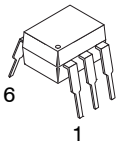
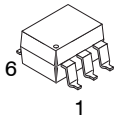
6-Pin DIP Low Input Current Phototransistor Optocouplers

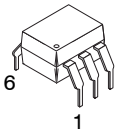
MCT5210M, MCT5211M



PDIP6 8.51x6.35, 2.54P
CASE 646BX



PDIP6 8.51x6.35, 2.54P
CASE 646BY



PDIP6 8.51x6.35, 2.54P
CASE 646BZ

Description

The MCT5210M and MCT5211M devices consist of a high−efficiency AlGaAs infrared emitting diode coupled with an NPN phototransistor in a six−pin dual−in−line package.

The devices are well suited for CMOS to LSTT/TTL interfaces, offering 250% CTR CE(SAT) with 1 mA of LED input current. With an LED input current of 1.6 mA, data rates to 20 kbits/s are possible.

Both can easily interface LSTTL to LSTTL/TTL, and with use of an external base−to−emitter resistor data rates of 100 kbits/s can be achieved.

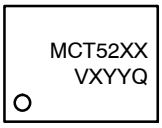
Features

- High $CTR_{CE(SAT)}$ Comparable to Darlingtons
- High Common Mode Transient Rejection: 5 kV/μs
- Data Rates Up to 150 kbits/s (NRZ)
- Safety and Regulatory Approvals:
  - UL1577; 4,170 VAC_{RMS} for 1 Minute
  - DIN−EN/IEC60747−5−5, 850 V Peak Working Insulation Voltage
- These are Pb−Free Devices

Applications

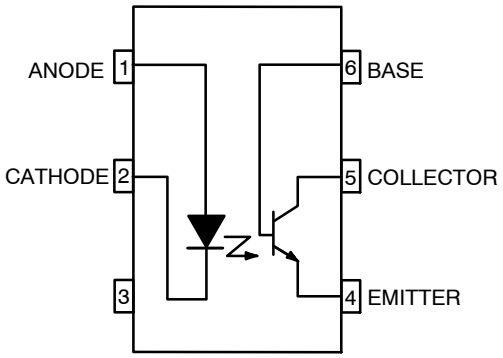
- CMOS to CMOS/LSTTL Logic Isolation
- LSTTL to CMOS/LSTTL Logic Isolation
- RS−232 Line Receiver
- Telephone Ring Detector
- AC Line Voltage Sensing
- Switching Power Supply

MARKING DIAGRAM



MCT52XX	=	Device Number XX = 10, 11
V	=	DIN EN/IEC60747−5−5 Option (only appears on component ordered with this option)
X	=	One−Digit Year Code, e.g., ‘5’
YY	=	Digit Work Week, Ranging from‘01’ to ‘53’
Q	=	Assembly Package Code

SCHEMATIC



ORDERING INFORMATION

See detailed ordering and shipping information on page 16 of this data sheet.

SAFETY AND INSULATION RATINGS (As per DIN EN/IEC 60747−5−5, this optocoupler is suitable for "safe electrical insulation" only within the safety limit data. Compliance with the safety ratings shall be ensured by means of protective circuits.)

Parameter		Characteristics
Installation Classifications per DIN VDE 0110/1.89 Table 1, For Rated Mains Voltage	<150 V_{RMS}	I–IV
	<300 V_{RMS}	I–IV
Climatic Classification		55/100/21
Pollution Degree (DIN VDE 0110/1.89)		2
Comparative Tracking Index		175

Symbol	Parameter	Value	Unit
V_{PR}	Input−to−Output Test Voltage, Method A, V_{IORM} x 1.6 = V_{PR}, Type and Sample Test with t_m = 10 s, Partial Discharge < 5 pC	1360	V_{peak}
	Input−to−Output Test Voltage, Method B, V_{IORM} x 1.875 = V_{PR}, 100% Production Test with t_m = 1 s, Partial Discharge < 5 pC	1594	V_{peak}
V_{IORM}	Maximum Working Insulation Voltage	850	V_{peak}
V_{IOTM}	Highest Allowable Over−Voltage	6000	V_{peak}
	External Creepage	≥7	mm
	External Clearance	≥7	mm
	External Clearance (for Option TV, 0.4" Lead Spacing)	≥10	mm
DTI	Distance Through Insulation (Insulation Thickness)	≥0.5	mm
T_S	Case Temperature (Note 1)	175	°C
$I_{S, INPUT}$	Input Current (Note 1)	350	mA
$P_{S, OUTPUT}$	Output Power (Note 1)	800	mW
R_{IO}	Insulation Resistance at T_S, V_{IO} = 500 V (Note 1)	$>10^9$	Ω

1. Safety limit values – maximum values allowed in the event of a failure.

ABSOLUTE MAXIMUM RATINGS (T_A = 25°C unless otherwise noted)

Symbol	Parameter	Value	Unit
TOTAL DEVICE			
T_{STG}	Storage Temperature	−40 to +125	°C
T_{OPR}	Operating Temperature	−40 to +100	°C
T_J	Junction Temperature	−40 to +125	°C
T_{SOL}	Lead Solder Temperature	260 for 10 seconds	°C
P_D	Total Device Power Dissipation @ 25°C (LED plus detector)	225	mW
	Derate Linearly from 25°C	3.5	mW/°C
EMITTER			
I_F	Continuous Forward Current	50	mA
V_R	Reverse Input Voltage	6	V
I_F(pk)	Forward Current – Peak (1 μs pulse, 300 pps)	3.0	A
P_D	LED Power Dissipation at 25°C	75	mW
	Derate Linearly from 25°C	1.0	mW/°C
DETECTOR			
I_C	Continuous Collector Current	150	mA
P_D	Detector Power Dissipation @ 25°C	150	mW
	Derate Linearly from 25°C	2.0	mW/°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.

