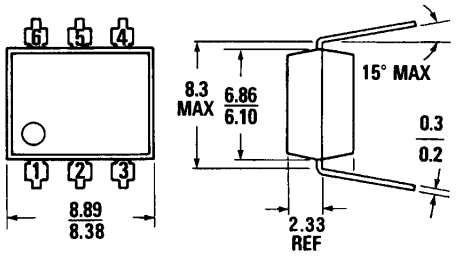
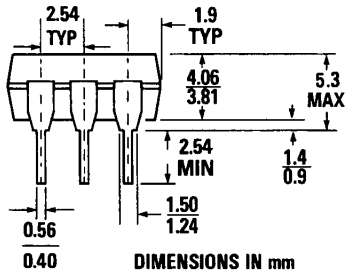
QT OPTOELECTRONICS

HIGH-PERFORMANCE AlGaAs PHOTOTRANSISTOR OPTOCOUPLERS

MCT5200
MCT5201

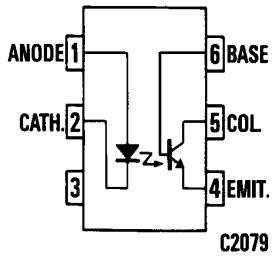
PACKAGE DIMENSIONS





DIMENSIONS IN mm
PACKAGE CODE K

ST1603A



Equivalent Circuit

DESCRIPTION

The MCT520X are high performance logic compatible phototransistor type optically coupled isolator products. They are constructed using a very low degradation and high-efficiency AlGaAs, 890 nm infrared emitter, coupled to a high speed NPN phototransistor, in a six-pin dual-in-line package. They provide a very high current transfer ratio (CTR), high switching speed and 5300 VAC RMS withstand test voltage performance. The critical circuit design parameters of CTR_{CE} and CTR_{CB} are guaranteed over a temperature range of 0-70°C resulting in guaranteed switching propagation delays when interfaced to LSTTL logic.

The MCT5201 has a minimum saturated CTR of 120% for a LED input current of 5 mA. Maximum LSTTL interface propagation delays of 30 μs are guaranteed with the use of an external 330K resistor between the base and emitter. The MCT5200 is specified for a minimum saturated CTR of 75% for an input current of 10 mA.

FEATURES

- High $CTR_{CE\ (SAT)}$ comparable to Darlingtons
- Guaranteed switching speed with LSTTL load
- Performance guaranteed over 0°C to 70°C
- High common mode rejection—5 kV/μs
- Data rates up to 150 kbits/s (NRZ)
- Underwriters Laboratory (UL) recognized file #E90700

APPLICATIONS

- LSTTL digital logic isolation
- IEEE 488 isolated inputs
- Switching power supply
- High speed industrial interfaces
- Isolated microprocessor inputs

ABSOLUTE MAXIMUM RATINGS

TOTAL PACKAGE

Storage temperature	−55°C to 150°C
Operating temperature	−55°C to 100°C
Lead temperature (soldering, 10 sec)	260°C
Total package, power dissipation (LED plus detector)	260 mW
Derate linearly from 25°C	3.5 mW/°C

INPUT DIODE

Forward DC current	40 mA
Reverse voltage	6 V
Peak forward current (1 μs pulse, 300 pps)	1.0 A
Power dissipation	54 mW
Derate linearly from 25°C	0.7 mW/°C

OUTPUT TRANSISTOR

Power dissipation	200 mW
Derate linearly from 25°C	2.67 mW/°C

INDIVIDUAL COMPONENT CHARACTERISTICS (T_A=25°C Unless Otherwise Specified)

