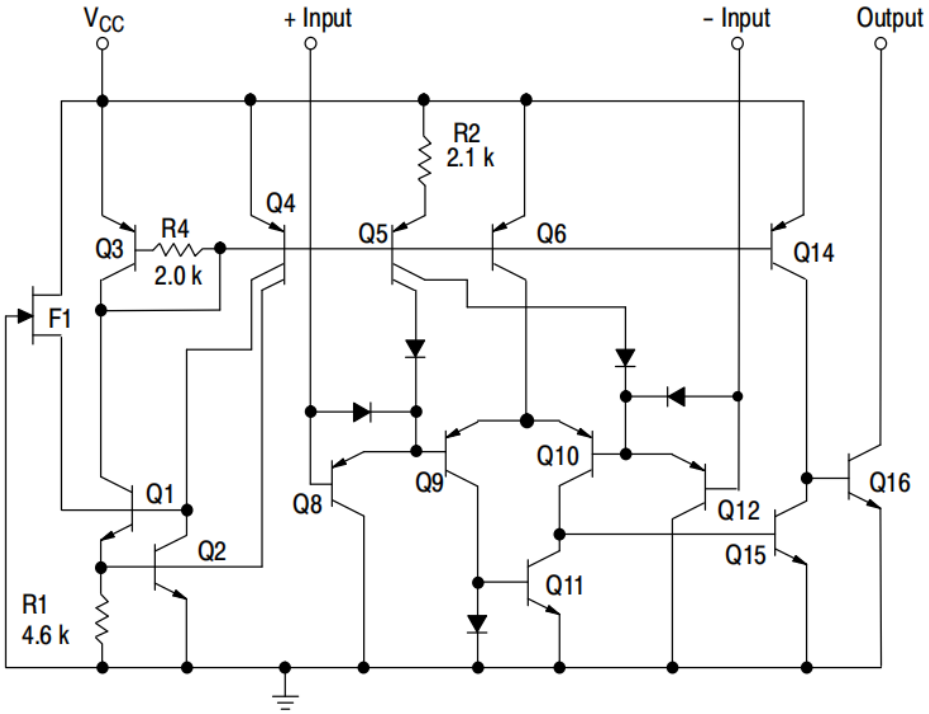


Figure 1. Representative Schematic Diagram
(Diagram shown is for 1 comparator)

MAXIMUM RATINGS

Rating	Symbol	Value	Unit
Power Supply Voltage	V_{CC}	+36 or ±18	V
Input Differential Voltage	V_{IDR}	36	V
Input Common Mode Voltage Range (Note 1)	V_{ICR}	−0.3 to +36	V
Output Voltage	V_O	36	V
Output Short Circuit−to−Ground Output Sink Current (Note 2)	I_{SC} I_{Sink}	Continuous 20	mA
Power Dissipation @ T_A = 25°C Derate above 25°C	P_D $1/R_{\theta JA}$	570 5.7	mW mW/°C
Operating Ambient Temperature Range LM293 LM393, LM393E LM2903, LM2903E LM2903V, NCV2903 (Note 3)	T_A	 −25 to +85 0 to +70 −40 to +105 −40 to +125	°C
Maximum Operating Junction Temperature LM393, LM393E, LM2903, LM2903E, LM2903V LM293, NCV2903	$T_{J(max)}$	 150 150	°C
Storage Temperature Range	T_{stg}	−65 to +150	°C

Stresses exceeding those listed in the Maximum Ratings table may damage the device. If any of these limits are exceeded, device functionality should not be assumed, damage may occur and reliability may be affected.