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

Symbol	Parameter	Test Conditions	Min	Typ	Max	Unit
INDIVIDUAL COMPONENT CHARACTERISTICS						
EMITTER						
V_F	Input Forward Voltage	I_F = 5 mA	–	1.25	1.50	V
$\frac{\Delta V_F}{\Delta T_A}$	Forward Voltage Temperature Coefficient	I_F = 2 mA	–	−1.75	–	mV/°C
V_R	Reverse Voltage	I_R = 10 μA	6	–	–	V
C_J	Junction Capacitance	V_F = 0 V, f = 1.0 MHz	–	18	–	pF
DETECTOR						
BV_{CEO}	Breakdown Voltage Collector−to−Emitter	I_C = 1.0 mA, I_F = 0	30	100	–	V
BV_{CBO}	Breakdown Voltage Collector−to−Base	I_C = 10 μA, I_F = 0	30	120	–	V
BV_{EBO}	Breakdown Voltage Emitter−to−Base	I_E = 10 μA, I_F = 0	5	10	–	V
I_{CER}	Dark Current, Collector−to−Emitter	V_{CE} = 10 V, I_F = 0, R_{BE} = 1 MΩ	–	1	100	nA
C_{CE}	Capacitance, Collector−to−Emitter	V_{CE} = 0 V, f = 1 MHz	–	10	–	pF
C_{CB}	Capacitance, Collector−to−Base	V_{CB} = 0 V, f = 1 MHz	–	80	–	pF
C_{EB}	Capacitance, Emitter−to−Base	V_{EB} = 0 V, f = 1 MHz	–	15	–	pF

ELECTRICAL CHARACTERISTICS (T_A = 25°C, unless otherwise noted) (continued)

Symbol	Parameter	Test Conditions	Device	Min	Typ	Max	Unit
TRANSFER CHARACTERISTICS							
DC CHARACTERISTICS							
$CTR_{CE(SAT)}$	Saturated Current Transfer Ratio Collector−to−Emitter (Note 2)	I_F = 3.0 mA, V_{CE} = 0.4 V	MCT5210M	60	–	–	%
		I_F = 1.6 mA, V_{CE} = 0.4 V	MCT5211M	100	–	–	%
		I_F = 1.0 mA, V_{CE} = 0.4 V		75	–	–	%
$CTR_{(CE)}$	Current Transfer Ratio Collector−to−Emitter (Note 2)	I_F = 3.0 mA, V_{CE} = 5.0 V	MCT5210M	70	–	–	%
		I_F = 1.6 mA, V_{CE} = 5.0 V	MCT5211M	150	–	–	%
		I_F = 1.0 mA, V_{CE} = 5.0 V		110	–	–	%
$CTR_{(CB)}$	Current Transfer Ratio Collector−to−Base (Note 3)	I_F = 3.0 mA, V_{CE} = 4.3 V	MCT5210M	0.2	–	–	%
		I_F = 1.6 mA, V_{CE} = 4.3 V	MCT5211M	0.3	–	–	%
		I_F = 1.0 mA, V_{CE} = 4.3 V		0.25	–	–	%
$V_{CE(SAT)}$	Saturation Voltage	I_F = 3.0 mA, I_{CE} = 1.8 mA	MCT5210M	–	–	0.4	V
		I_F = 1.6 mA, I_{CE} = 1.6 mA	MCT5211M	–	–	0.4	V

ELECTRICAL CHARACTERISTICS (T_A = 25°C, unless otherwise noted) (continued)

Symbol	Parameter	Test Conditions		Device	Min	Typ	Max	Unit
TRANSFER CHARACTERISTICS								
AC CHARACTERISTICS								
T_{PHL}	Propagation Delay HIGH−to−LOW (Note 4)	R_L = 330 Ω, R_{BE} = ∞	I_F = 3.0 mA, V_{CC} = 5.0 V	MCT5210M	–	10	–	μs
		R_L = 3.3 kΩ, R_{BE} = 39 kΩ			–	7	–	μs
		R_L = 750 Ω, R_{BE} = ∞	I_F = 1.6 mA, V_{CC} = 5.0 V	MCT5211M	–	14	–	μs
		R_L = 4.7 kΩ, R_{BE} = 91 kΩ			–	15	–	μs
		R_L = 1.5 kΩ, R_{BE} = ∞	I_F = 1.0 mA, V_{CC} = 5.0 V		–	17	–	μs
		R_L = 10 kΩ, R_{BE} = 160 kΩ			–	24	–	μs
T_{PLH}	Propagation Delay LOW−to−HIGH (Note 5)	R_L = 330 Ω, R_{BE} = ∞	I_F = 3.0 mA, V_{CC} = 5.0 V	MCT5210M	–	0.4	–	μs
		R_L = 3.3 kΩ, R_{BE} = 39 kΩ			–	8	–	μs
		R_L = 750 Ω, R_{BE} = ∞	I_F = 1.6 mA, V_{CC} = 5.0 V	MCT5211M	–	2.5	–	μs
		R_L = 4.7 kΩ, R_{BE} = 91 kΩ			–	11	–	μs
		R_L = 1.5 kΩ, R_{BE} = ∞	I_F = 1.0 mA, V_{CC} = 5.0 V		–	7	–	μs
		R_L = 10 kΩ, R_{BE} = 160 kΩ			–	16	–	μs

ELECTRICAL CHARACTERISTICS (T_A = 25°C, unless otherwise noted) (continued)

Symbol	Parameter	Test Conditions	Min	Typ	Max	Unit
ISOLATION CHARACTERISTICS						
V_{ISO}	Input−Output Isolation Voltage (Note 6)	t = 1 Minute	4170	–	–	VAC_{RMS}
R_{ISO}	Isolation Resistance (Note 6)	V_{I-O} = ±500 VDC, T_A= 25°C	10^{11}	–	–	Ω
C_{ISO}	Isolation Capacitance (Note 7)	V_{I-O} = 0 V, f = 1 MHz	–	0.4	0.6	pF
CM_H	Common Mode Transient Rejection – Output HIGH	V_{CM} = 50 V_{P-P}, R_L = 750 Ω, I_F = 0	–	5000	–	V/μs
CM_L	Common Mode Transient Rejection – Output LOW	V_{CM} = 50 V_{P-P}, R_L = 750 Ω, I_F = 1.6 mA	–	5000	–	V/μs

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.