CHARACTERISTIC	SYMBOL	MIN.	TYP.	MAX.	UNITS	TEST CONDITIONS	FIG.	NOTE
INPUT DIODE								
Forward voltage	V_F		1.3	1.5	V	I_F=5 mA	1	
Forward voltage coefficient	$\Delta V_F/\Delta T_A$		−1.9		mV/°C	I_F=2 mA	1	
Reverse voltage	V_R	6			V	I_R=10 μA		
Junction capacitance	C_J		18		pF	V_F=0 V, f=1 MHz		
			112			V_F=1 V, f=1 MHz		
OUTPUT TRANSISTOR								
DC forward current gain	$h_{FE(SAT)}$		400	—		V_{CE}=0.4 V, I_{CE}=6 mA	8,9	
Breakdown voltage Collector to emitter	BV_{CEO}	30	45		V	I_C=1.0 mA, I_F=0		
Collector to base	BV_{CBO}	30	70		V	I_C=10 μA, I_F=0		
Emitter to base	BV_{EBO}	5	7		V	I_E=10 μA		
Leakage Collector to emitter	I_{CER}		5	100	nA	V_{CE}=10 V, I_F=0, R_{BE}=1 MΩ	11	
Capacitance Collector to emitter	C		8		pF	V_{CE}=0, f=1 MHz		
Collector to base			20		pF	V_{CB}=5, f=1 MHz	12	
Emitter to base			7		pF	V_{EB}=0, f=1 MHz		

TRANSFER CHARACTERISTICS

(Over Recommended Temperature, T_A=**0°C to 70°C** Unless Otherwise Specified)

DC CHARACTERISTICS	SYMBOL	DEVICE	MIN.	TYP.*	MAX.	UNITS	TEST CONDITIONS	FIG.	NOTE
Saturated current transfer ratio (collector to emitter)	$CTR_{CE(SAT)}$	MCT5200	75	150		%	I_F=10 mA, V_{CE}=0.4V	2, 3, 4	1
		MCT5201	120	225		%	I_F=5.0 mA, V_{CE}=0.4 V	2, 3, 5	
Current transfer ratio (collector to emitter)	CTR_{CE}	MCT5200		200		%	I_F=10 mA, V_{CE}=5.0 V		1
		MCT5201		300		%	I_F=5 mA, V_{CE}=5.0 V		
Current transfer ratio (collector to base)	CTR_{CB}	MCT5200	0.2	0.3		%	I_F=10 mA, V_{CB}=4.3V		2
		MCT5201	0.28	0.5		%	I_F=5.0 mA, V_{CB}=4.3 V	6,7	
Saturation voltage (collector to emitter)	$V_{CE(SAT)}$	MCT5200		0.2	0.4	V	I_F=10 mA, I_{CE}=7.5 mA		
		MCT5201		0.2	0.4	V	I_F=5 mA, I_{CE}=6 mA		

**All typicals T_A=25°C*

SWITCHING CHARACTERISTICS

(Over Recommended Temperature, T_A=0°C to 70°C Unless Otherwise Specified)

AC CHARACTERISTICS	SYMBOL	MIN.	TYP.*	MAX.	UNITS	TEST CONDITIONS	FIG.	NOTE
MCT-5200								
Delay time	t_d		3	7	µs	I_F=10 mA, V_{CE}=0.4 V R_L=1.0 K, R_{BE}=330 K V_{CC}=5.0 V	15,18	3,4 5,6
Rise time	t_r		2	6	µs			
Storage time	t_s		12	18	µs			
Fall time	t_f		17	30	µs			
Propagation delay H→L	t_{PHL}	µs	5	12	µs	I_F=10 mA, V_{CE}=0.4 V V_{CC}=5.0 V, R_L=(Fig. 18) R_{BE}=330 K		7
Propagation delay L→H	t_{PLH}	µs	13	20	µs			
MCT-5201								
Delay time	t_d		7	15	µs	I_F=5 mA, V_{CE}=0.4 V R_L=1.0 K, R_{BE}=330 K V_{CC}=5.0 V	13,18	3,4 5,6
Rise time	t_r		6	20	µs			
Storage time	t_s		8	13	µs			
Fall time	t_f		19	30	µs			
Propagation delay H→L	t_{PHL}		12	30	µs	I_F=5 mA, V_{CE}=0.4 V V_{CC}=5.0 V, R_L=(Fig. 18) R_{BE}=330 K		7
Propagation delay L→H	t_{PLH}		8	13	µs			

All typicals T_A=25°C

ISOLATION CHARACTERISTICS (T_A=25°C Unless Otherwise Specified)

