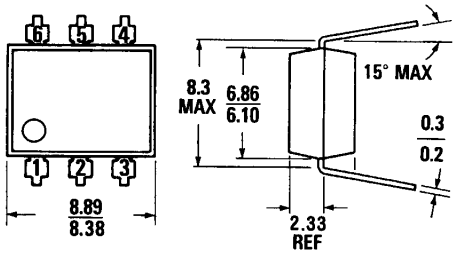
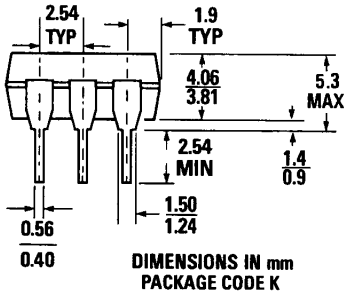
OPTOELECTRONICS

HIGH-PERFORMANCE AlGaAs PHOTOTRANSISTOR OPTOCOUPLERS

MCT5210
MCT5211

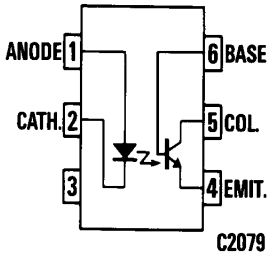
PACKAGE DIMENSIONS





DIMENSIONS IN mm
PACKAGE CODE K

ST1603A



Equivalent Circuit

DESCRIPTION

The MCT-521X are high performance CMOS/LSTTL logic compatible phototransistor type optically coupled isolator products. They are constructed using a very low degradation and high-efficiency AlGaAs, infrared emitter, coupled to a photoefficient high gain NPN phototransistor in a six pin dual-in-line package. This package provides a minimum of 5300 VAC Withstand Test Insulation, and 5000 V/μs common mode transient rejection.

The MCT-5211 is well suited for CMOS to LSTT/TTL interfaces, for it offers 250% $CTR_{CE(SAT)}$ with 1 mA of LED input current. When an LED input current of 1.6 mA is supplied data rates to 20K bits/s are possible.

The MCT-5210 can easily interface LSTTL to LSTTL/TTL, and with use of an external base to emitter resistor data rates of 100 K bits/s can be achieved.

FEATURES

- High $CTR_{CE(SAT)}$ comparable to Darlingtons
- CTR guaranteed 0°C to 70°C
- High common mode transient rejection—5 kV/μs
- Data rates up to 50 kbits/s (NRZ)
- Underwriters Laboratory (UL) recognized file #E90700

APPLICATIONS

- CMOS to CMOS/LSTTL logic isolation
  LSTTL to CMOS/LSTTL logic isolation
- RS-232 line receiver
- Telephone ring detector
- AC line voltage sensing

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 at 25°C (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

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

CHARACTERISTICS	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	5			V	I_R=10 μA		
Junction capacitance	C_J		18		pF	V_F=0 V, f=1 MHz		
			112		pF	V_F=1 V, f=1 MHz		
OUTPUT TRANSISTOR								
DC forward current gain	$h_{FE(SAT)}$		350		—	V_{CE}=0.4 V, I_{CE}=2 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_C=10 μA, I_F=0		
Leakage current Collector to emitter	I_{CER}			100	nA	V_{CE}=10 V, I_F=0, R_{BE}=1 MΩ		
Capacitance Collector to emitter	C		10		pF	V_{CE}=0, f=1 MHz		
Collector to base			80		pF	V_{CB}=0, f=1 MHz		
Emitter to base			15		pF	V_{EB}=0, f=1 MHz	11	

TRANSFER CHARACTERISTICS OVER RECOMMENDED TEMPERATURE (T_A=0°C to 70°C Unless Otherwise Specified)

CHARACTERISTICS	SYMBOL	DEVICE	MIN	TYP*	MAX	UNITS	TEST CONDITIONS	FIG.	NOTE
Saturated current		MCT5210	60	350		%	I_F=3.0 mA, V_{CE}=0.4 V	2	
Transfer ratio	$CTR_{CE\ SAT}$	MCT5211	100	300		%	I_F=1.6 mA, V_{CE}=0.4 V	3	1
(Collector to emitter)			75	250		%	I_F=1.0 mA, V_{CE}=0.4 V		
Current transfer ratio		MCT5210	70	400		%	I_F=3.0 mA, V_{CE}=5.0 V	5	
(Collector to emitter)	CTR_{CE}	MCT5211	150	350		%	I_F=1.6 mA, V_{CE}=5.0 V	4	1
			110	300		%	I_F=1.0 mA, V_{CE}=5.0 V		
Current transfer ratio		MCT5210	0.2	0.9		%	I_F=3.0 mA, V_{CB}=4.3 V	6	
(Collector to base)	CTR_{CB}	MCT5211	0.3	0.75		%	I_F=1.6 mA, V_{CB}=4.3 V	7	2
			0.25	0.6		%	I_F=1.0 mA, V_{CB}=4.3 V		
Saturation voltage	$V_{CE\ SAT}$	MCT5210		0.2	0.4	V	I_F=3.0 mA, I_{CE}=1.8 mA		
(Collector to emitter)		MCT5211		0.2	0.4	V	I_F=1.6 mA, I_{CE}=1.6 mA		

