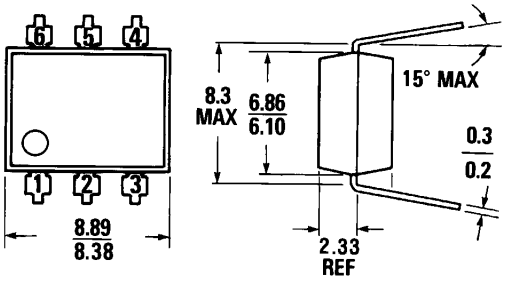
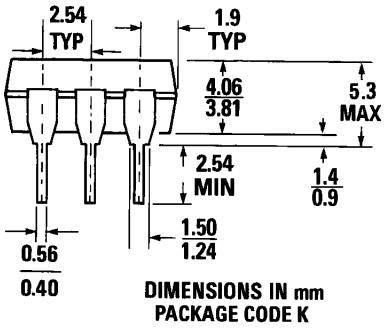
FAIRCHILD
SEMICONDUCTOR™

PHOTOTRANSISTOR OPTOCOUPLER

MCT2E

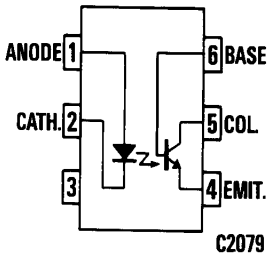
PACKAGE DIMENSIONS





DIMENSIONS IN mm
PACKAGE CODE K

ST1603A



Equivalent Circuit

DESCRIPTION

The MCT2E is a NPN silicon planar phototransistor optically coupled to a gallium arsenide infrared emitting diode.

FEATURES & APPLICATIONS

- Utility/economy isolator
- AC line/digital logic isolator
- Digital logic/digital logic isolator
- Telephone/telegraph line receiver
- Twisted pair line receiver
- High frequency power supply feedback control
- Relay contact monitor
- Power supply monitor
- UL recognized — File E90700

ABSOLUTE MAXIMUM RATINGS

Storage temperature . . . . . −55°C to 150°C
Operating temperature . . . . . −55°C to 100°C
Lead soldering temperature (10 sec) . . . . . 260°C

INPUT DIODE

Forward current . . . . . 60 mA
Reverse voltage . . . . . 3.0 V
Peak forward current
(1 μs pulse, 300 pps) . . . . . 3.0 A
Power dissipation at 25°C ambient . . . . . 200 mW
Derate linearly from 25°C . . . . . 2.6 mW/°C

OUTPUT TRANSISTOR

Power dissipation at 25°C ambient . . . . . 200 mW
Derate linearly from 25°C . . . . . 2.6 mW/°C
Total package power dissipation at 25°C ambient
(LED plus detector) . . . . . 250 mW
Derate linearly from 25°C . . . . . 3.3 mW/°C
Collector-Emitter Current (I_{CE}) . . . . . 50 mA

ELECTRO-OPTICAL CHARACTERISTICS
(25°C Free Air Temperature Unless Otherwise Specified)

INDIVIDUAL COMPONENT CHARACTERISTICS

CHARACTERISTIC	SYMBOL	MIN.	TYP.	MAX.	UNITS	TEST CONDITIONS
INPUT DIODE						
Forward voltage	V_F		1.25	1.50	V	I_F=20 mA
Reverse voltage	V_R	3.0	25		V	I_R=10 μA
Junction capacitance	C_J		50		pF	V_F=0 V, F=1 MHz
Reverse leakage current	I_R		.01	10	μA	V_R=3.0V
OUTPUT TRANSISTOR						
DC forward current gain	h_{FE}	100	250			V_{CE}=5 V, I_C=100 μA
Collector to emitter breakdown volt.	BV_{CEO}	30	85		V	I_C=1.0 mA, I_F=0
Collector to base breakdown voltage	BV_{CBO}	70	165		V	I_C=10 μA, I_F=0
Emitter to collector breakdown voltage	BV_{ECO}	7	14		V	I_E=100 μA, I_F=0
Collector to emitter, leakage current	I_{CEO}		5	50	nA	V_{CE}=10 V, I_F=0
Collector to base leakage current	I_{CBO}		0.1	20	nA	V_{CB}=10 V, I_F=0
Capacitance collector to emitter	C_{CEO}		8		pF	V_{CE}=0
Capacitance collector to base	C_{CBO}		20		pF	V_{CB}=10 V
Capacitance emitter to base	C_{EBO}		10		pF	V_{BE}=0

TRANSFER CHARACTERISTICS

DC CHARACTERISTICS	SYMBOL	MIN.	TYP.	MAX.	UNITS	TEST CONDITIONS
DC collector current transfer ratio	CTR_{CE}	20	60		%	V_{CE}=10 V, I_F=10 mA, Note 1
DC base current transfer ratio	CTR_{CB}		.35		%	V_{CB}=10 V, I_F=10 mA
Collector-emitter, saturation voltage	V_{CE} (sat)		0.24	0.4	V	I_C=2.0 mA, I_F=16 mA

