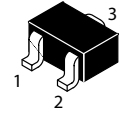
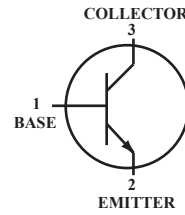


General Purpose Transistor NPN Silicon



SOT-323(SC-70)

Maximum Ratings

Rating	Symbol	Value	Unit
Collector-Emitter Voltage	V _{CEO}	40	V _{dc}
Collector-Base Voltage	V _{CBO}	60	V _{dc}
Emitter-Base Voltage	V _{EBO}	6.0	V _{dc}
Collector Current-Continuous	I _C	200	mA _{dc}

Thermal Characteristics

Characteristics	Symbol	Max	Unit
Total Device Dissipation TA=25°C	P _D	150	mW
Thermal Resistance, Junction to Ambient	R _{θJA}	833	°C/W
Junction and Storage, Temperature	T _J , T _{stg}	-55 to +150	°C

Device Marking

MMBT3904W=AM

Electrical Characteristics (TA=25°C Unless Otherwise noted)

Characteristics	Symbol	Min	Max	Unit
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Off Characteristics

Collector-Emitter Breakdown Voltage ⁽²⁾ (I _C =1.0mA _{dc} , I _B =0)	V _{(BR)CEO}	40	-	V _{dc}
Collector-Base Breakdown Voltage (I _C =10 μA _{dc} , I _E =0)	V _{(BR)CBO}	60	-	V _{dc}
Emitter-Base Breakdown Voltage (I _E =10 μA _{dc} , I _C =0)	V _{(BR)EBO}	6.0	-	V _{dc}
Base Cutoff Current (V _{CE} =30 V _{dc} , V _{EB} =3.0 V _{dc})	I _{BL}	-	50	nA _{dc}
Collector Cutoff Current (V _{CE} =30V _{dc} , V _{EB} =3.0V _{dc})	I _{CEX}	-	50	nA _{dc}

1. Device Mounted FR4 glass epoxy printed circuit board using the minimum recommended footprint.

2. Pulse Test: Pulse Width ≤300μs, Duty Cycle ≤2.0%

Electrical Characteristics ($T_A=25^\circ\text{C}$ unless otherwise noted) (Continued)

Characteristics	Symbol	Min	Max	Unit
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On Characteristics (2)

DC Current Gain ($I_C=0.1\text{ mA}$, $V_{CE}=1.0\text{ Vdc}$) ($I_C=1.0\text{ mA}$, $V_{CE}=1.0\text{ Vdc}$) ($I_C=10\text{ mA}$, $V_{CE}=1.0\text{ Vdc}$) ($I_C=50\text{ mA}$, $V_{CE}=1.0\text{ Vdc}$) ($I_C=100\text{ mA}$, $V_{CE}=1.0\text{ Vdc}$)	H_{FE}	40 70 100 60 30	. . 300 . .	-
Collector-Emitter Saturation Voltage (2) ($I_C=10\text{ mA}$, $I_B=1.0\text{ mA}$) ($I_C=50\text{ mA}$, $I_B=5.0\text{ mA}$)	$V_{CE(sat)}$. .	0.2 0.3	Vdc
Base-Emitter Saturation Voltage (2) ($I_C=10\text{ mA}$, $I_B=1.0\text{ mA}$) ($I_C=50\text{ mA}$, $I_B=5.0\text{ mA}$)	$V_{BE(sat)}$	0.65 .	0.85 0.95	Vdc