**All typicals T_A=25°C*

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

CHARACTERISTICS	SYMBOL	DEVICE	MIN	TYP	MAX	UNITS	TEST CONDITIONS		FIG.	NOTE
Propagation delay H-L	t_{PHL}	MCT-5210		10		μs	R_L=330 Ω, R_{BE}=∞	I_F=3.0 mA		
				12		μs	R_L=3.3 K, R_{BE}=39 K	V_{CC}=5.0 V		
		MCT-5211		20		μs	R_L=750 Ω, R_{BE}=∞	I_F=1.6 mA	12	3
				25		μs	R_L=4.7 K, R_{BE}=91 K	V_{CC}=5.0 V	13	
				40		μs	R_L=1.5 K, R_{BE}=∞	I_F=1.0 mA		
				45		μs	R_L=10 K, R_{BE}=160 K	V_{CC}=5.0 V		
Propagation delay L-H	t_{PLH}	MCT-5210		10		μs	R_L=330 Ω, R_{BE}=∞	I_F=3.0 mA		
				12		μs	R_L=3.3 K, R_{BE}=39 K	V_{CC}=5.0 V		
		MCT-5211		20		μs	R_L=750 Ω, R_{BE}=∞	I_F=1.6 mA		
				25		μs	R_L=4.7 K, R_{BE}=91 K	V_{CC}=5.0 V	12	4
				40		μs	R_L=1.5 K, R_{BE}=∞	I_F=1.0 mA	13	
				45		μs	R_L=10 K, R_{BE}=160 K	V_{CC}=5.0 V		

ISOLATION CHARACTERISTICS (T_A=0°C Unless Otherwise Specified)

CHARACTERISTICS	SYMBOL	MIN	TYP	MAX	UNITS	TEST CONDITIONS	FIG.	NOTE
Common mode transient Rejection - output high	CM_H		5000		v/μs	V_{CM}=50 V_{p-p}, R_L=750 Ω I_F=0	14	
Common mode transient Rejection - output low	CM_L		5000		v/μs	V_{CM}=50 I_{p-p} R_L=750 Ω I_F=1.6 mA		
Common mode coupling capacitor	C_{CM}		0.2		pF		14	5
Package capacitance input/output	C_{I-O}		0.7		pF	V_{I-O}=0, f=1 MHz		6
Withstand insulation test voltage	V_{ISO}	5300			$V_{AC(RMS)}$	I_{I-O}≤1 μA, 1 minute		7
	V_{ISO}	7500			$V_{AC(Peak)}$			
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 the input LED current (I_F) x 100%, at a specified voltage between the collector and emitter (V_{CE}).*
2. *The collector base Current Transfer Ratio (CTR_{CB}) is defined as the collector base photocurrent (I_{CB}) divided by the input LED current (I_F) time 100%.*
3. *Referring to Figure 13 the t_{PHL} propagation delay is measured from the rising edge of the data input (A) to the rising edge of the rising edge of the data output (B).*
4. *Referring to Figure 13 the t_{PLH} propagation delay is measured from the falling edge of data input (A) to the falling edge of the data output (B).*
5. *C_{CM} is the capacitance between the LED (input assembly) to the base of the phototransistor.*
6. *C_{I-O} is the capacitance between the input (pins 1, 2, 3 connected) and the output, (pins 4, 5, 6 connected).*
7. *Device considered a two terminal device: Pins 1, 2, and 3 shorted together, and pins 5, 6, and 7 are shorted together.*