CHARACTERISTICS	SYMBOL	MIN.	TYP.	MAX.	UNITS	TEST CONDITIONS	FIG.	NOTE
Common mode rejection—output high	CM_H		5000		v/µs	V_{CM}=50 V_{p-p} R_L=1 KΩ, I_F=0	17	
Common mode rejection—output low	CM_L		5000		v/µs	V_{CM}=50 V_{p-p} R_L=1 KΩ, I_F=5 mA		
Common mode coupling capacitor	C_{cm}		0.2		pF		8	
Package capacitance input/output	C_{I-O}		0.7		pF	V_{I-O}=0, f=1 MHz	9	
Withstand insulation test voltage	V_{ISO}	5300			$V_{AC(RMS)}$	I_{I-O}≤1 µA, 1 minute	10	8
	V_{ISO}	7500			$V_{AC(Peak)}$	I_{I-O}≤1 µA, 1 minute	10	8
Insulation resistance	R_{ISO}	10^{11}			Ohms	V_{I-O}=500 V		

NOTES

1. *DC current transfer ratio (CTR_{CE}) is defined as the transistor collector current (I_{CE}) divided by input LED current (I_F) x 100%, at a specified voltage collector to emitter (V_{CE}).*
2. *Current transfer ratio is defined as the collector to base photocurrent (I_{CB}) divided by the input LED current (I_F) times 100%.*
3. *Switching delay time (t_d) is measured for 50% of LED current to 90% falling edge of V_O.*
4. *Rise time (t_r) is measured from the 90% to 10% of V_O falling edge.*
5. *Storage time (t_s) is measured from 50% of falling edge of LED current to 10% of rise edge of V_O.*
6. *Fall time (t_f) is measured from the 10% to 90% of the rising edge of V_O.*
7. *The t_{PLH} propagation delay is measured from 50% point on the falling edge of the input pulse to the 1.3 V point on the rising edge of the output pulse. The t_{PHL} propagation delay is measured from 50% point on the rising edge of input to 1.3 V point on falling edge of output pulse.*
8. *Device considered a two terminal device: Pins 1, 2, and 3 are shorted together. Pins 4, 5, and 6 are shorted together.*

TYPICAL ELECTRO-OPTICAL CHARACTERISTICS (T_A=25°C Unless Otherwise Specified)

