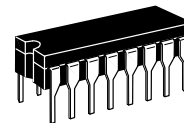


MC14060B

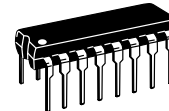
14-Bit Binary Counter and Oscillator

The MC14060B is a 14-stage binary ripple counter with an on-chip oscillator buffer. The oscillator configuration allows design of either RC or crystal oscillator circuits. Also included on the chip is a reset function which places all outputs into the zero state and disables the oscillator. A negative transition on Clock will advance the counter to the next state. Schmitt trigger action on the input line permits very slow input rise and fall times. Applications include time delay circuits, counter controls, and frequency dividing circuits.

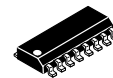
- Fully static operation
- Diode Protection on All Inputs
- Supply Voltage Range = 3.0 V to 18 V
- Capable of Driving Two Low-power TTL Loads or One Low-power Schottky TTL Load Over the Rated Temperature Range
- Buffered Outputs Available from Stages 4 Through 10 and 12 Through 14
- Common Reset Line
- Pin-for-Pin Replacement for CD4060B



L SUFFIX
CERAMIC
CASE 620



P SUFFIX
PLASTIC
CASE 648



D SUFFIX
SOIC
CASE 751B

ORDERING INFORMATION

MC14XXXBCP Plastic
MC14XXXBCL Ceramic
MC14XXXBD SOIC

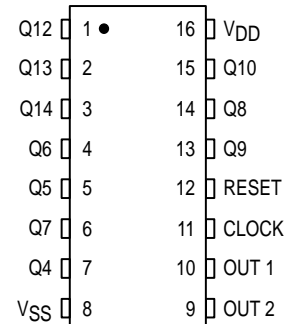
T_A = -55° to 125°C for all packages.

TRUTH TABLE

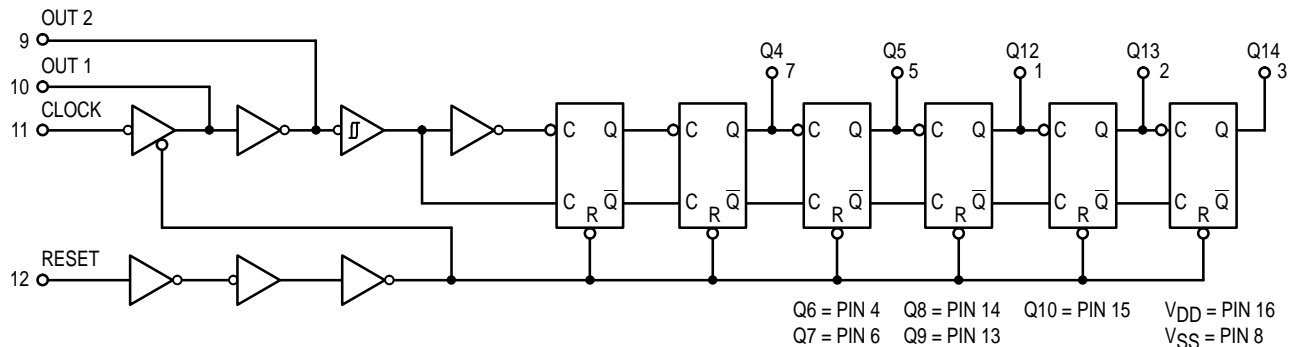
Clock	Reset	Output State
⎓	L	No Change
⎓	L	Advance to next state
X	H	All Outputs are low

X = Don't Care

PIN ASSIGNMENT



LOGIC DIAGRAM



MAXIMUM RATINGS* (Voltages Referenced to V_{SS})

Symbol	Parameter	Value	Unit
V _{DD}	DC Supply Voltage	- 0.5 to + 18.0	V
V _{in} , V _{out}	Input or Output Voltage (DC or Transient)	- 0.5 to V _{DD} + 0.5	V
I _{in} , I _{out}	Input or Output Current (DC or Transient), per Pin	± 10	mA
P _D	Power Dissipation, per Package†	500	mW
T _{stg}	Storage Temperature	- 65 to + 150	°C
T _L	Lead Temperature (8–Second Soldering)	260	°C

This device contains protection circuitry to guard against damage due to high static voltages or electric fields. However, precautions must be taken to avoid applications of any voltage higher than maximum rated voltages to this high-impedance circuit. For proper operation, V_{in} and V_{out} should be constrained to the range V_{SS} ≤ (V_{in} or V_{out}) ≤ V_{DD}.

