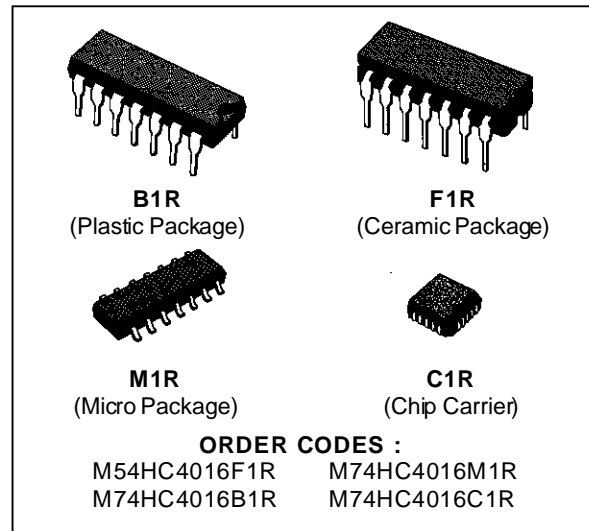


QUAD BILATERAL SWITCH

- HIGH SPEED
 $t_{PD} = 9 \text{ ns (TYP.) AT } V_{CC} = 5 \text{ V}$
- LOW POWER DISSIPATION
 $I_{CC} = 1 \mu\text{A (MAX.) AT } T_A = 25 \text{ }^\circ\text{C}$
- HIGH NOISE IMMUNITY
 $V_{NIH} = V_{NIL} = 28 \% V_{CC} \text{ (MIN.)}$
- LOW "ON" RESISTANCE
 $R_{ON} = 60 \Omega \text{ (TYP.) AT } V_{CC} = 9 \text{ V, } I_{I/O} = 100 \mu\text{A}$
- SINE WAVE DISTORSION
 $0.042 \% \text{ (TYP.) AT } V_{CC} = 9 \text{ V}_{PP}, f = 1\text{KHz}$
- WIDE OPERATING VOLTAGE RANGE
 $V_{CC} \text{ (OPR)} = 2 \text{ V TO } 12 \text{ V}$
- PIN AND FUNCTION COMPATIBLE WITH 4016B

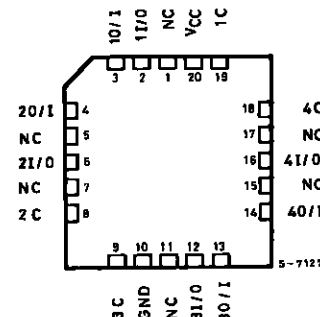
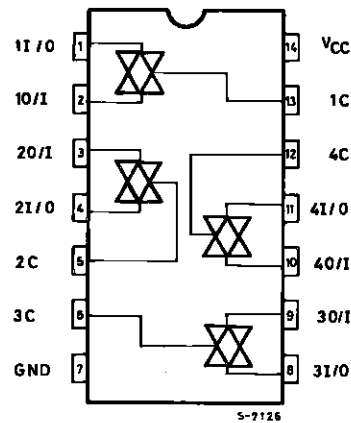


DESCRIPTION

The M54/74HC4016 is a high speed CMOS QUAD BILATERAL SWITCH fabricated in silicon gate C²MOS technology. It has high speed performance combined with true CMOS low power consumption.

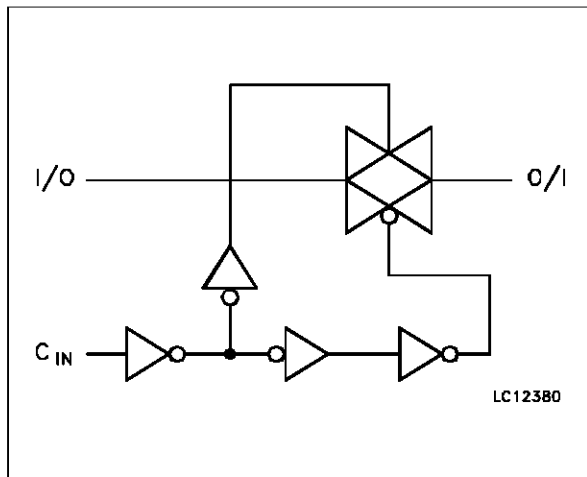
The C input is provided to control the switch ; the switch is ON when the C input is held high and off when C is held low.