1. For supply voltages less than 36 V, the absolute maximum input voltage is equal to the supply voltage.
2. The maximum output current may be as high as 20 mA, independent of the magnitude of V_{CC}, output short circuits to V_{CC} can cause excessive heating and eventual destruction.
3. *NCV2903 is qualified for automotive use.*

ESD RATINGS

Rating	HBM	MM	Unit
ESD Protection at any Pin (Human Body Model − HBM, Machine Model − MM)			
NCV2903 (Note 3)	2000	200	V
LM393E, LM2903E	1500	150	V
LM393DG/DR2G, LM2903DG/DR2G	250	100	V
All Other Devices	1500	150	V

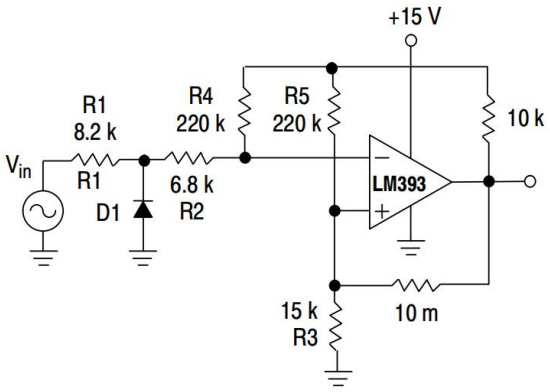
ELECTRICAL CHARACTERISTICS (V_{CC} = 5.0 Vdc, $T_{low} \le T_A \le T_{high}$, unless otherwise noted.)

Characteristic	Symbol	LM293, LM393, LM393E			LM2903/E/V, NCV2903			Unit
		Min	Typ	Max	Min	Typ	Max	
Input Offset Voltage (Note 5)	V_{IO}							mV
T_A = 25°C		–	±1.0	±5.0	–	±2.0	±7.0	
$T_{low} \le T_A \le T_{high}$		–	–	±9.0	–	±9.0	±15	
Input Offset Current	I_{IO}							nA
T_A = 25°C		–	±5.0	±50	–	±5.0	±50	
$T_{low} \le T_A \le T_{high}$		–	–	±150	–	±50	±200	
Input Bias Current (Note 6)	I_{IB}							nA
T_A = 25°C		–	20	250	–	20	250	
$T_{low} \le T_A \le T_{high}$		–	–	400	–	20	500	
Input Common Mode Voltage Range (Note 6)	V_{ICR}							V
T_A = 25°C		0	–	V_{CC} −1.5	0	–	V_{CC} −1.5	
$T_{low} \le T_A \le T_{high}$		0	–	V_{CC} −2.0	0	–	V_{CC} −2.0	
Voltage Gain $R_L \ge 15$ kΩ, V_{CC} = 15 Vdc, T_A = 25°C	A_{VOL}	50	200	–	25	200	–	V/mV
Large Signal Response Time V_{in} = TTL Logic Swing, V_{ref} = 1.4 Vdc V_{RL} = 5.0 Vdc, R_L = 5.1 kΩ, T_A = 25°C	–	–	300	–	–	300	–	ns
Response Time (Note 8) V_{RL} = 5.0 Vdc, R_L = 5.1 kΩ, T_A = 25°C	t_{TLH}	–	1.3	–	–	1.5	–	μs
Input Differential Voltage (Note 9) All $V_{in} \ge$ GND or V− Supply (if used)	V_{ID}	–	–	V_{CC}	–	–	V_{CC}	V
Output Sink Current $V_{in} \ge 1.0$ Vdc, V_{in+} = 0 Vdc, $V_O \le 1.5$ Vdc T_A = 25°C	I_{Sink}	6.0	16	–	6.0	16	–	mA
Output Saturation Voltage	V_{OL}							mV
$V_{in} \ge 1.0$ Vdc, V_{in+} = 0, $I_{Sink} \le 4.0$ mA, T_A = 25°C		–	150	400	–	–	400	
$T_{low} \le T_A \le T_{high}$		–	–	700	–	200	700	
Output Leakage Current	I_{OL}							nA
V_{in-} = 0 V, $V_{in+} \ge 1.0$ Vdc, V_O = 5.0 Vdc, T_A = 25°C		–	0.1	–	–	0.1	–	
V_{in-} = 0 V, $V_{in+} \ge 1.0$ Vdc, V_O = 30 Vdc, $T_{low} \le T_A \le T_{high}$		–	–	1000	–	–	1000	
Supply Current	I_{CC}							mA
R_L = ∞ Both Comparators, T_A = 25°C		–	0.4	1.0	–	0.4	1.0	
R_L = ∞ Both Comparators, V_{CC} = 30 V		–	–	2.5	–	–	2.5	

Product parametric performance is indicated in the Electrical Characteristics for the listed test conditions, unless otherwise noted. Product performance may not be indicated by the Electrical Characteristics if operated under different conditions.