Unused inputs must always be tied to an appropriate logic voltage level (e.g., either V_{SS} or V_{DD}). Unused outputs must be left open.

* Maximum Ratings are those values beyond which damage to the device may occur.

† Temperature Derating:

Plastic "P and D/DW" Packages: - 7.0 mW/°C From 65°C To 125°C

Ceramic "L" Packages - 12 mW/°C From 100°C To 125°C

ELECTRICAL CHARACTERISTICS (Voltages Referenced to V_{SS})

Characteristic	Symbol	V _{DD} Vdc	- 55° C		25° C			125° C		Unit	
			Min	Max	Min	Typ #	Max	Min	Max		
Output Voltage "0" Level V _{in} = V _{DD} or 0	V _{OL}	5.0	—	0.05	—	0	0.05	—	0.05	V	
		10	—	0.05	—	0	0.05	—	0.05		
		15	—	0.05	—	0	0.05	—	0.05		
V _{in} = 0 or V _{DD} "1" Level	V _{OH}	5.0	4.95	—	4.95	5.0	—	4.95	—	V	
		10	9.95	—	9.95	10	—	9.95	—		
		15	14.95	—	14.95	15	—	14.95	—		
Input Voltage "0" Level (V _O = 4.5 or 0.5 V) (V _O = 9.0 or 1.0 V) (V _O = 13.5 or 1.5 V)	V _{IL}	5.0	—	1.5	—	2.25	1.5	—	1.5	V	
		10	—	3.0	—	4.50	3.0	—	3.0		
		15	—	4.0	—	6.75	4.0	—	4.0		
	"1" Level (V _O = 0.5 or 4.5 V) (V _O = 1.0 or 9.0 V) (V _O = 1.5 or 13.5 V)	V _{IH}	5.0	3.5	—	3.5	2.75	—	3.5	—	V
			10	7.0	—	7.0	5.50	—	7.0	—	
			15	11.0	—	11.0	8.25	—	11.0	—	
Input Voltage "0" Level (V _O = 4.5 Vdc) (For Input 11 and Output 10) (V _O = 9.0 Vdc) (V _O = 13.5 Vdc)	V _{IL}	5.0	—	1.0	—	2.25	1.0	—	1.0	Vdc	
		10	—	2.0	—	4.50	2.0	—	2.0		
		15	—	2.5	—	6.75	2.5	—	2.5		
	"1" Level (V _O = 0.5 Vdc) (V _O = 1.0 Vdc) (V _O = 1.5 Vdc)	V _{IH}	5.0	4.0	—	4.0	2.75	—	4.0	—	Vdc
			10	8.0	—	8.0	5.50	—	8.0	—	
			15	12.5	—	12.5	8.25	—	12.5	—	
Output Drive Current (V _{OH} = 2.5 V) (Except Source (V _{OH} = 4.6 V) Pins 9 and 10) (V _{OH} = 9.5 V) (V _{OH} = 13.5 V)	I _{OH}	5.0	- 3.0	—	- 2.4	- 4.2	—	- 1.7	—	mA	
		5.0	- 0.64	—	- 0.51	- 0.88	—	- 0.36	—		
		10	- 1.6	—	- 1.3	- 2.25	—	- 0.9	—		
		15	- 4.2	—	- 3.4	- 8.8	—	- 2.4	—		
	Sink (V _{OL} = 0.4 V) (V _{OL} = 0.5 V) (V _{OL} = 1.5 V)	I _{OL}	5.0	0.64	—	0.51	0.88	—	0.36	—	mA
			10	1.6	—	1.3	2.25	—	0.9	—	
15			4.2	—	3.4	8.8	—	2.4	—		
Input Current	I _{in}	15	—	± 0.1	—	± 0.00001	± 0.1	—	± 1.0	μA	
Input Capacitance (V _{in} = 0)	C _{in}	—	—	—	—	5.0	7.5	—	—	pF	
Quiescent Current (Per Package)	I _{DD}	5.0	—	5.0	—	0.005	5.0	—	150	μA	
		10	—	10	—	0.010	10	—	300		
		15	—	20	—	0.015	20	—	600		
Total Supply Current**† (Dynamic plus Quiescent, Per Package) (C _L = 50 pF on all outputs, all buffers switching)	I _T	5.0 10 15	I _T = (0.25 μA/kHz) f + I _{DD} I _T = (0.54 μA/kHz) f + I _{DD} I _T = (0.85 μA/kHz) f + I _{DD}							μA	

Data labelled "Typ" is not to be used for design purposes but is intended as an indication of the IC's potential performance.