PIN CONNECTIONS (top view)

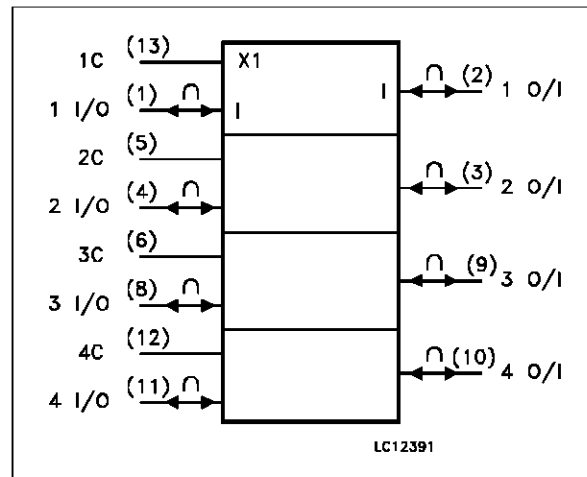


NC =
No Internal
Connection

LOGIC DIAGRAM



IEC LOGIC SYMBOL



PIN DESCRIPTION

PIN No	SYMBOL	NAME AND FUNCTION
1, 4, 8, 11	1 to 4 I/O	Independent Inputs/Outputs
2, 3, 9, 10	1 to 4 O/I	Independent Outputs/Inputs
13, 5, 6, 12	1C to 4C	Enable Inputs (Active HIGH)
7	GND	Ground (0V)
14	V _{CC}	Positive Supply Voltage

TRUTH TABLE

CONTROL	SWITCH FUNCTION
H	ON
L	OFF

ABSOLUTE MAXIMUM RATING

Symbol	Parameter	Value	Unit
V _{CC}	Supply Voltage	-0.5 to +13	V
V _{IN}	DC Input Voltage	-0.5 to V _{CC} + 0.5	V
V _{I/O}	DC Input/Output Voltage	-0.5 to V _{CC} + 0.5	V
I _{OK}	Control Input DC Diode Current	± 20	mA
I _{I/OK}	I/O DC Diode Current	± 20	mA
I _O	DC Output Source Sink Current Per Output Pin	± 25	mA
I _{CC} or I _{GND}	DC V _{CC} or Ground Current	± 50	mA
P _D	Power Dissipation	500 (*)	mW
T _{stg}	Storage Temperature	-65 to +150	°C
T _L	Lead Temperature (10 sec)	300	°C

Absolute Maximum Ratings are those values beyond which damage to the device may occur. Functional operation under these condition is not implied.

(*) 500 mW: ≡ 65 °C derate to 300 mW by 10mW/°C: 65 °C to 85 °C

RECOMMENDED OPERATING CONDITIONS

Symbol	Parameter	Value	Unit	
V _{CC}	Supply Voltage	2 to 12	V	
V _I	Input Voltage (Control)	0 to V _{CC}	V	
V _{I/O}	Input/Output Voltage	0 to V _{CC}	V	
T _{op}	Operating Temperature: M54HC Series M74HC Series	-55 to +125 -40 to +85	°C °C	
t _r , t _f	Input Rise and Fall Time	V _{CC} = 2 V	0 to 1000	ns
		V _{CC} = 4.5 V	0 to 500	
		V _{CC} = 6 V	0 to 400	
		V _{CC} = 10 V	0 to 250	