LM293 T_{low} = −25°C, T_{high} = +85°C
LM393, LM393E T_{low} = 0°C, T_{high} = +70°C
LM2903, LM2903E T_{low} = −40°C, T_{high} = +105°C
LM2903V & NCV2903 T_{low} = −40°C, T_{high} = +125°C
NCV2903 is qualified for automotive use.

4. The maximum output current may be as high as 20 mA, independent of the magnitude of V_{CC}, output short circuits to V_{CC} can cause excessive heating and eventual destruction.
5. At output switch point, $V_O \simeq 1.4$ Vdc, R_S = 0 Ω with V_{CC} from 5.0 Vdc to 30 Vdc, and over the full input common mode range (0 V to V_{CC} = −1.5 V).
6. Due to the PNP transistor inputs, bias current will flow out of the inputs. This current is essentially constant, independent of the output state, therefore, no loading changes will exist on the input lines.
7. Input common mode of either input should not be permitted to go more than 0.3 V negative of ground or minus supply. The upper limit of common mode range is V_{CC} −1.5 V.
8. Response time is specified with a 100 mV step and 5.0 mV of overdrive. With larger magnitudes of overdrive faster response times are obtainable.
9. The comparator will exhibit proper output state if one of the inputs becomes greater than V_{CC}, the other input must remain within the common mode range. The low input state must not be less than −0.3 V of ground or minus supply.

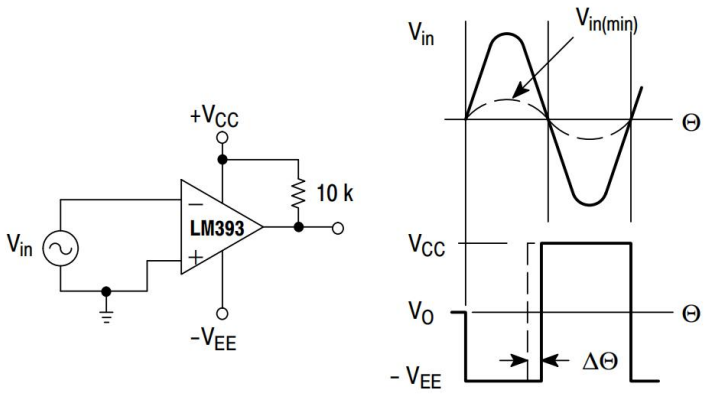


D1 prevents input from going negative by more than 0.6 V.

$$R1 + R2 = R3$$

$$R3 \leq \frac{R5}{10}$$ for small error in zero crossing.

Figure 2. Zero Crossing Detector (Single Supply)



$V_{in(min)} \approx 0.4$ V peak for 1% phase distortion ($\Delta\Theta$).

Figure 3. Zero Crossing Detector (Split Supply)