** The formulas given are for the typical characteristics only at 25°C.

SWITCHING CHARACTERISTICS ($C_L = 50 \text{ pF}$, $T_A = 25^\circ\text{C}$)

Characteristic	Symbol	V_{DD} Vdc	Min	Typ #	Max	Unit	
Output Rise Time (Counter Outputs)	t_{TLH}	5.0	—	40	200	ns	
		10	—	25	100		
		15	—	20	80		
Output Fall Time (Counter Outputs)	t_{THL}	5.0	—	50	200	ns	
		10	—	30	100		
		15	—	20	80		
Propagation Delay Time Clock to Q4	t_{PLH}	5.0	—	415	740	ns	
		10	—	175	300		
		15	—	125	200		
	Clock to Q14		5.0	—	1.5	2.7	μs
			10	—	0.7	1.3	
			15	—	0.4	1.0	
Clock Pulse Width	t_{WH}	5.0	100	65	—	ns	
		10	40	30	—		
		15	30	20	—		
Clock Pulse Frequency	f_ϕ	5.0	—	5	3.5	MHz	
		10	—	14	8		
		15	—	17	12		
Clock Rise and Fall Time	t_{TLH} t_{THL}	5.0	No Limit			ns	
		10					
		15					
Reset Pulse Width	t_w	5.0	120	40	—	ns	
		10	60	15	—		
		15	40	10	—		
Propagation Delay Time Reset to On	t_{PHL}	5.0	—	170	350	ns	
		10	—	80	160		
		15	—	60	100		

#Data labelled "Typ" is not to be used for design purposes but is intended as an indication of the IC's potential performance.

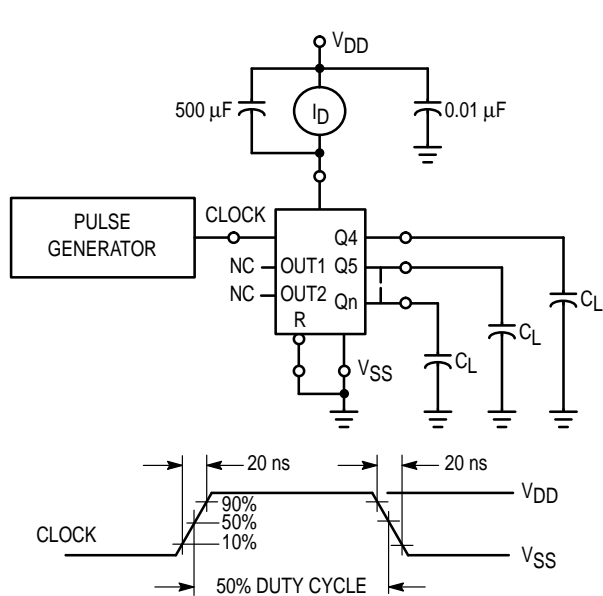


Figure 1. Power Dissipation Test Circuit and Waveform

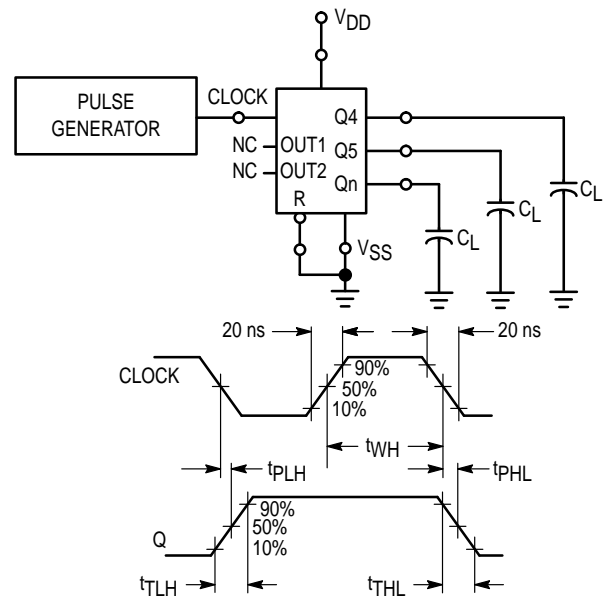
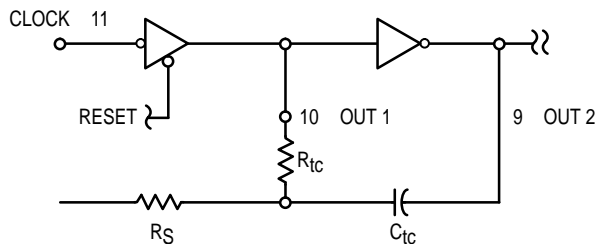