DC SPECIFICATIONS

Symbol	Parameter	Test Conditions		Value						Unit		
		V _{CC} (V)		T _A = 25 °C 54HC and 74HC			-40 to 85 °C 74HC		-55 to 125 °C 54HC			
				Min.	Typ.	Max.	Min.	Max.	Min.		Max.	
V _{IHC}	High Level Control Input Voltage	2.0		1.5			1.5		1.5		V	
		4.5		3.15			3.15		3.15			
		9.0		6.3			6.3		6.3			
		12.0		8.4			8.4		8.4			
V _{ILC}	Low Level Control Input Voltage	2.0				0.5		0.5		0.5	V	
		4.5				1.35		1.35		1.35		
		9.0				2.5		2.5		2.5		
		12.0				3.6		3.6		3.6		
R _{ON}	ON Resistance	4.5	V _{IN} = V _{IHC} V _{I/O} = V _{CC} to GND I _{I/O} = 100 μA		160	320		400		450	Ω	
		9.0		85	170		213		260			
		12.0		60	120		150		180			
			4.5	V _{IN} = V _{IHC} V _{I/O} = V _{CC} or GND I _{I/O} = 100 μA		80	160		200		250	
			9.0		60	120		150		200		
			12.0		50	100		125		150		
ΔR _{ON}	Difference of ON Resistance Between Switches	4.5	V _{IN} = V _{IHC} V _{I/O} = V _{CC} or GND I _{I/O} ≤ 100 μA		16						Ω	
		9.0		9								
		12.0		6								
I _{OFF}	Input/Output Leakage Current (SWITCH OFF)	12.0	V _{OS} = V _{CC} or GND V _{IS} = V _{CC} or GND V _{IN} = V _{ILC}			±0.1		±1		±2	μA	
I _{Iz}	Switch Input Leakage Current (SWITCH ON, OUTPUT OPEN)	12.0	V _{OS} = V _{CC} or GND V _{IN} = V _{IHC}			±0.1		±1		±2	μA	
I _{IN}	Control Input Current	6.0	V _{IN} = V _{CC} or GND			±0.1		±1		±1	μA	
I _{CC}	Quiescent Supply Current	6.0	V _{IN} = V _{CC} or GND			1		10		20	μA	
		9.0				4		40		80		
		12.0				8		80		160		

M54/M74HC4016

AC ELECTRICAL CHARACTERISTICS ($C_L = 50$ pF, Input $t_r = t_f = 6$ ns)

Symbol	Parameter	Test Conditions		Value						Unit	
		V_{CC} (V)		$T_A = 25$ °C 54HC and 74HC			-40 to 85 °C 74HC		-55 to 125 °C 54HC		
				Min.	Typ.	Max.	Min.	Max.	Min.		Max.
$\phi_{I/O}$	Phase Difference Between Input and Output	2.0			20	50		65		75	ns
		4.5			5	10		13		15	
		9.0			4	8		10		12	
		12.0			3	7		9		11	
t_{PZL} t_{PZH}	Output Enable Time	2.0	$R_L = 1K\Omega$		40	100		125		150	ns
		4.5			10	20		25		30	
		9.0			8	15		20		24	
		12.0			7	14		18		21	
t_{PLZ} t_{PHZ}	Output Disable Time	2.0	$R_L = 1K\Omega$		60	150		190		225	ns
		4.5			15	30		38		45	
		9.0			10	26		33		36	
		12.0			8	24		30		32	
C_{IN}	Input Capacitance				5	10		10		10	pF
$C_{I/O}$	Switch Terminal Capacitance	9.0			5						pF
C_{IOS}	Feed Through Capacitance	9.0			1						pF
$C_{PD} (*)$	Power Dissipation Capacitance	5.0			15						pF

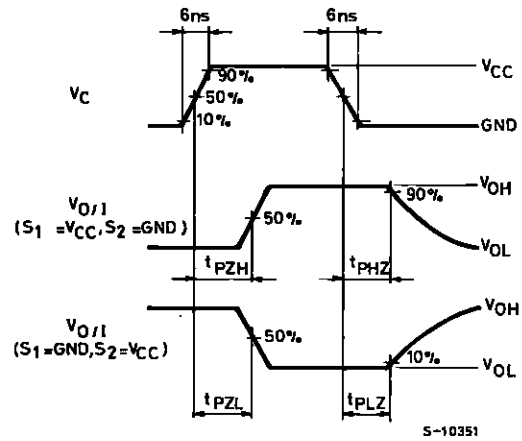
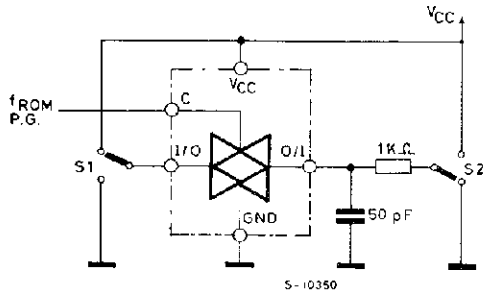
(*) C_{PD} is defined as the value of the IC's internal equivalent capacitance which is calculated from the operating current consumption without load. (Refer to Test Circuit). Average operating current can be obtained by the following equation. $I_{CC(opr)} = C_{PD} \cdot V_{CC} \cdot f_{IN} + I_{CC}$