2. DC Current Transfer Ratio (CTR_{CE}) is defined as the transistor collector current (I_{CE}) divided by the input LED current (I_F) x 100%, at a specified voltage between the collector and emitter (V_{CE}).
3. The collector base Current Transfer Ratio (CTR_{CB}) is defined as the transistor collector base photocurrent (I_{CB}) divided by the input LED current (I_F) time 100%.
4. Referring to Figure 16 the T_{PHL} propagation delay is measured from the 50% point of the rising edge of the data input pulse to the 1.3 V point on the falling edge of the output pulse.
5. Referring to Figure 16 the T_{PLH} propagation delay is measured from the 50% point of the falling edge of data input pulse to the 1.3 V point on the rising edge of the output pulse.
6. Device considered a two terminal device: pins 1, 2, and 3 shorted together and pins 5, 6 and 7 are shorted together.
7. C_{ISO} is the capacitance between the input (pins 1, 2, 3 connected) and the output (pin 4, 5, 6 connected).

TYPICAL PERFORMANCE CURVES

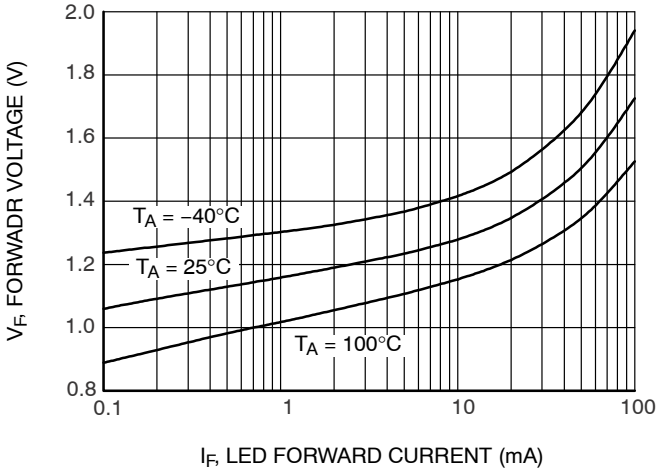


Figure 1. LED Forward Voltage vs. Forward Current

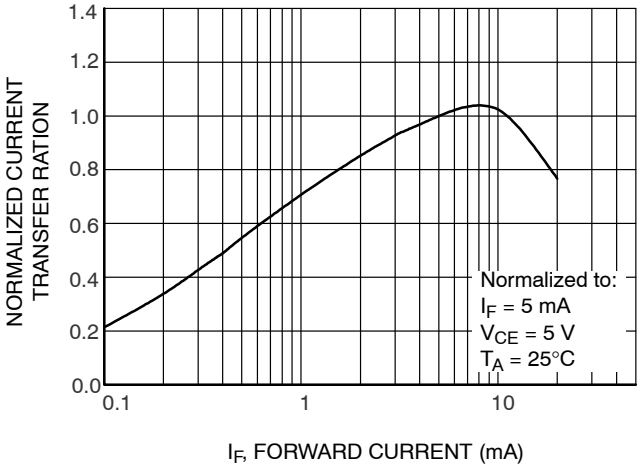


Figure 2. Normalized Current Transfer Ratio vs. Forward Current

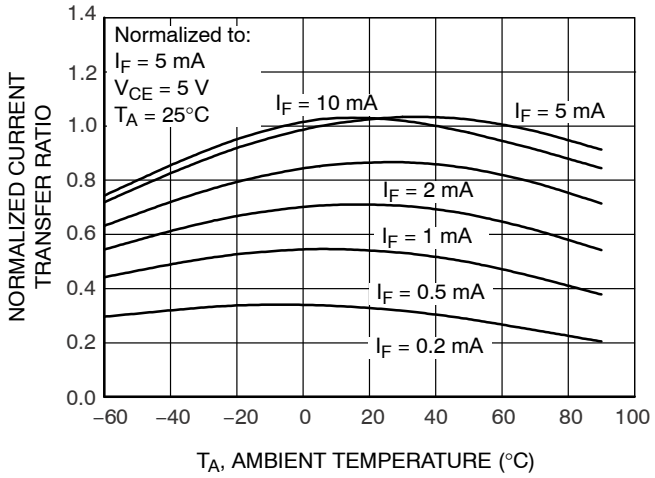


Figure 3. Normalized CTR vs. Temperature

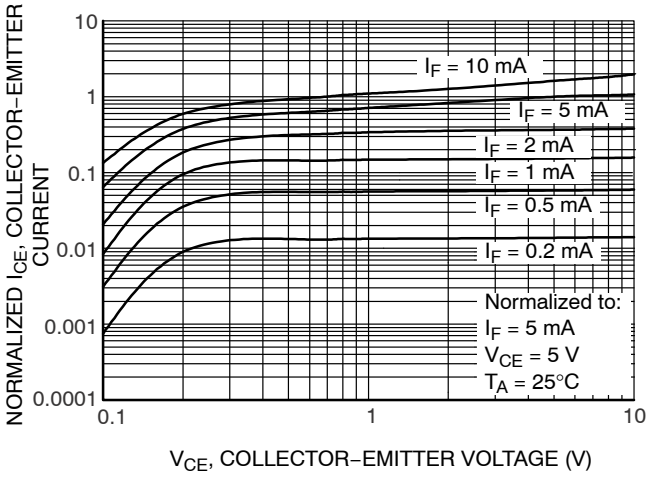


Figure 4. Normalized Collector vs. Collector−Emitter Voltage

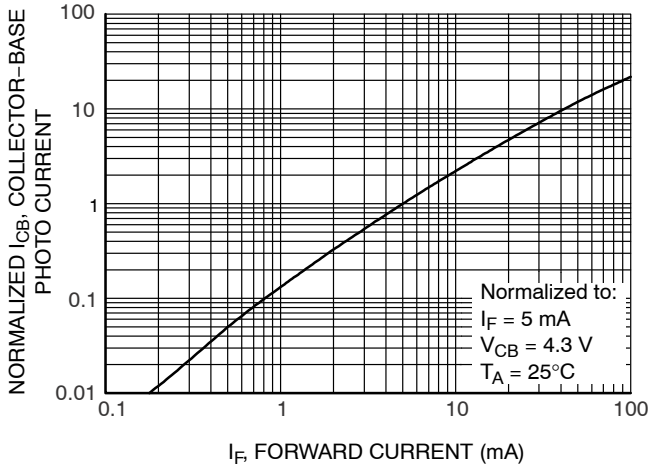


Figure 5. Normalized Collector Base Photocurrent Ration vs. Forward Current

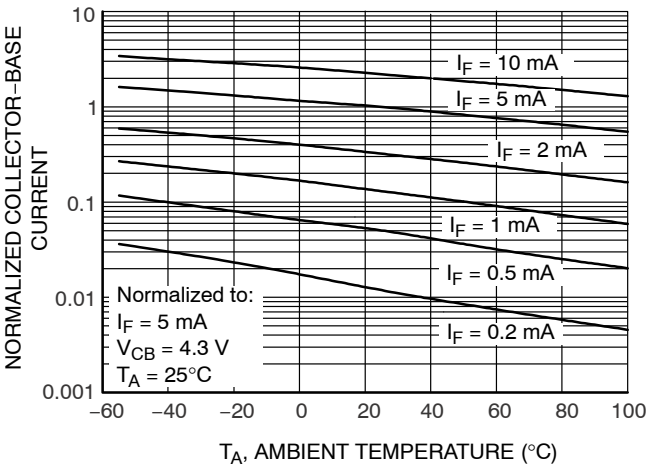


Figure 6. Normalized Collector−Base Current vs. Temperature

TYPICAL PERFORMANCE CURVES (continued)