Figure 2. Switching Time Test Circuit and Waveforms



$$f \approx \frac{1}{2.3R_{Tc}C_{Tc}}$$

if $1 \text{ kHz} \leq f \leq 100 \text{ kHz}$
 and $2R_{Tc} < R_S < 10R_{Tc}$
 (f in Hz, R in ohms, C in farads)

The formula may vary for other frequencies. Recommended maximum value for the resistors in $1 \text{ M}\Omega$.

Figure 3. Oscillator Circuit Using RC Configuration

TYPICAL RC OSCILLATOR CHARACTERISTICS

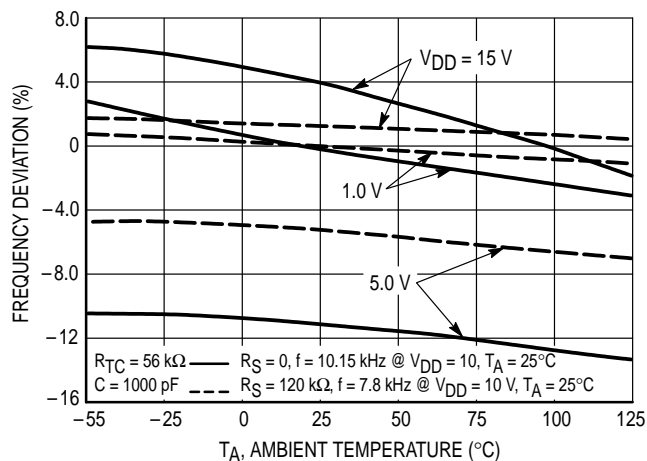


Figure 4. RC Oscillator Stability

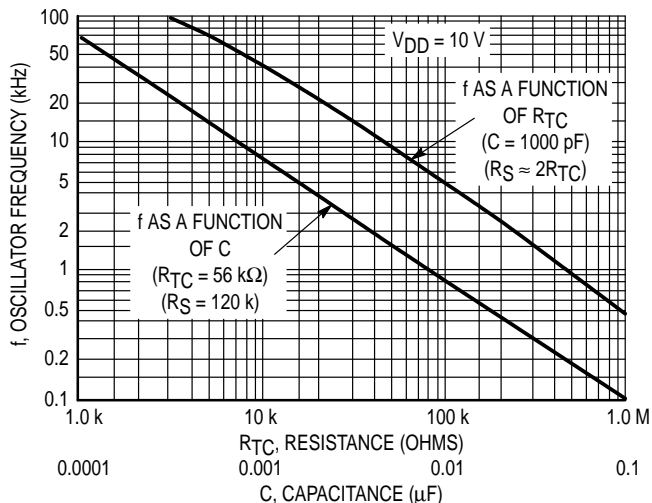


Figure 5. RC Oscillator Frequency as a Function of R_{Tc} and C

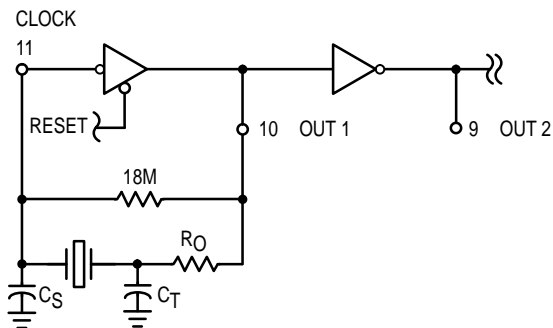


Figure 6. Typical Crystal Oscillator Circuit

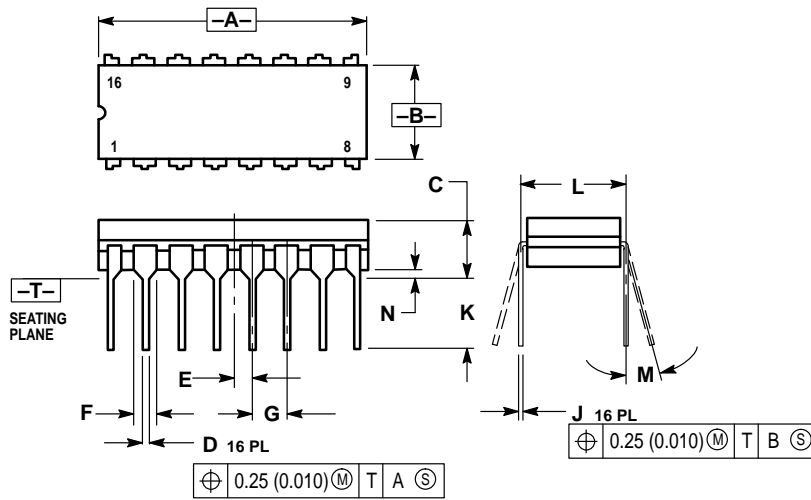
Characteristic	500 kHz Circuit	32 kHz Circuit	Unit
Crystal Characteristics			
Resonant Frequency	500	32	kHz
Equivalent Resistance, R_S	1.0	6.2	kΩ
External Resistor/Capacitor Values			
R_O	47	750	kΩ