ANALOG SWITCH CHARACTERISTICS ($GND = 0$ V $T_A = 25$ °C)

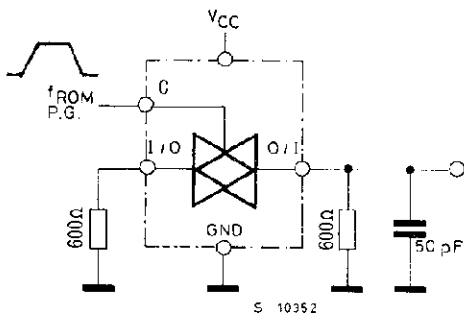
Symbol	Parameter	Test Conditions			Value	Unit
		V_{CC} (V)	V_{IN} (Vp-p)		Typ.	
	Sine Wave Distortion (THD)	4.5	4.5	$f_{IN} = 1$ KHz $R_L = 10$ K Ω $C_L = 50$ pF	0.118	%
		9.0	9.0		0.042	
		12.0	12.0		0.032	
f_{MAX}	Frequency Response (Switch ON)	4.5	Adjust f_{IN} voltage to Obtain 0 dBm at V_{OS} .		23	MHz
		9.0	Increase f_{IN} Frequency until dB Meter reads -3dB		38	
		12.0	$R_L = 50$ Ω $C_L = 50$ pF		42	
	Feedthrough Attenuation (Switch OFF)	4.5	V_{IN} is centered at $V_{CC}/2$. Adjust input for 0 dBm		-50	dB
		9.0	$R_L = 600$ Ω $C_L = 50$ pF $f_{IN} = 1$ MHz sine wave		-50	
		12.0			-50	
	Crosstalk (Control Input to Signal Output)	4.5	$R_L = 600$ Ω $C_L = 50$ pF		8	mV
		9.0	$f_{IN} = 1$ MHz square wave ($t_r = t_f = 6$ ns)		23	
		12.0			40	
	Crosstalk (Between Any Switches)	4.5	Adjust V_{IN} to Obtain 0 dBm at input		-50	dB
		9.0	$R_L = 600$ Ω $C_L = 50$ pF $f_{IN} = 1$ MHz sine wave		-50	
		12.0			-50	

SWITCHING CHARACTERISTICS TEST CIRCUIT

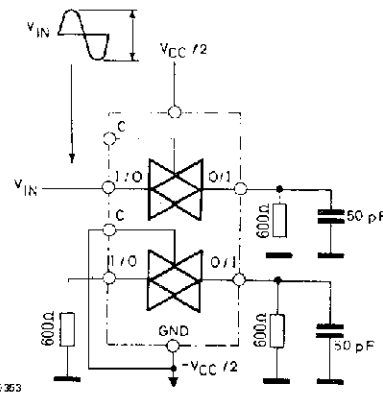
t_{PLZ} , t_{PHZ} , t_{PZL} , t_{PZH} .



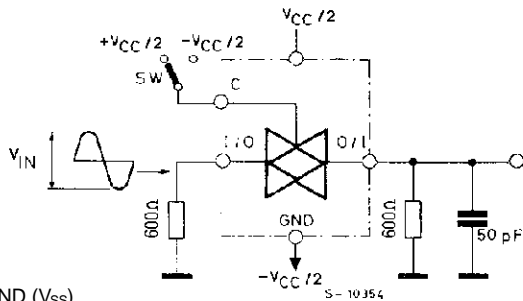
CROSSTALK (control to output)



CROSSTALK BETWEEN ANY TWO SWITCHES

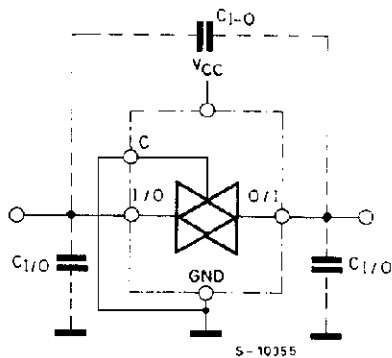


BANDWIDTH AND FEEDTHROUGH ATTENUATION



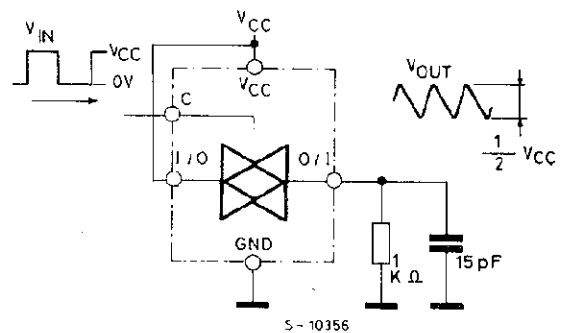
GND (Vss)