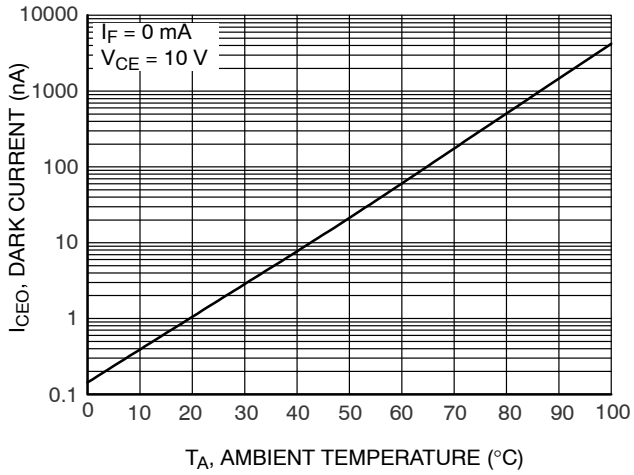


Figure 7. Collector−Emitter Dark Current vs. Ambient Temperature

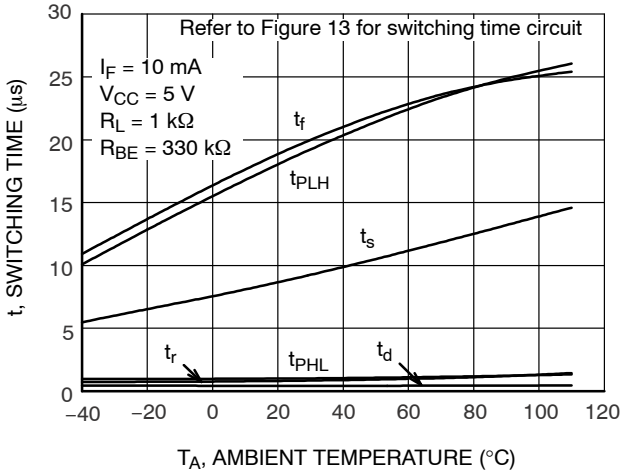


Figure 8. Switching Time vs. Ambient Temperature

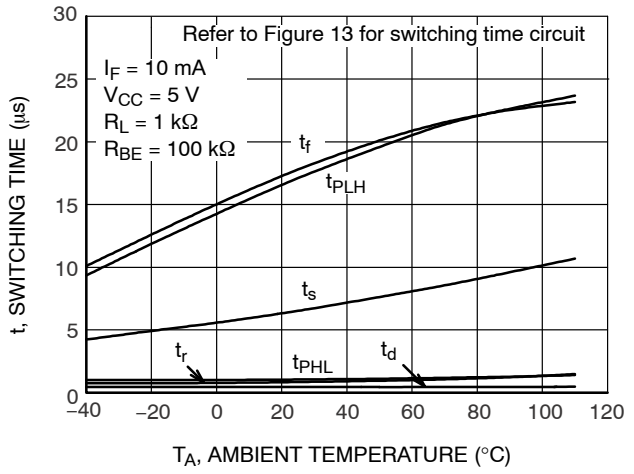


Figure 9. Switching Time vs. Ambient Temperature

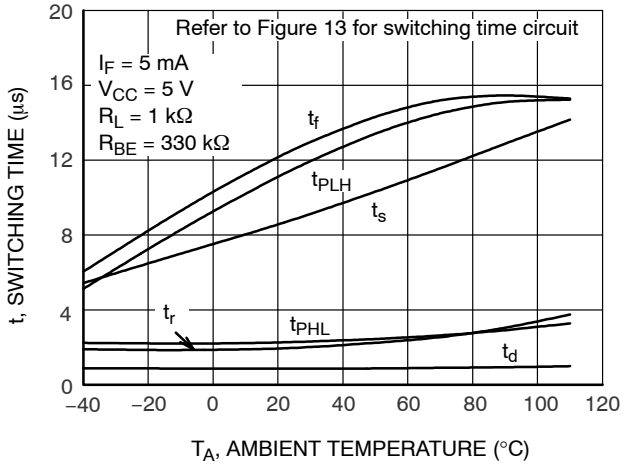


Figure 10. Switching Time vs. Ambient Temperature

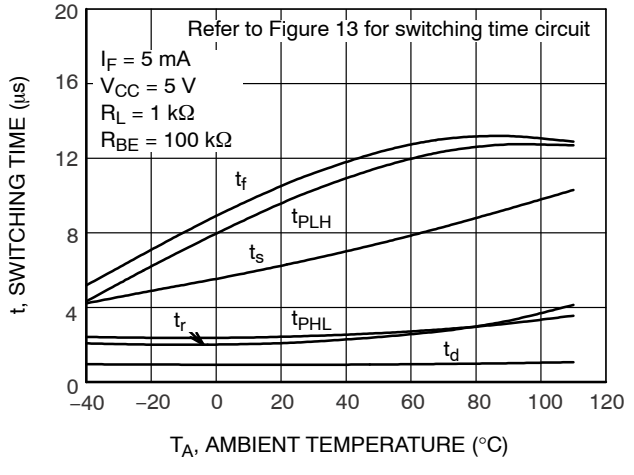


Figure 11. Switching Time vs. Ambient Temperature