C_T	82	82	pF
C_S	20	20	pF
Frequency Stability			
Frequency Changes as a Function of V_{DD} ($T_A = 25^\circ\text{C}$)			
V_{DD} Change from 5.0 V to 10V	+ 6.0	+ 2.0	ppm
V_{DD} Change from 10 V to 15 V	+ 2.0	+ 2.0	ppm
Frequency Change as a Function of Temperature ($V_{DD} = 10 \text{ V}$)			
T_A Change from -55°C to $+25^\circ\text{C}$ Complete Oscillator*	+ 100	+ 120	ppm
T_A Change from $+25^\circ\text{C}$ to $+125^\circ\text{C}$ Complete Oscillator*	- 160	- 560	ppm

* Complete oscillator includes crystal, capacitors, and resistors.

Figure 7. Typical Data for Crystal Oscillator Circuit

OUTLINE DIMENSIONS

L SUFFIX CERAMIC DIP PACKAGE CASE 620-10 ISSUE V

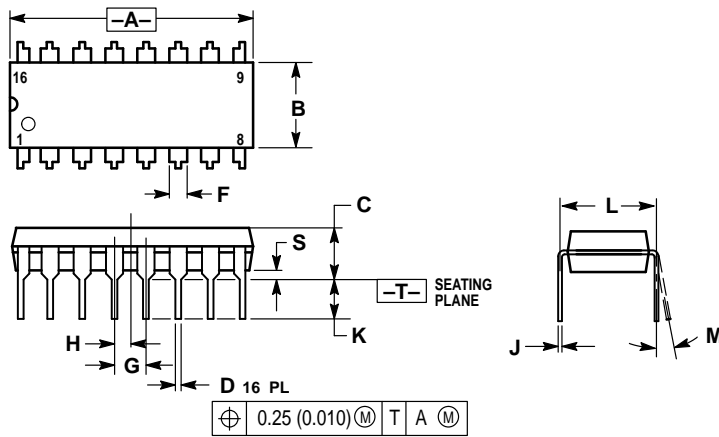


NOTES:

1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
2. CONTROLLING DIMENSION: INCH.
3. DIMENSION L TO CENTER OF LEAD WHEN FORMED PARALLEL.
4. DIMENSION F MAY NARROW TO 0.76 (0.030) WHERE THE LEAD ENTERS THE CERAMIC BODY.