Small-signal Characteristics

Current-Gain-Bandwidth Product ($I_C=10\text{ mA}$, $V_{CE}=20\text{ Vdc}$, $f=100\text{ MHz}$)	f_T	300	-	MHz
Output Capacitance ($V_{CB}=5.0\text{ Vdc}$, $I_E=0$, $f=1.0\text{ MHz}$)	C_{obo}	-	4.0	pF
Input Capacitance ($V_{EB}=0.5\text{ Vdc}$, $I_C=0$, $f=1.0\text{ MHz}$)	C_{ibo}	-	8.0	pF
Input Impedance ($V_{CE}=10\text{ Vdc}$, $I_C=1.0\text{ mA}$, $f=1.0\text{ kHz}$)	h_{ie}	1.0	10	k ohms
Voltage Feedback Ratio ($V_{CE}=10\text{ Vdc}$, $I_C=1.0\text{ mA}$, $f=1.0\text{ kHz}$)	h_{re}	0.5	8.0	$\times 10^{-4}$
Small-Signal Current Gain ($V_{CE}=10\text{ Vdc}$, $I_C=1.0\text{ mA}$, $f=1.0\text{ kHz}$)	h_{fe}	100	400	.
Output Admittance ($V_{CE}=10\text{ Vdc}$, $I_C=1.0\text{ mA}$, $f=1.0\text{ kHz}$)	h_{oe}	1.0	40	μhos
Noise Figure ($V_{CE}=5.0\text{ Vdc}$, $I_C=100\text{ }\mu\text{A}$, $R_S=1.0\text{ k ohms}$, $f=1.0\text{ kHz}$)	NF	-	5.0	dB

Switching Characteristics

Delay Time	(Vcc= 3.0 Vdc, VBE= -0.5 Vdc Ic= 10 mA, IB1= 1.0 mA)	t_d	-	35	ns
Rise Time		t_r	-	35	
Storage Time	(Vcc= 3.0 Vdc, Ic= 10 mA, IB1=IB2= 1.0 mA)	t_s	-	200	ns
Fall Time		t_f	-	50	