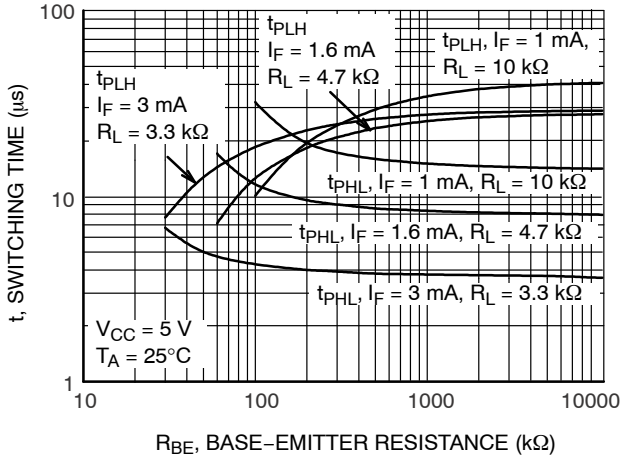


Figure 12. Switching Time vs. Base−Emitter Resistance

SWITCHING TIME TEST CIRCUIT AND WAVEFORMS

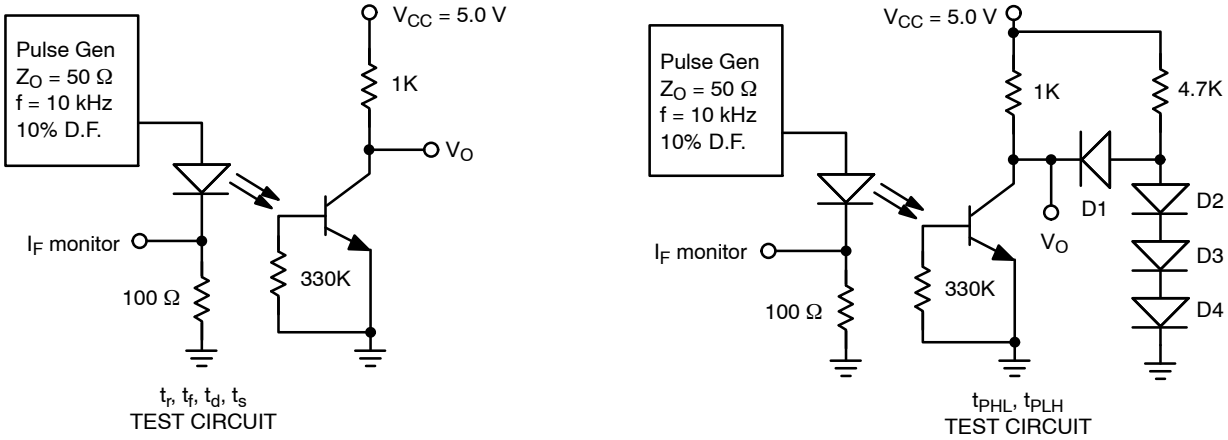


Figure 13. Switching Time Test Circuit

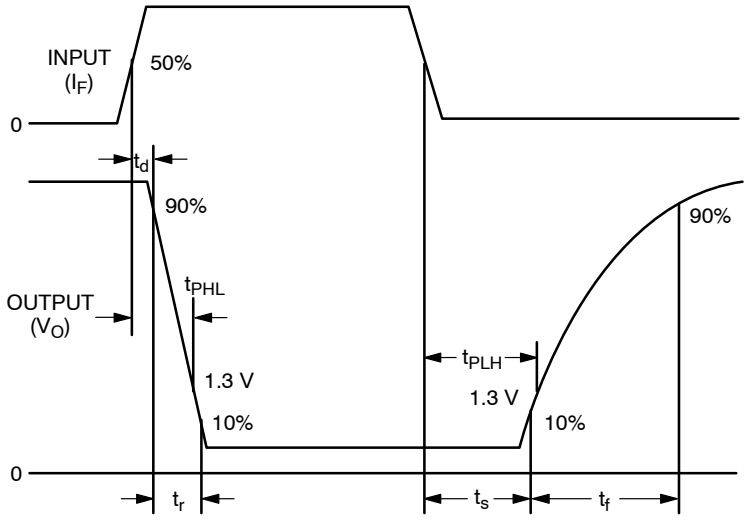


Figure 14. Switching Time Test Circuit

REFLOW PROFILE

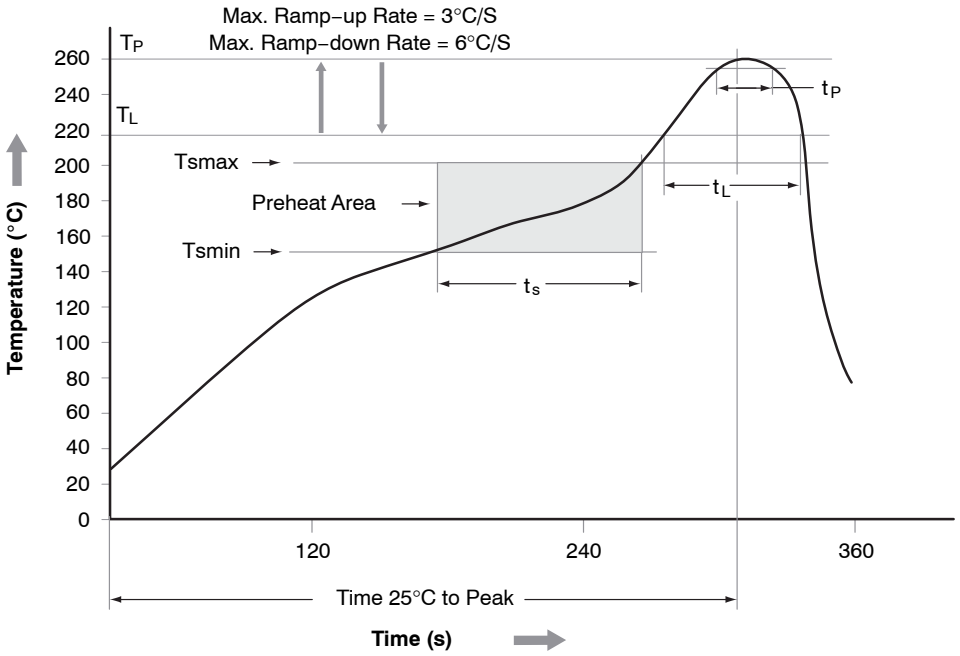


Figure 15. Reflow Profile

Table 1.

Profile Feature	Pb−Free Assembly Profile
Temperature Minimum (Tsmin)	150°C