C_{I-O} C_{I/O}

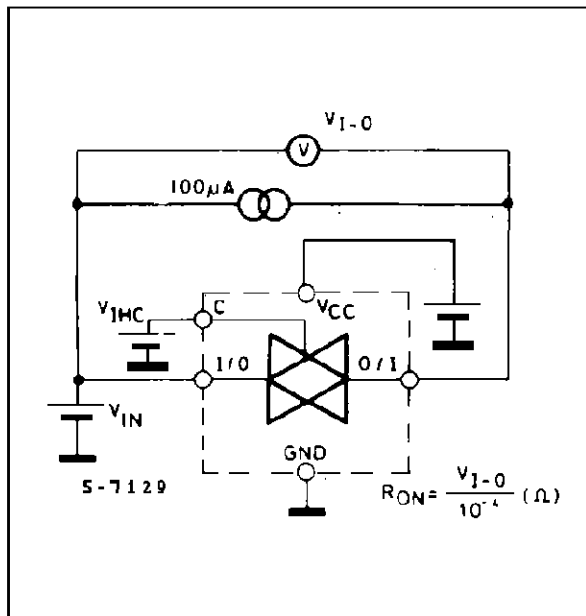


GND (Vss)

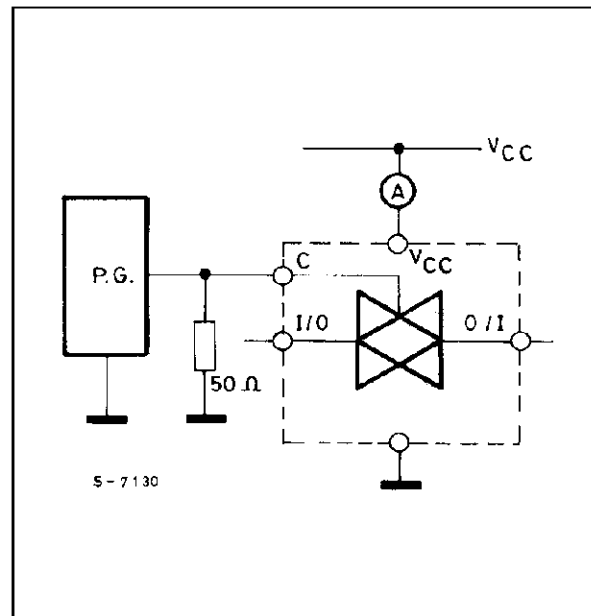
MAXIMUM CONTROL FREQUENCY



CHANNEL RESISTANCE (R_{ON})