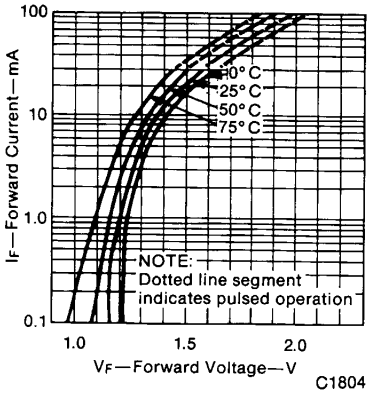


Fig. 1. Forward Voltage vs. Forward Current

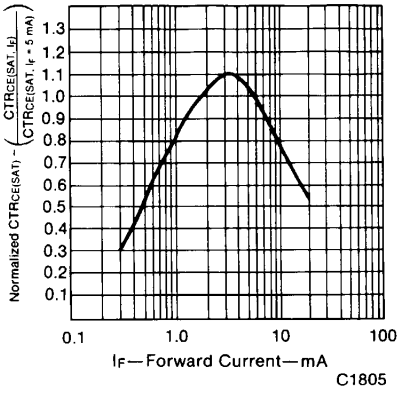


Fig. 2. Normalized Current Transfer Ratio vs. Forward Current

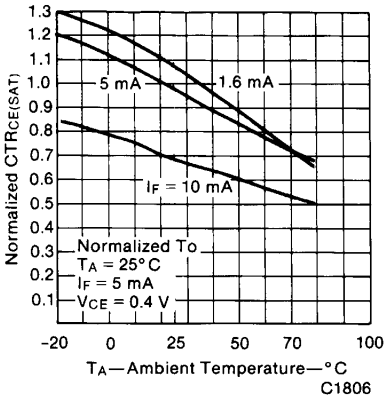


Fig. 3. Normalized CTR vs. Temperature

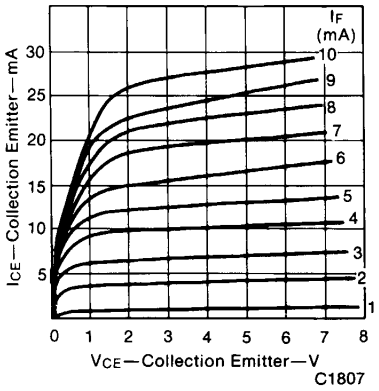


Fig. 4. MCT5200 Collector Current vs. Collector to Emitter Voltage

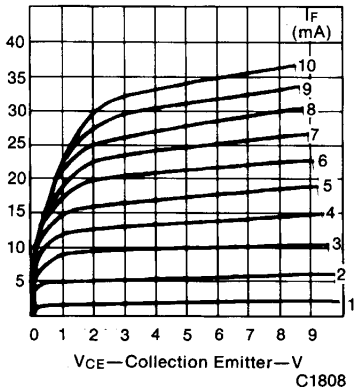


Fig. 5. MCT5201 Collector Current vs. Collector to Emitter Voltage

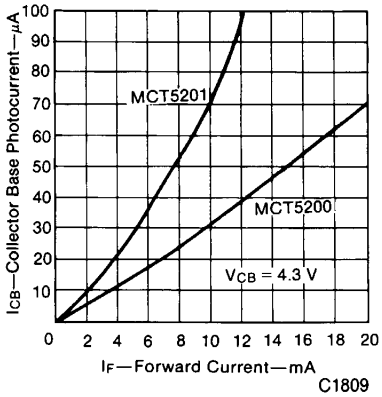


Fig. 6. Collector Base Photocurrent vs. Forward Current

TYPICAL ELECTRO-OPTICAL CHARACTERISTICS
(T_A=25°C Unless Otherwise Specified) (Cont'd)

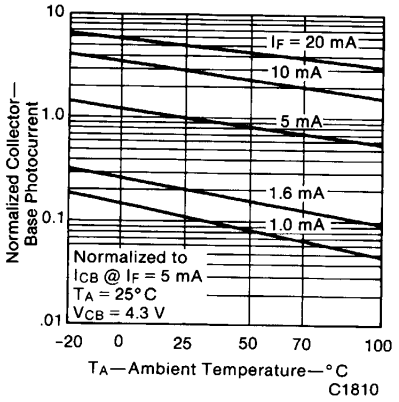


Fig. 7. Normalized Collector Base Photocurrent vs. Ambient Temperature

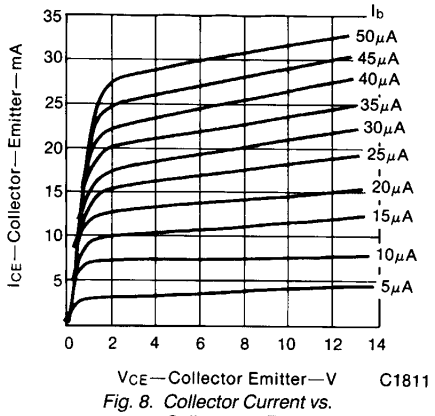


Fig. 8. Collector Current vs. Collector to Emitter Voltage

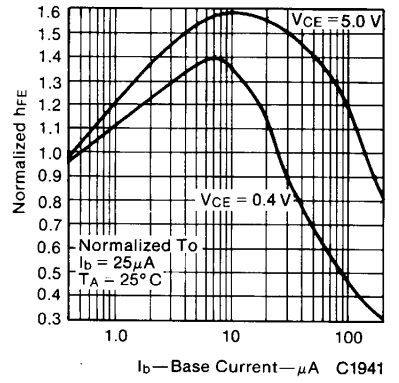


Fig. 9. Normalized h_{FE} vs. Base Current

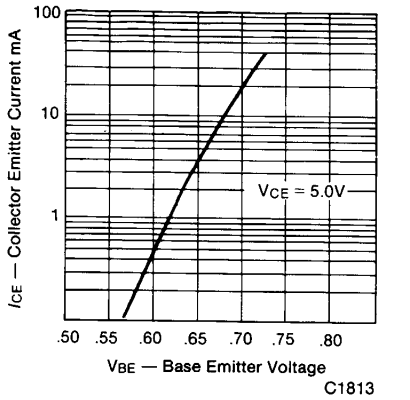


Fig. 10. Collector Current (I_{CE}) vs. Base Emitter Voltage (V_{BE})