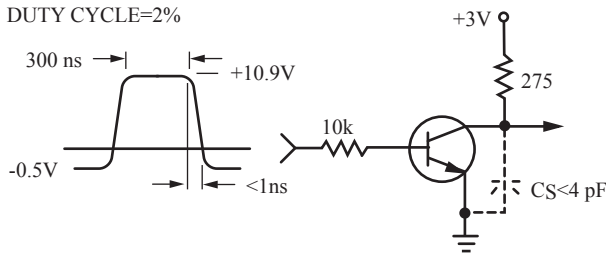


Figure 1. Delay and Rise Time Equivalent Test Circuit

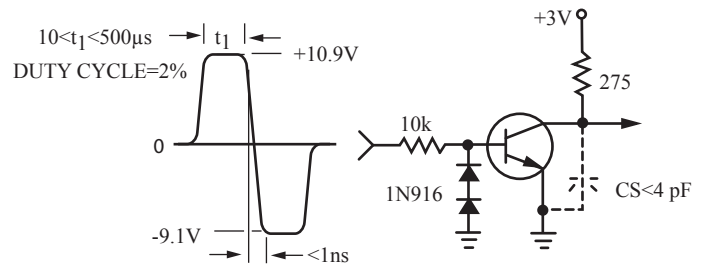


Figure 2. Storage and Fall Time Equivalent Test Circuit

*Total shunt capacitance of test jig and connectors

TYPICAL TRANSIENT CHARACTERISTICS

— $T_J=25^\circ\text{C}$ - - - $T_J=125^\circ\text{C}$

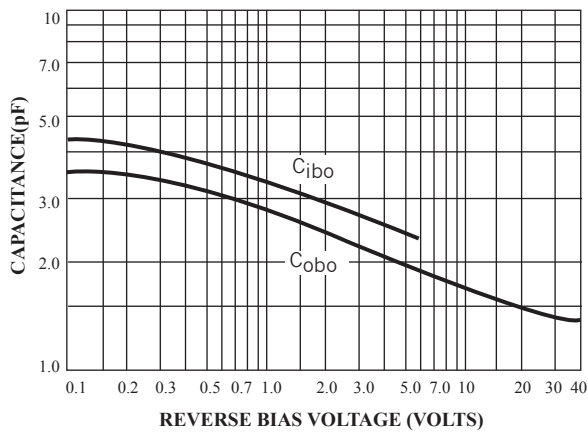


Figure 3. Capacitance

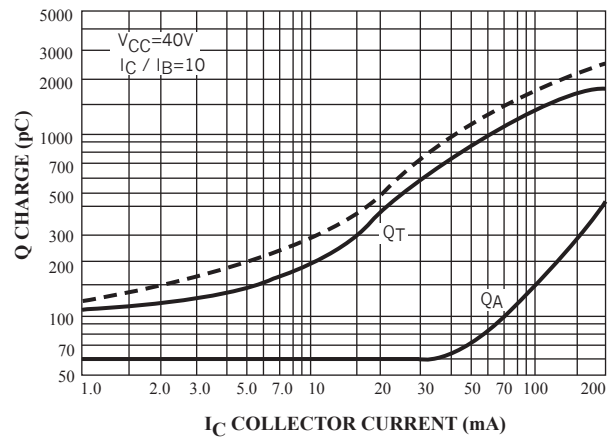


Figure 4. Charge Data

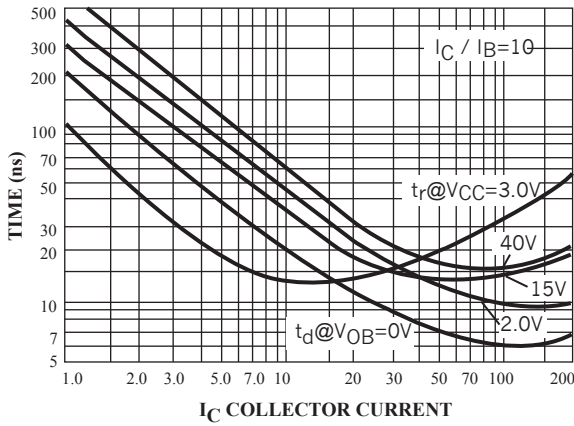


Figure 5. Turn-On Time

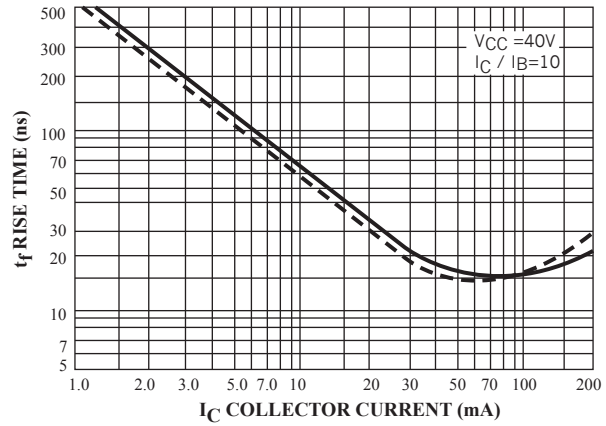


Figure 6. Rise Time

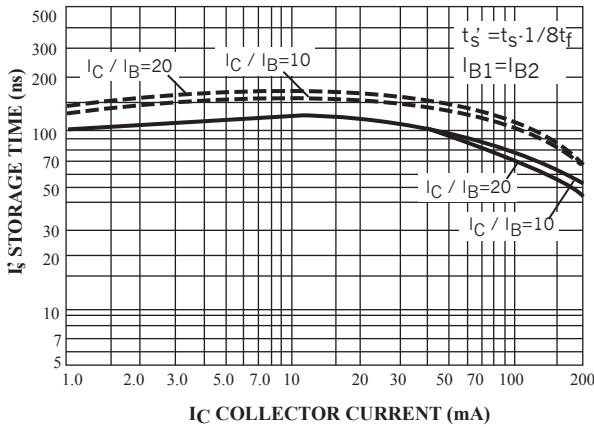


Figure 7. Storage Time

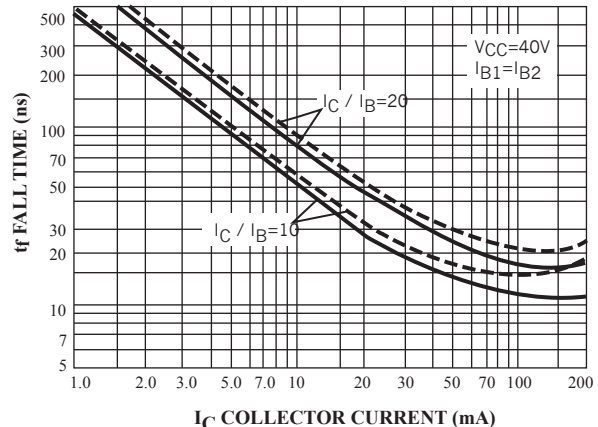


Figure 8. Fall Time

TYPICAL AUDIO SMALL-SIGNAL CHARACTERISTICS NOISE FIGURE VARIATIONS (VCE=5.0 Vdc, TA=25 °C, Bandwidth=1.0Hz)