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

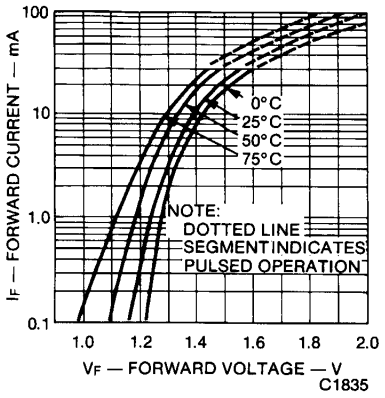


Fig. 1. Forward Voltage vs. Forward Current

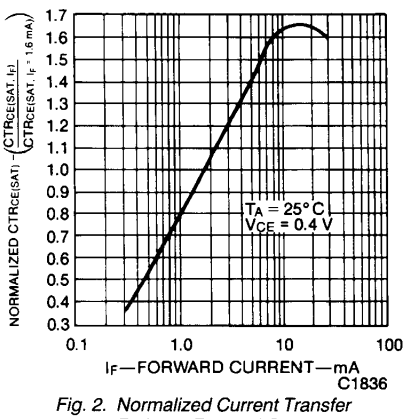


Fig. 2. Normalized Current Transfer Ratio vs. Forward Current

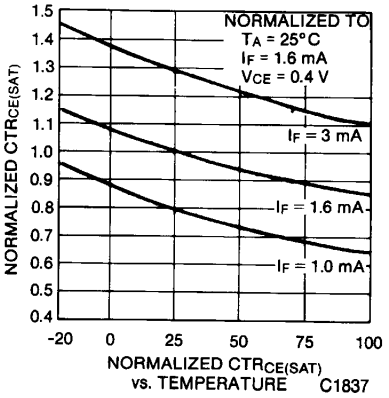


Fig. 3. Normalized CTR vs. Temperature

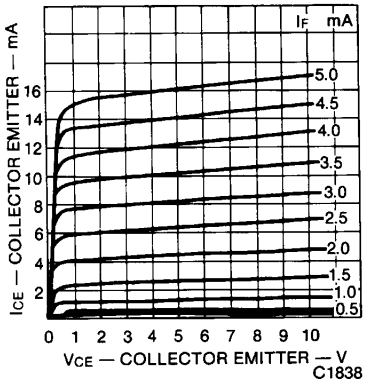


Fig. 4. DC Characteristics MCT5210

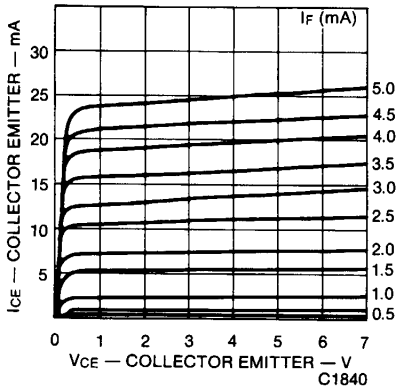


Fig. 5. DC Characteristics MCT5211

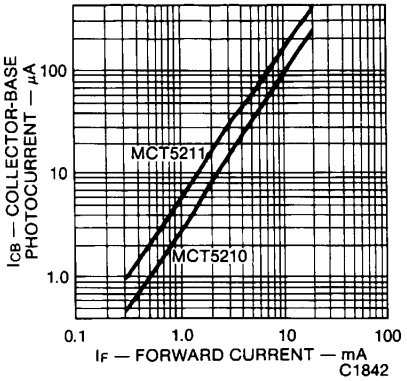


Fig. 6. Collector Base Photocurrent vs. Forward Current

TYPICAL ELECTRO-OPTICAL CHARACTERISTICS

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

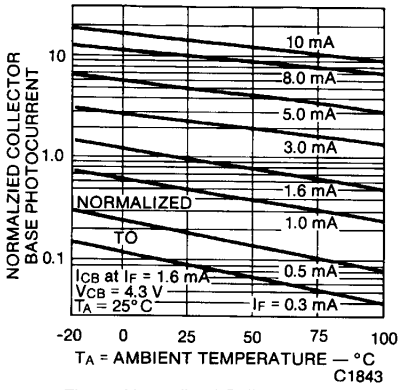


Fig. 7. Normalized Collector Base Photocurrent vs. Temperature

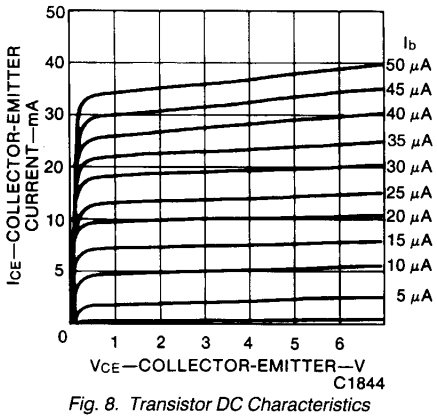


Fig. 8. Transistor DC Characteristics