Temperature Maximum (Tsmax)	200°C
Time (t_S) from (Tsmin to Tsmax)	60 – 120 seconds
Ramp−up Rate (t_L to t_P)	3°C/second maximum
Liquidous Temperature (T_L)	217°C
Time (t_L) Maintained Above (T_L)	60 – 150 seconds
Peak Body Package Temperature	260°C +0°C / −5°C
Time (t_P) within 5°C of 260°C	30 seconds
Ramp−down Rate (T_P to T_L)	6°C/second maximum
Time 25°C to Peak Temperature	8 minutes maximum

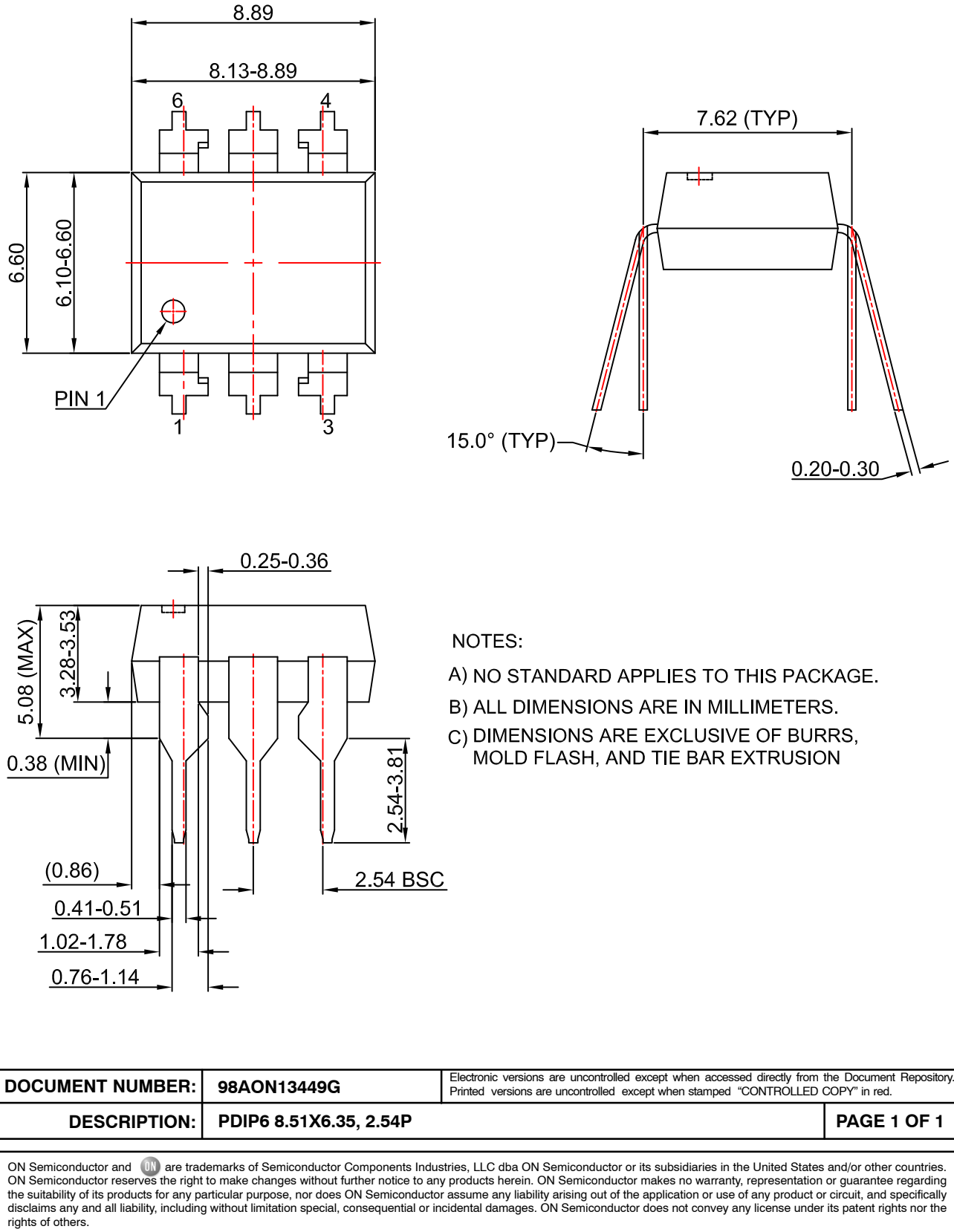
ORDERING INFORMATION (Note 8)