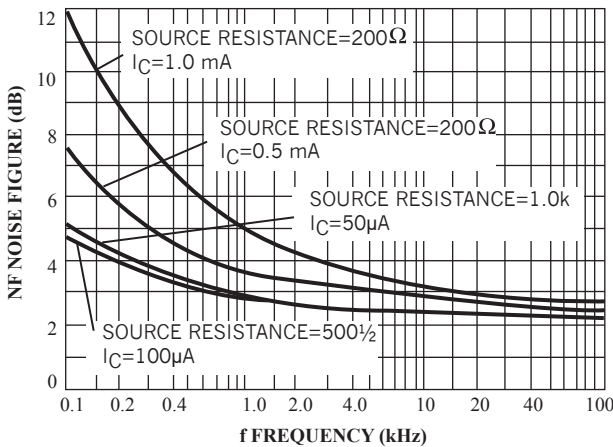


Figure 9.

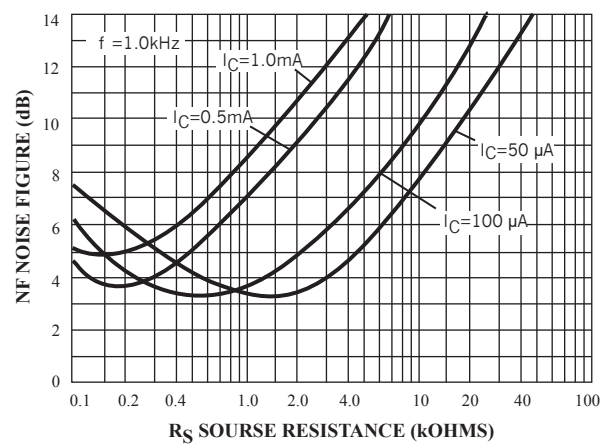


Figure 10.

h PARAMETERS ($V_{CE}=10\text{ Vdc}$, $m\ f=1.0\text{ kHz}$, $T_A=25^\circ\text{C}$)