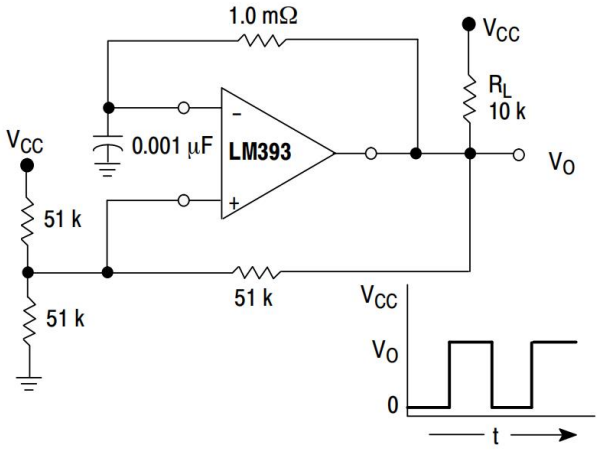
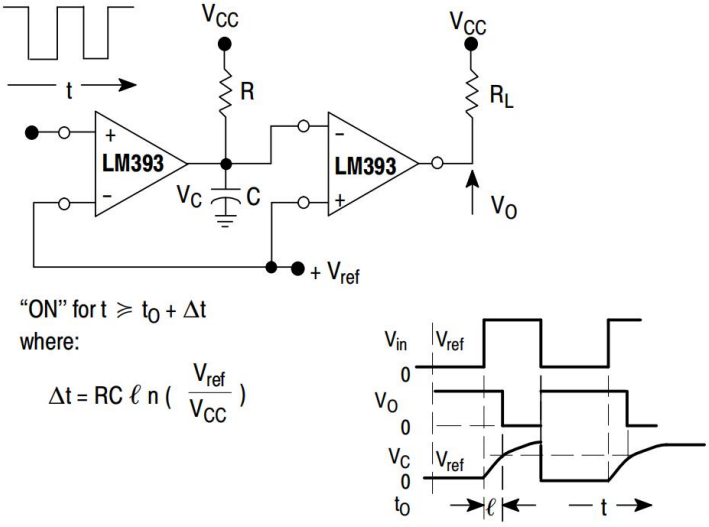


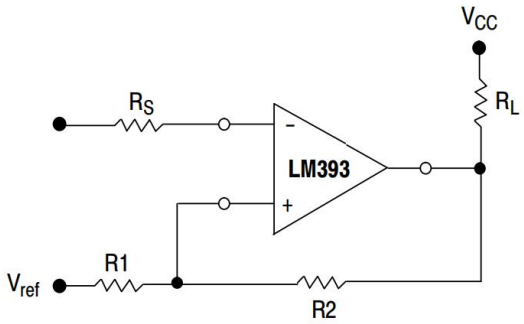
Figure 4. Free−Running Square−Wave Oscillator



"ON" for $t \geq t_O + \Delta t$
where:

$$\Delta t = RC\,\ell n\left(\frac{V_{ref}}{V_{CC}}\right)$$

Figure 5. Time Delay Generator



$$R_S = R1 \,||\, R2$$

$$V_{th1} = V_{ref} + \frac{(V_{CC} - V_{ref})\,R1}{R1 + R2 + R_L}$$

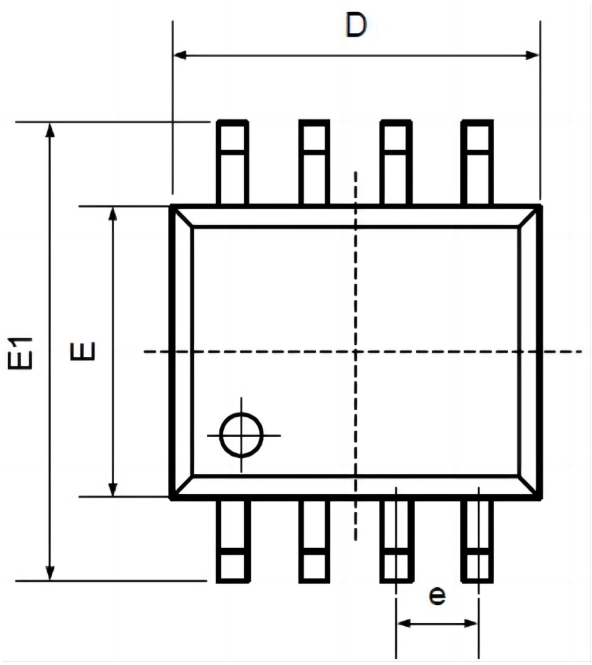
$$V_{th2} = V_{ref} - \frac{(V_{ref} - V_O\ \text{Low})\,R1}{R1 + R2}$$