Part Number	Package	Packing Method
MCT5210M	DIP 6−Pin	Tube (50 Units)
MCT5210SM	SMT 6−Pin (Lead Bend)	Tube (50 Units)
MCT5210SR2M	SMT 6−Pin (Lead Bend)	Tape and Reel (1000 Units)
MCT5210VM	DIP 6−Pin, DIN EN/IEC60747−5−5 Option	Tube (50 Units)
MCT5210SVM	SMT 6−Pin (Lead Bend), DIN EN/IEC60747−5−5 Option	Tube (50 Units)
MCT5210SR2VM	SMT 6−Pin (Lead Bend), DIN EN/IEC60747−5−5 Option	Tape and Reel (1000 Units)
MCT5210TVM	DIP 6−Pin, 0.4” Lead Spacing, DIN EN/IEC60747−5−5 Option	Tube (50 Units)

8. The product orderable part number system listed in this table also applies to the MCT5211M device.

PDIP6 8.51x6.35, 2.54P
CASE 646BX
ISSUE O

DATE 31 JUL 2016



NOTES:

A) NO STANDARD APPLIES TO THIS PACKAGE.

B) ALL DIMENSIONS ARE IN MILLIMETERS.

C) DIMENSIONS ARE EXCLUSIVE OF BURRS, MOLD FLASH, AND TIE BAR EXTRUSION

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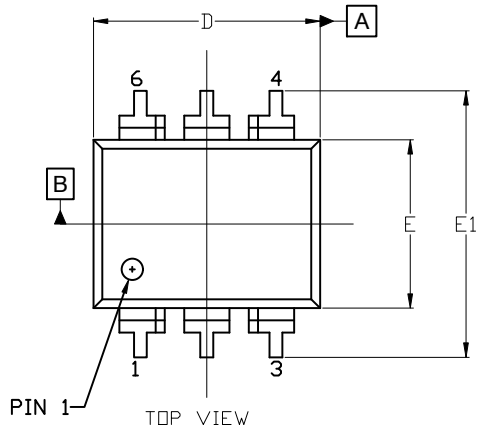
DESCRIPTION:	**PDIP6 8.51X6.35, 2.54P**	**PAGE 1 OF 1**

MECHANICAL CASE OUTLINE
PACKAGE DIMENSIONS

ON Semiconductor®

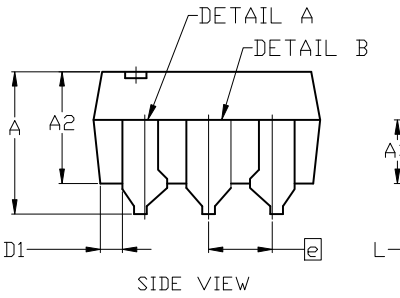
PDIP6 8.51x6.35, 2.54P
CASE 646BY
ISSUE A

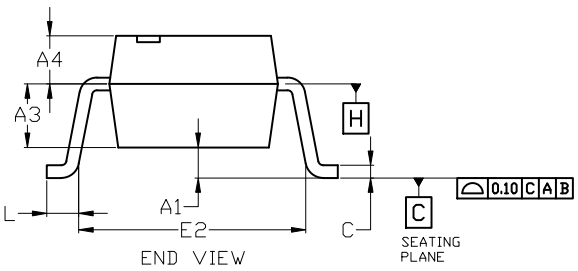
DATE 15 JUL 2019

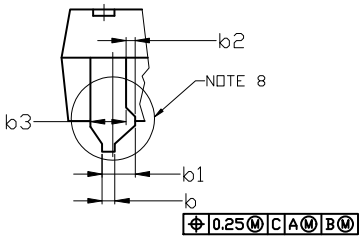


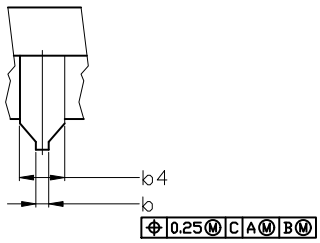
NOTES:
1. DIMENSIONING AND TOLERANCING PER ASME Y14.5M, 2009.
2. CONTROLLING DIMENSION: MILLIMETERS
3. DIMENSIONS A, A1, AND L ARE MEASURED WITH THE PACKAGE SEATED.
4. DIMENSIONS D, D1, AND E1 DO NOT INCLUDE MOLD FLASH OR PROTRUSIONS. MOLD FLASH OR PROTRUSIONS ARE NOT TO EXCEED 2.54mm.
5. PACKAGE CONTOUR IS OPTIONAL (ROUNDED OR SQUARE CORNERS).
6. CENTER LINE OF CORNER LEADS ARE LOCATED BY LOCATING THE CENTER OF FEATURE b2 AND b3.