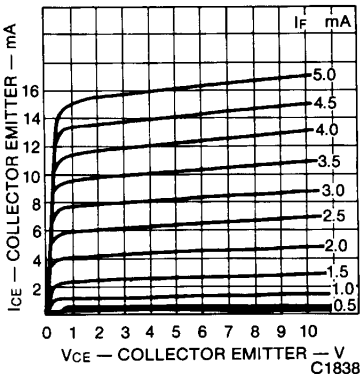


Fig. 9. $h_{FE(SAT)}$ vs. I_b vs. Temperature

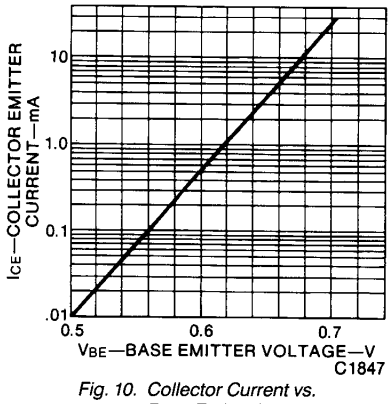


Fig. 10. Collector Current vs. Base Emitter Voltage

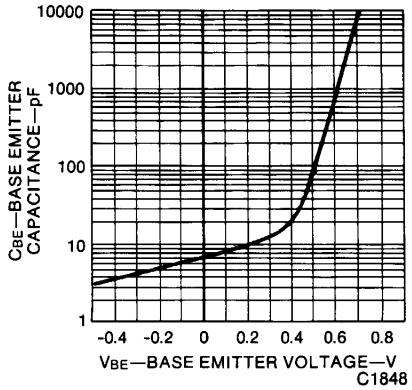


Fig. 11. C_{BE} vs. V_{BE}

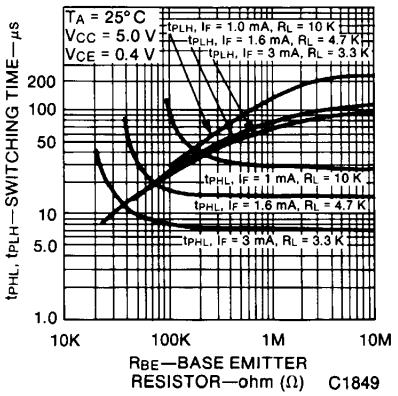
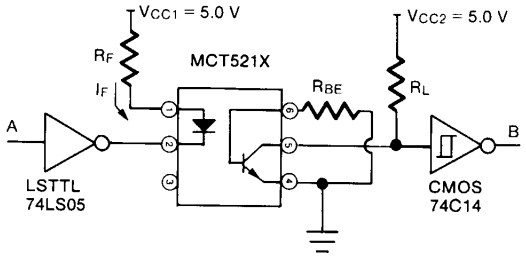
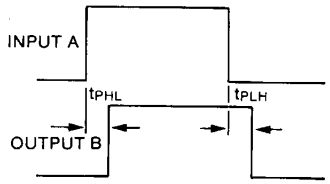


Fig. 12. Switching Time vs. R_{BE}

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



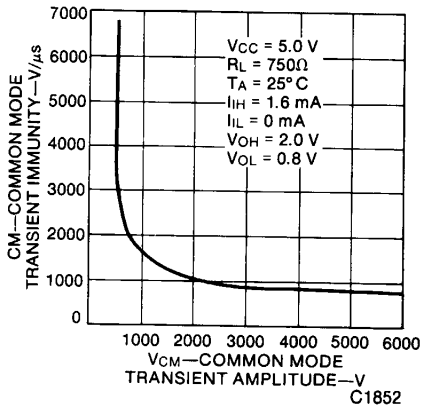


TYPICAL SWITCHING TIME T_A = 25° C

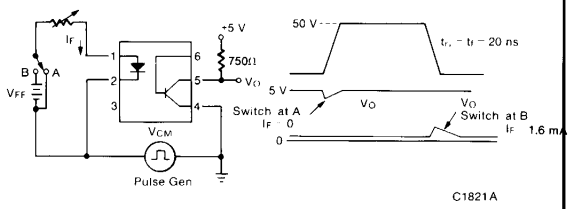
IF mA	RF KΩ	RL KΩ	RBE KΩ	tPHL µs	tPLH µs	Data K bit/s
1.0	3.3	1.5	∞	40	40	12.5
1.0	3.3	10	160	45	45	11
1.6	2.0	750	∞	20	20	25
1.6	2.0	4.7	91	25	25	20
3.0	1.1	.33	∞	10	10	50
3.0	1.1	3.3	39	12	12	42

C1850

Fig. 13. Switching Speed Test Circuit



C1852



C1821A

Fig. 14. Common Mode Transient Rejection & Test Circuit