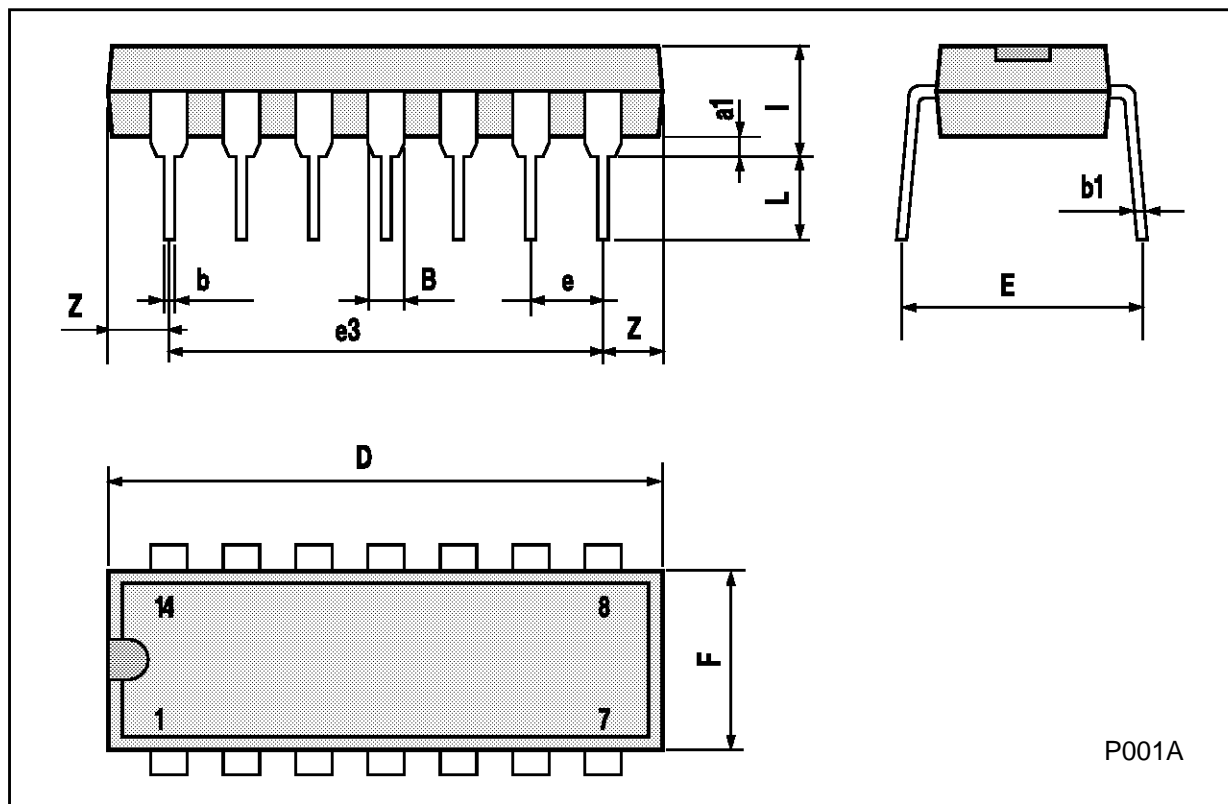


I_{CC} (Opr.)



Plastic DIP14 MECHANICAL DATA

DIM.	mm			inch		
	MIN.	TYP.	MAX.	MIN.	TYP.	MAX.
a1	0.51			0.020		
B	1.39		1.65	0.055		0.065
b		0.5			0.020	
b1		0.25			0.010	
D			20			0.787
E		8.5			0.335	
e		2.54			0.100	
e3		15.24			0.600	
F			7.1			0.280
I			5.1			0.201
L		3.3			0.130	
Z	1.27		2.54	0.050		0.100



Ceramic DIP14/1 MECHANICAL DATA

DIM.	mm			inch		
	MIN.	TYP.	MAX.	MIN.	TYP.	MAX.
A			20			0.787
B			7.0			0.276
D		3.3			0.130	
E	0.38			0.015		
e3		15.24			0.600	
F	2.29		2.79	0.090		0.110
G	0.4		0.55	0.016		0.022
H	1.17		1.52	0.046		0.060
L	0.22		0.31	0.009		0.012
M	1.52		2.54	0.060		0.100
N			10.3			0.406
P	7.8		8.05	0.307		0.317
Q			5.08			0.200



P053C

SO14 MECHANICAL DATA

DIM.	mm			inch		
	MIN.	TYP.	MAX.	MIN.	TYP.	MAX.
A			1.75			0.068
a1	0.1		0.2	0.003		0.007
a2			1.65			0.064
b	0.35		0.46	0.013		0.018
b1	0.19		0.25	0.007		0.010
C		0.5			0.019	
c1	45° (typ.)					
D	8.55		8.75	0.336		0.344
E	5.8		6.2	0.228		0.244
e		1.27			0.050	
e3		7.62			0.300	
F	3.8		4.0	0.149		0.157
G	4.6		5.3	0.181		0.208
L	0.5		1.27	0.019		0.050
M			0.68			0.026
S	8° (max.)					



PLCC20 MECHANICAL DATA

DIM.	mm			inch		
	MIN.	TYP.	MAX.	MIN.	TYP.	MAX.
A	9.78		10.03	0.385		0.395
B	8.89		9.04	0.350		0.356
D	4.2		4.57	0.165		0.180
d1		2.54			0.100	
d2		0.56			0.022	
E	7.37		8.38	0.290		0.330
e		1.27			0.050	
e3		5.08			0.200	
F		0.38			0.015	
G			0.101			0.004
M		1.27			0.050	
M1		1.14			0.045	



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