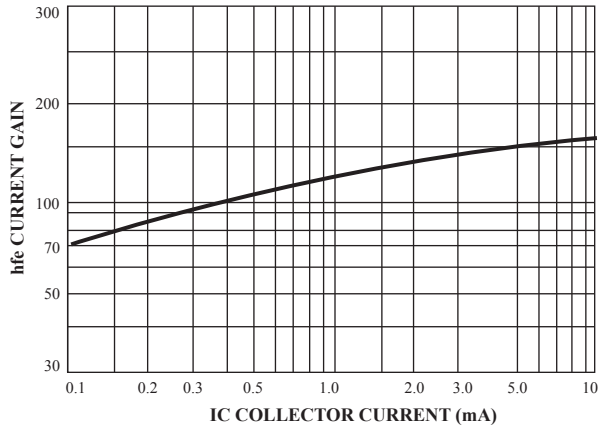


Figure 11. Current Gain

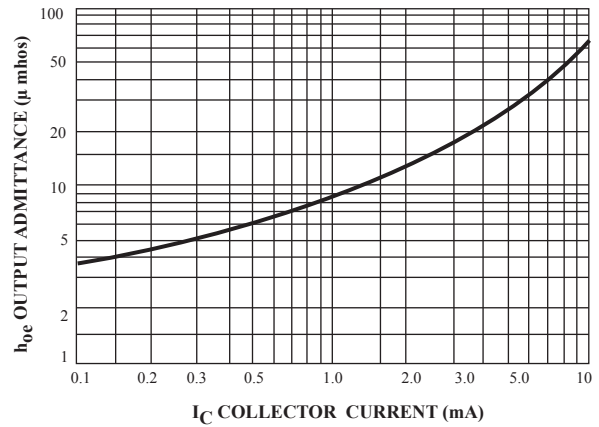


Figure 12. Output Admittance

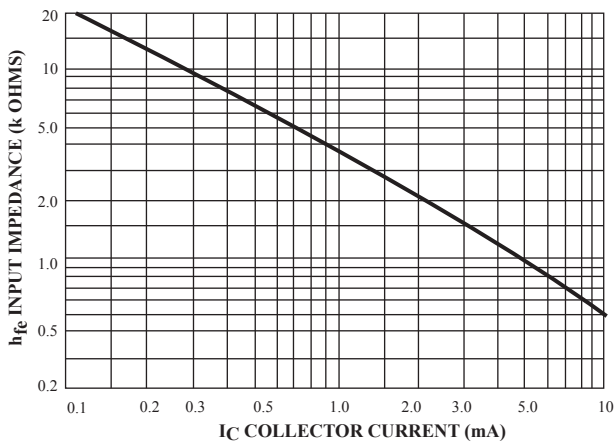


Figure 13. Input Impedance

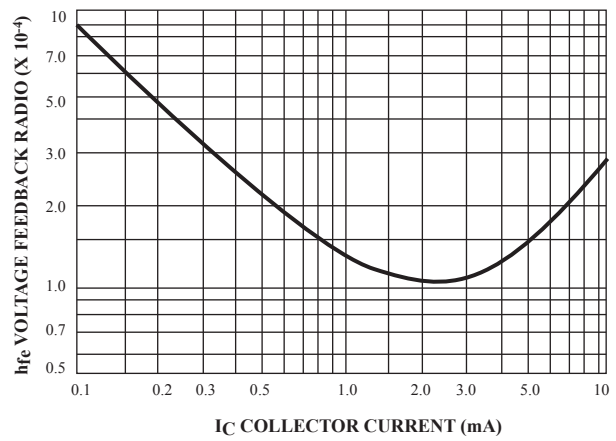


Figure 14. Voltage Feedback Ratio

TYPICAL STATIC CHARACTERISTICS

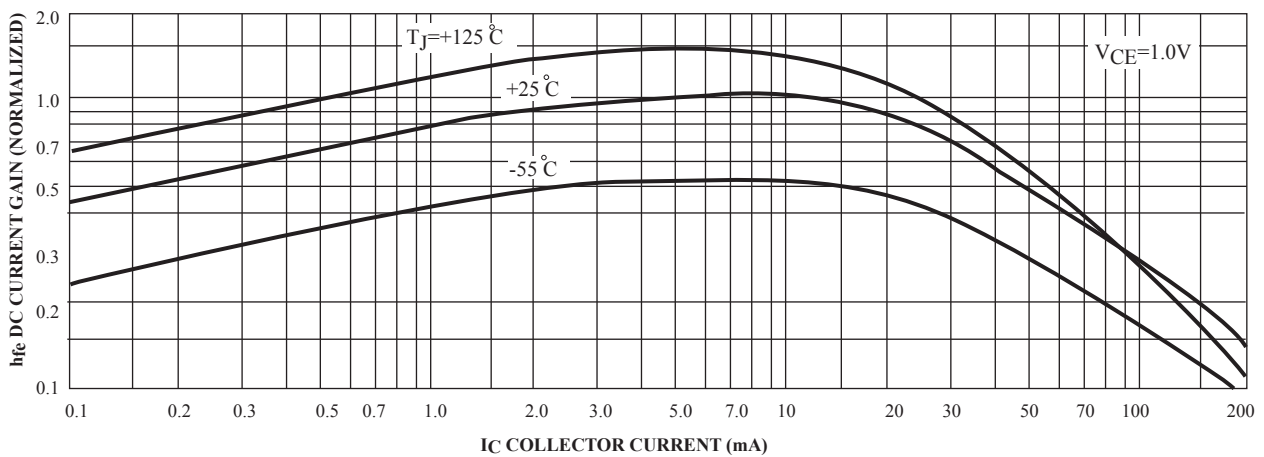


Figure 15. DC Current Gain

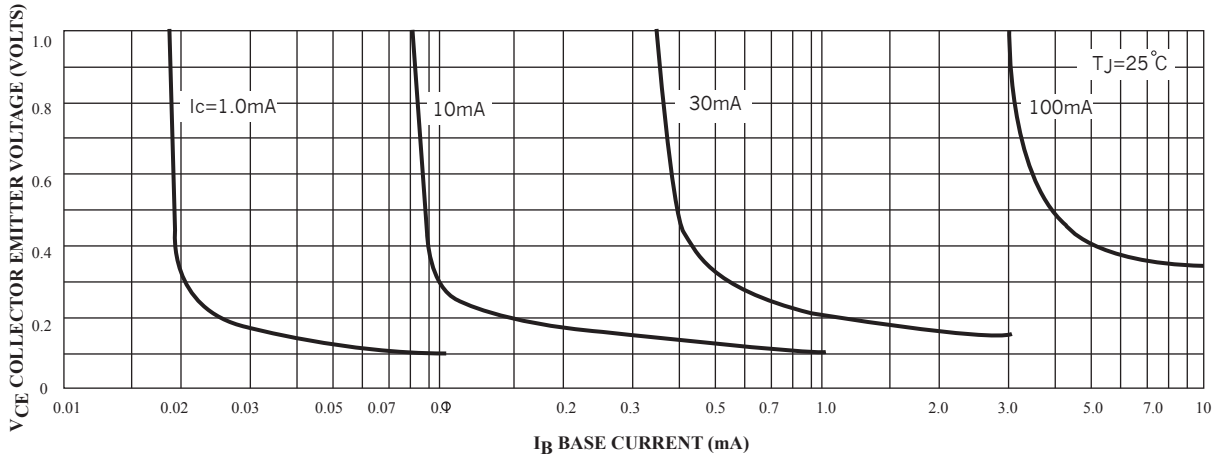