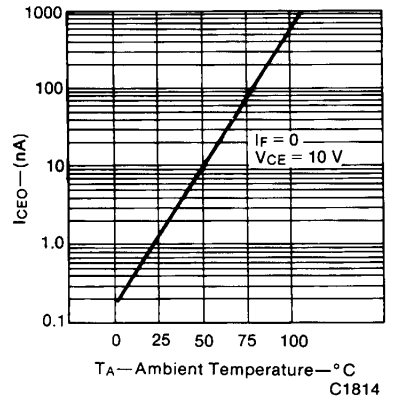


Fig. 11. Collector to Emitter Leakage Current vs. Temperature

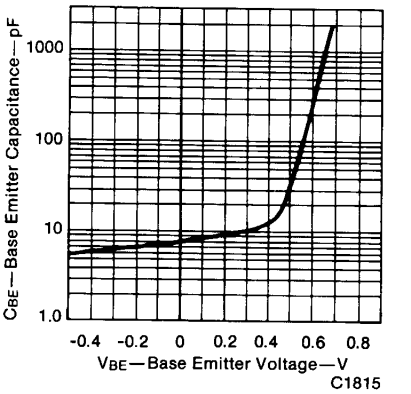


Fig. 12. Base Emitter Capacitance vs. Base Emitter Voltage

TYPICAL ELECTRO-OPTICAL CHARACTERISTICS
(T_A=25°C Unless Otherwise Specified) (Cont'd)