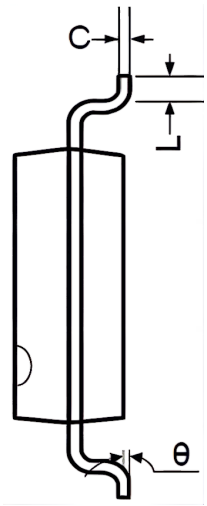
Figure 6. Comparator with Hysteresis

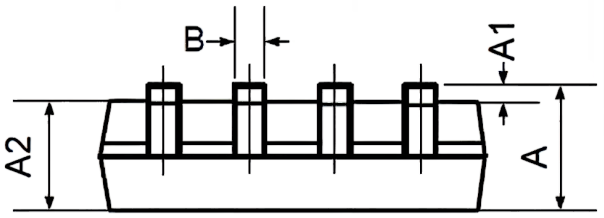
ORDERING INFORMATION

Order Number	Package	Package Quantity	Marking On The park
LM293DR2G-TUDI	SOP8	Tape,Reel,2500	LM293
LM293DMR2G-TUDI	MSOP8	Tape,Reel,2500	293
LM393DR2G-TUDI	SOP8	Tape,Reel,2500	LM393
LM393EDR2G-TUDI	SOP8	Tape,Reel,2500	393E
LM393NG-TUDI	DIP8	Tube,50,A box of 2000	LM393NG
LM393DMR2G-TUDI	MSOP8	Tape,Reel,2500	393
LM2903DR2G-TUDI	SOP8	Tape,Reel,2500	2903
LM2903EDR2G-TUDI	SOP8	Tape,Reel,2500	2903E
LM2903DMR2G-TUDI	MSOP8	Tape,Reel,2500	2903
LM2903NG-TUDI	DIP8	Tube,50,A box of 2000	LM2903NG
LM2903VDR2G-TUDI	SOP8	Tape,Reel,2500	2903V
LM2903VNG-TUDI	DP8	Tube,50,A box of 2000	LM2903VNG
NCV2903DR2G-TUDI	SOP8	Tape,Reel,2500	2903V
NCV2903DMR2G-TUDI	MSOP8	Tape,Reel,2500	903V

Package SOP8

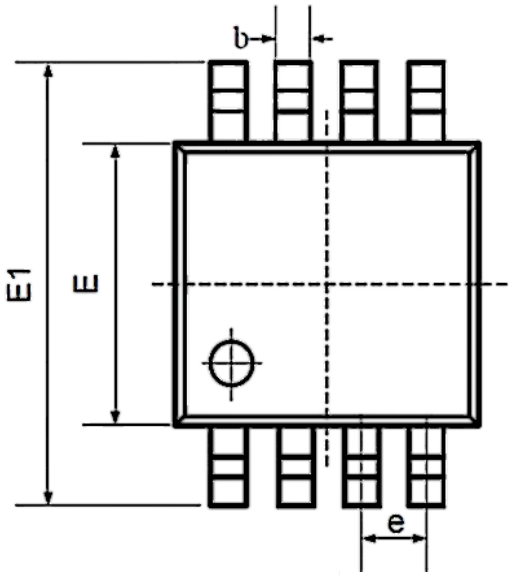


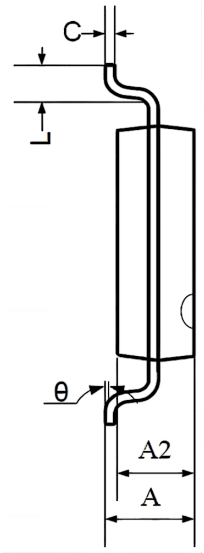


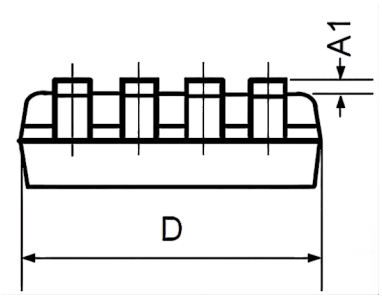


Symbol	Dimensions In Millimeters		Dimensions In Inches	
	Min	Max	Min	Max
A	1.350	1.750	0.053	0.069
A1	0.100	0.250	0.004	0.010
A2	1.350	1.550	0.053	0.061
B	0.330	0.510	0.013	0.020
C	0.190	0.250	0.007	0.010
D	4.780	5.000	0.188	0.197
E	3.800	4.000	0.150	0.157
E1	5.800	6.300	0.228	0.248
e	1.270TYP		0.050TYP	
L	0.400	1.270	0.016	0.050
θ	0°	8°	0°	8°