Figure 16. Collector Saturation Region

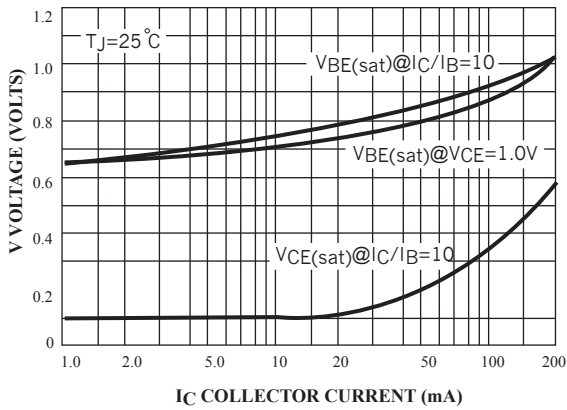


Figure 17. "ON" Voltage

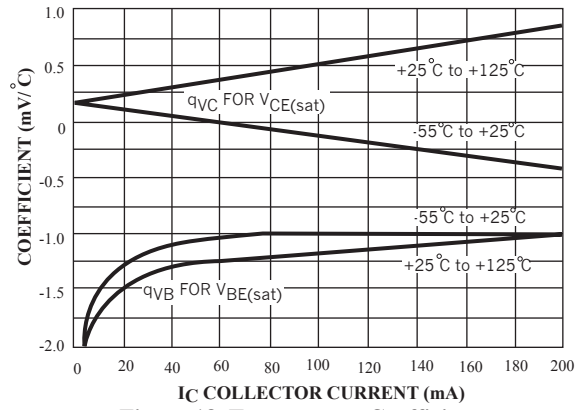
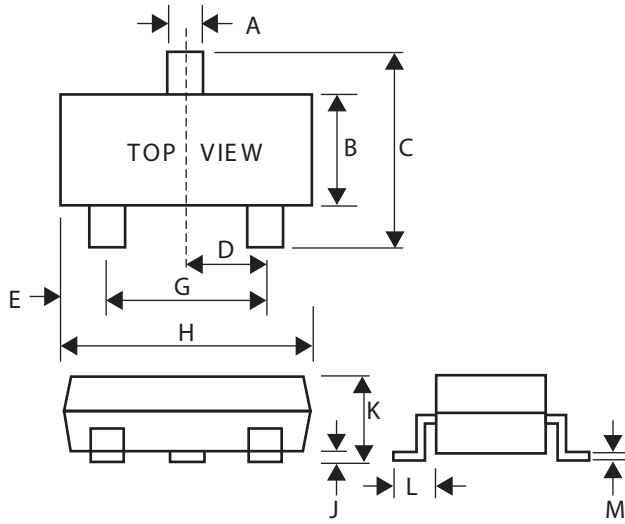


Figure 18. Temperature Coefficients

SOT-323 Outline Demensions

Unit:mm



SOT-323		
Dim	Min	Max
A	0.30	0.40
B	1.15	1.35
C	2.00	2.40
D	-	0.65
E	0.30	0.40
G	1.20	1.40
H	1.80	2.20
J	0.00	0.10
K	0.80	1.00
L	0.42	0.53
M	0.10	0.25