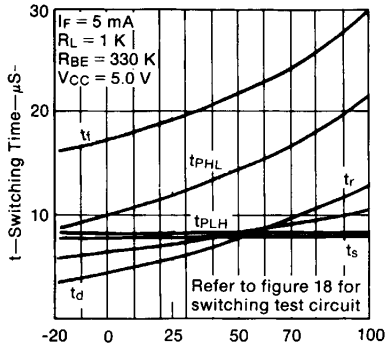


Fig. 13. Switching Time vs. Temperature I_F=5 mA R_{BE}=330 K

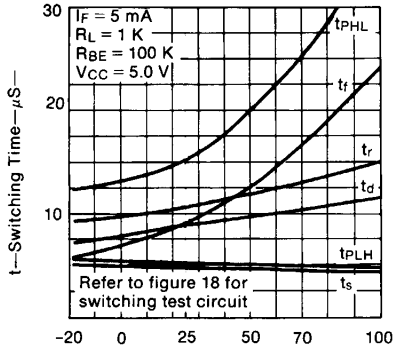


Fig. 14. Switching Speed vs. Temperature I_F=5 mA R_{BE}=100 K

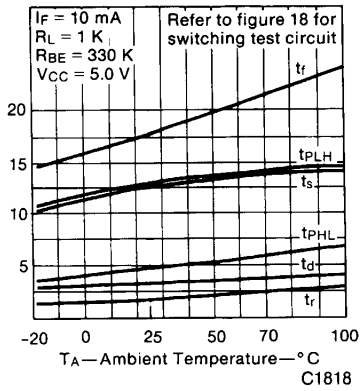


Fig. 15. Switching Speed vs. Temperature I_F=5 mA R_{BE}=330 K

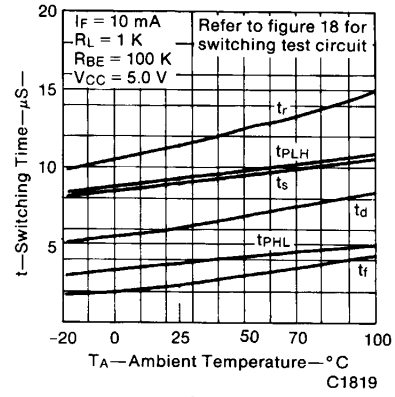


Fig. 16. Switching Speed vs. Temperature I_F=5 mA R_{BE}=100 K

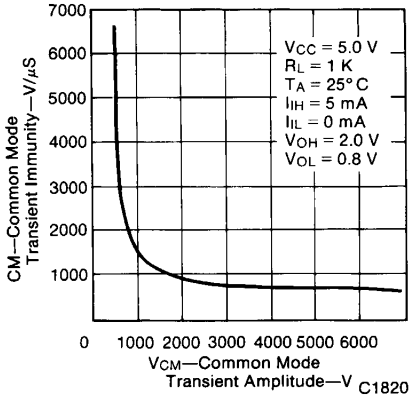


Fig. 17. Common Mode Transient Rejection vs. Common Mode Transient Voltage

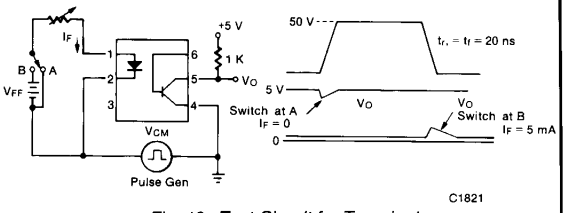
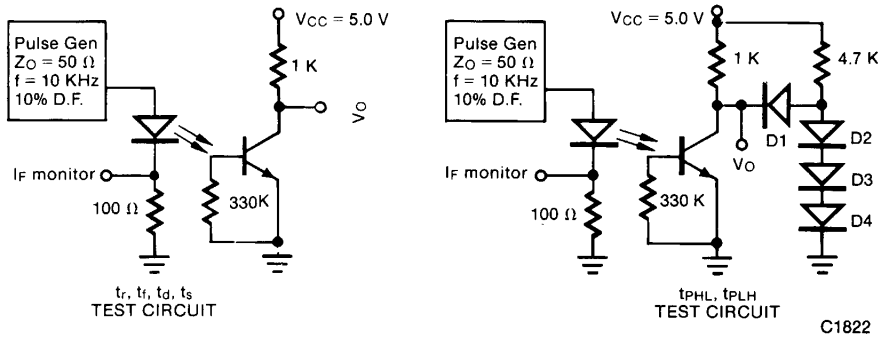


Fig. 18. Text Circuit for Transient Immunity and Typical Waveforms

TYPICAL ELECTRO-OPTICAL CHARACTERISTICS

(T_A=25°C Unless Otherwise Specified) (Cont'd)



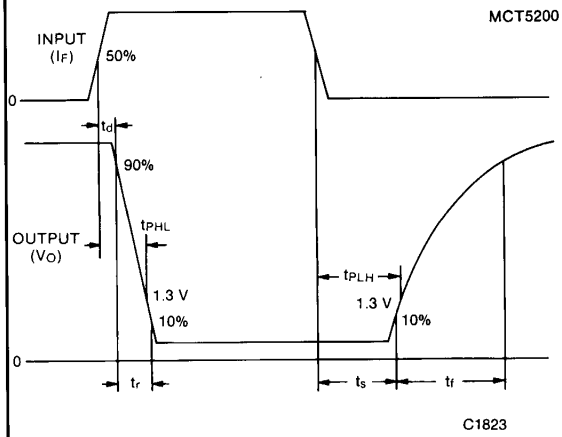
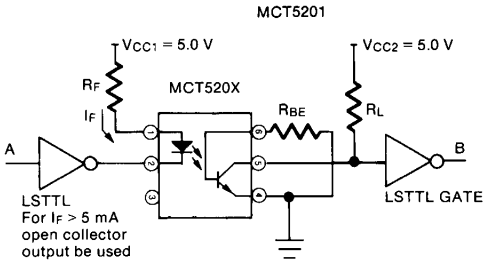


Fig. 19. Switching Circuit Waveforms



IF mA	RF Ω	RL Ω	RBE Ω	tPHL µs	tPLH µs	DATA* RATE NRZ
1.6	2 K	10 K	∞	15	12	37 K
3.0	1.1 K	4.7 K	470 K	10	10	50 K
5.0	620	1 K	330 K	12	8	50 K
10.0	330	1 K	100 K	7	11	56 K
10.0	330	2 K	47 K	3	4	140 K

$$\text{data}_{*NRZ} = \frac{1}{t_{PLH} + t_{PHL}}$$

C1824

Fig. 20. Typical Non-Inverting LSTTL to LSTTL Interface