DIM	INCHES		MILLIMETERS	
	MIN	MAX	MIN	MAX
A	0.750	0.785	19.05	19.93
B	0.240	0.295	6.10	7.49
C	—	0.200	—	5.08
D	0.015	0.020	0.39	0.50
E	0.050 BSC		1.27 BSC	
F	0.055	0.065	1.40	1.65
G	0.100 BSC		2.54 BSC	
H	0.008	0.015	0.21	0.38
K	0.125	0.170	3.18	4.31
L	0.300 BSC		7.62 BSC	
M	0°	15°	0°	15°
N	0.020	0.040	0.51	1.01

P SUFFIX PLASTIC DIP PACKAGE CASE 648-08 ISSUE R



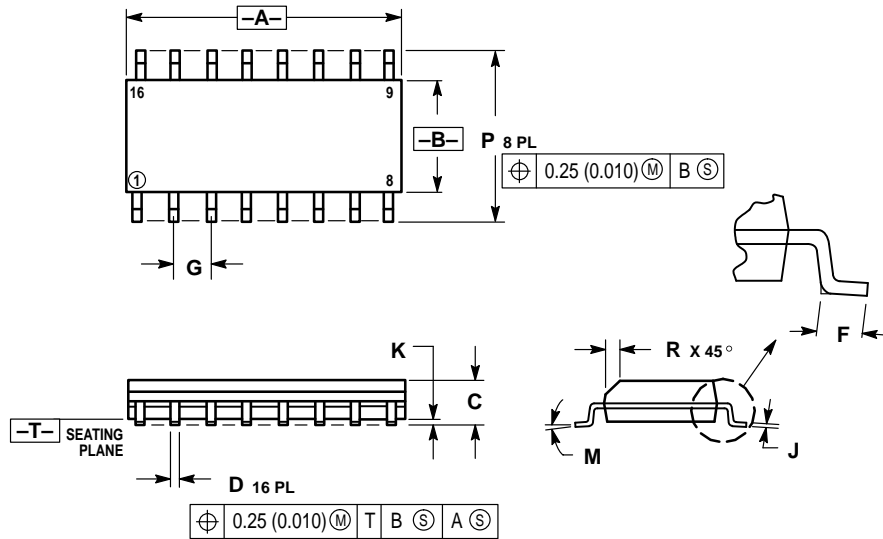
NOTES:

1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
2. CONTROLLING DIMENSION: INCH.
3. DIMENSION L TO CENTER OF LEADS WHEN FORMED PARALLEL.
4. DIMENSION B DOES NOT INCLUDE MOLD FLASH.
5. ROUNDED CORNERS OPTIONAL.

DIM	INCHES		MILLIMETERS	
	MIN	MAX	MIN	MAX
A	0.740	0.770	18.80	19.55
B	0.250	0.270	6.35	6.85
C	0.145	0.175	3.69	4.44
D	0.015	0.021	0.39	0.53
F	0.040	0.70	1.02	1.77
G	0.100 BSC		2.54 BSC	
H	0.050 BSC		1.27 BSC	
J	0.008	0.015	0.21	0.38
K	0.110	0.130	2.80	3.30
L	0.295	0.305	7.50	7.74
M	0°	10°	0°	10°
S	0.020	0.040	0.51	1.01

OUTLINE DIMENSIONS

D SUFFIX PLASTIC SOIC PACKAGE CASE 751B-05 ISSUE J



NOTES:

1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
2. CONTROLLING DIMENSION: MILLIMETER.
3. DIMENSIONS A AND B DO NOT INCLUDE MOLD PROTRUSION.
4. MAXIMUM MOLD PROTRUSION 0.15 (0.006) PER SIDE.
5. DIMENSION D DOES NOT INCLUDE DAMBAR PROTRUSION. ALLOWABLE DAMBAR PROTRUSION SHALL BE 0.127 (0.005) TOTAL IN EXCESS OF THE D DIMENSION AT MAXIMUM MATERIAL CONDITION.

DIM	MILLIMETERS		INCHES	
	MIN	MAX	MIN	MAX
A	9.80	10.00	0.386	0.393
B	3.80	4.00	0.150	0.157
C	1.35	1.75	0.054	0.068
D	0.35	0.49	0.014	0.019
F	0.40	1.25	0.016	0.049
G	1.27 BSC		0.050 BSC	
J	0.19	0.25	0.008	0.009
K	0.10	0.25	0.004	0.009
M	0°	7°	0°	7°
P	5.80	6.20	0.229	0.244
R	0.25	0.50	0.010	0.019

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MC14060B/D