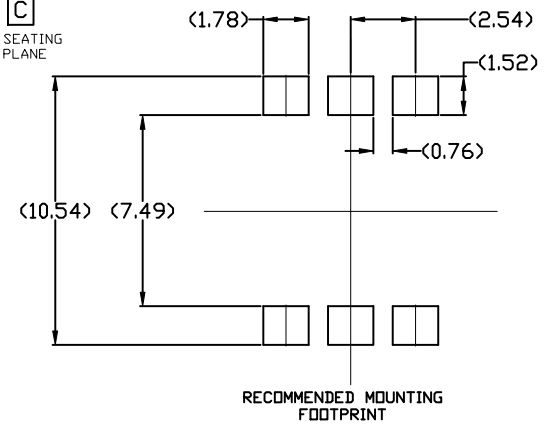
DIM	MILLIMETERS		
	MIN.	NOM.	MAX.
A	---	---	4.80
A1	0.38	---	---
A2	3.28	3.40	3.53
A3		2.49 REF	
A4		1.89 REF	
b	0.41	0.46	0.51
b1	0.76	0.92	1.14
b2	0.25	0.28	0.36
b3	1.02	1.40	1.78
b4		1.778 REF	
c	0.20	0.25	0.30
D	8.13	8.51	8.89
D1		0.86 REF	
E	6.10	6.35	6.60
E1	8.43	9.17	9.90
E2		8.13 REF	
e		2.54 BSC	
L	0.16	0.52	0.88











* For additional information on our Pb-Free strategy and soldering details, please download the ON Semiconductor Soldering and Mounting Techniques Reference Manual, SOLDERRM/D.

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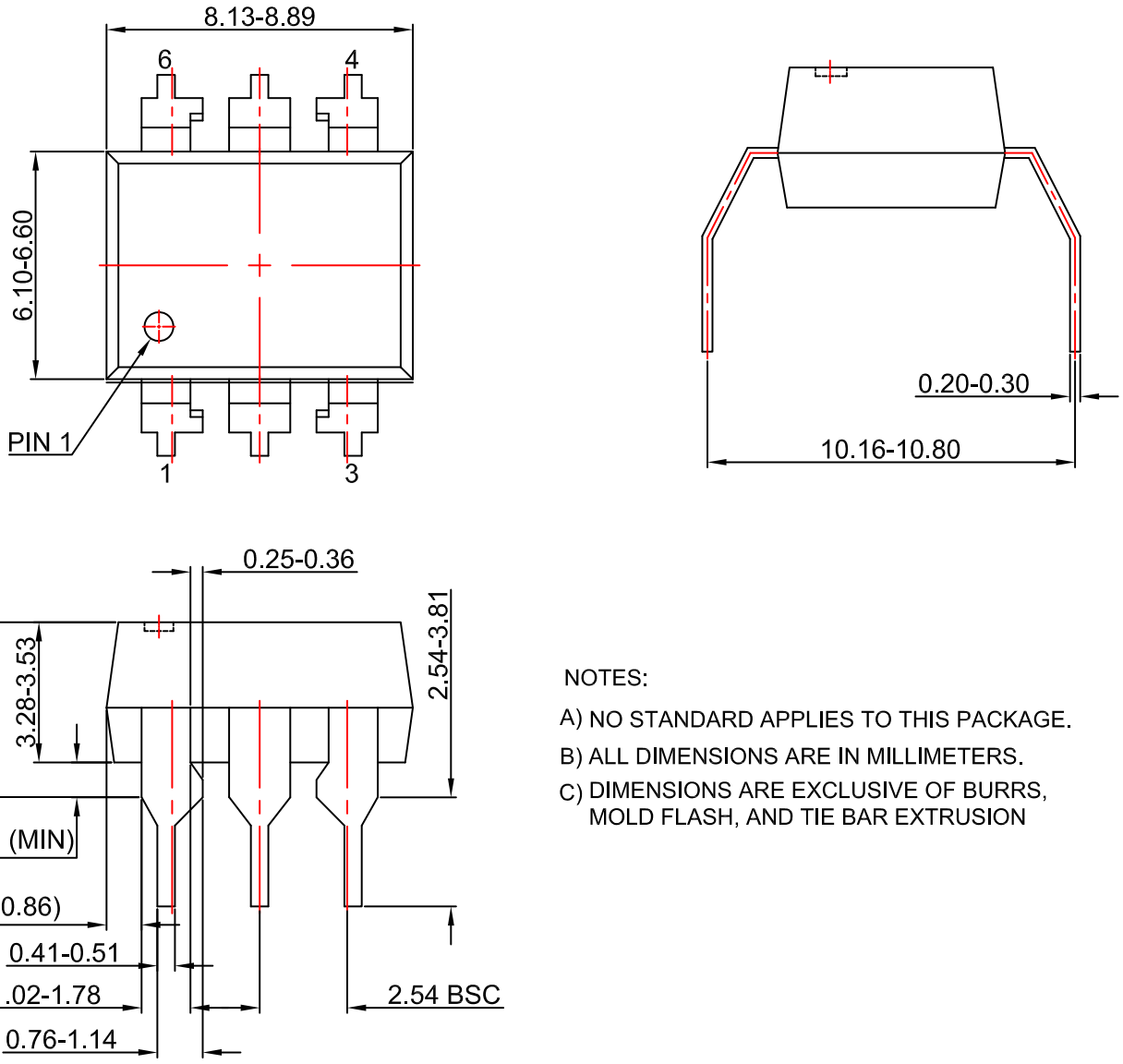

NOTES:

A) NO STANDARD APPLIES TO THIS PACKAGE.

B) ALL DIMENSIONS ARE IN MILLIMETERS.

C) DIMENSIONS ARE EXCLUSIVE OF BURRS, MOLD FLASH, AND TIE BAR EXTRUSION

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