Package MSOP8

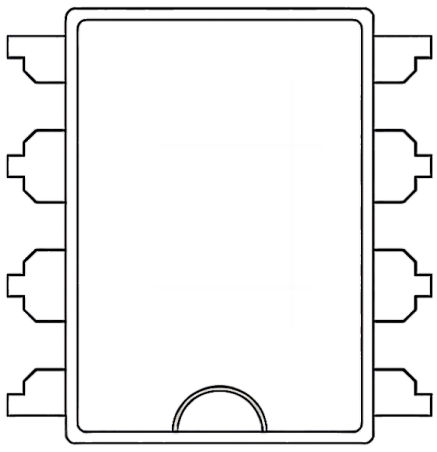


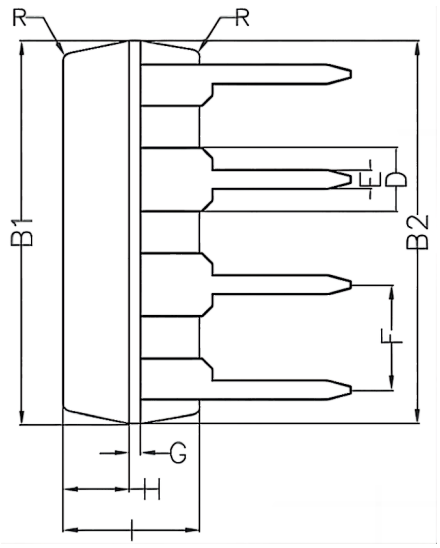


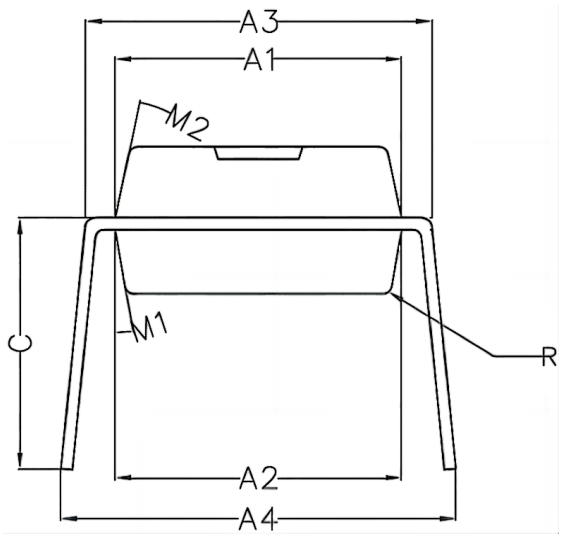


Symbol	Dimensions In Millimeters		Dimensions In Inches	
	Min	Max	Min	Max
A	0.800	1.200	0.031	0.047
A1	0.000	0.200	0.000	0.008
A2	0.760	0.970	0.030	0.038
b	0.30 TYP		0.012 TYP	
C	0.15 TYP		0.006 TYP	
D	2.900	3.100	0.114	0.122
e	0.65 TYP		0.026 TYP	
E	2.900	3.100	0.114	0.122
E1	4.700	5.100	0.185	0.201
L	0.410	0.650	0.016	0.026
θ	0°	6°	0°	6°

Package DIP8







Symbol	Min	Non	Max
A1	6.28	6.33	6.38
A2	6.33	6.38	6.43
A3	7.52	7.62	7.72
A4	7.80	8.40	9.00
B1	9.15	9.20	9.25
B2	9.20	9.25	9.30
C		5.57	
D		1.52	
E	0.43	0.45	0.47
F		2.54	
G		0.25	
H	1.54	1.59	1.64
工	3.22	3.27	3.32
R		0.20	
M1	9°	10°	11°
M2	11°	12°	13°

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