TRANSFER CHARACTERISTICS

CHARACTERISTICS		SYMBOL	MIN.	TYP.	MAX.	UNITS	TEST CONDITIONS
SWITCHING TIMES							
Non-saturated collector	Delay time	t_d		0.5		μs	R_L=100 Ω, I_C=2 mA, V_{CC}=10 V
	Rise time	t_r		2.5		μs	Fig. 10
	Storage time	t_s		0.1		μs	
	Fall time	t_f		2.6		μs	
Saturated collector	Delay time	t_d		2.0		μs	R_L=1 KΩ, I_C=2 mA, V_{CC}=10 V
	Rise time	t_r		15		μs	
	Storage time	t_s		0.1		μs	
	Fall time	t_f		15		μs	

ELECTRO-OPTICAL CHARACTERISTICS
(25°C Free Air Temperature Unless Otherwise Specified) (Cont'd)

TRANSFER CHARACTERISTICS (Cont'd)

		SYMBOL	TYP.	UNITS	TEST CONDITIONS
SWITCHING TIMES (Cont'd)					
Saturated					
t on (from 5 V to 0.8 V)		t_{on} (SAT)	5	μs	R_L=2 KΩ, I_F=15 mA, V_{CC}=5 V
t off (from SAT to 2.0 V)		t_{off} (SAT)	25		R_B=open
Saturated					
t on (from 5 V to 0.8 V)		t_{on} (SAT)	5	μs	R_L=2 KΩ, I_F=20 mA, V_{CC}=5 V
t off (from SAT to 2.0 V)		t_{off} (SAT)	18		R_B=100 KΩ
Non-saturated					
Base	Rise time	t_r	175	ns	R_L=1 KΩ, V_{CB}=10 V
	Fall time	t_f	175	ns	
Bandwidth (see note 2)		B_W	150	KHz	I_C=2 mA, V_{CE}=10 V, R_L=100Ω

ISOLATION CHARACTERISTICS

CHARACTERISTICS	SYMBOL	MIN.	TYP.	MAX.	UNITS	TEST CONDITIONS
Steady state isolation voltage	V_{iso}	7500			VAC-PEAK	I_{I-O} ≤ 1 μA, 1 minute
		5300			VAC-rms	I_{I-O} ≤ 1 μA, 1 minute
Isolation resistance		10^{11}	10^{12}		Ω	V_{I-O}=500 V
Isolation capacitance			.5		pF	F=1 MHz

TYPICAL ELECTRO-OPTICAL CHARACTERISTIC CURVES
(25°C Free Air Temperature Unless Otherwise Specified)

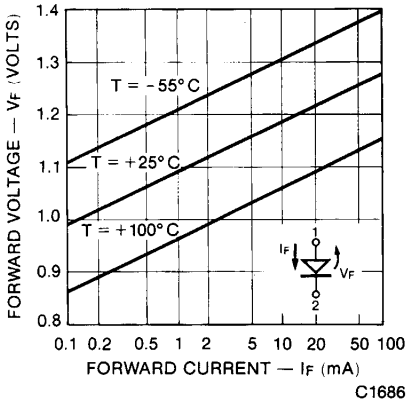


Fig. 1. Forward Voltage vs. Current

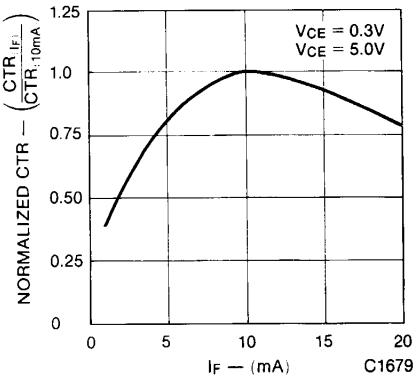


Fig. 2. Normalized CTR vs. Forward Current

TYPICAL ELECTRO-OPTICAL CHARACTERISTIC CURVES

(25°C Free Air Temperature Unless Otherwise Specified) (Cont'd)

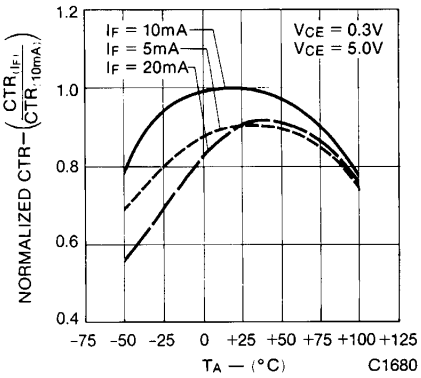


Fig. 3. Normalized CTR vs. Temperature

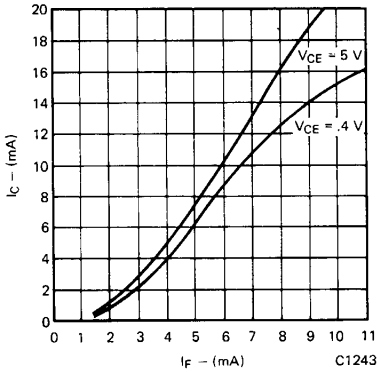


Fig. 4. Collector Current vs. Forward Current

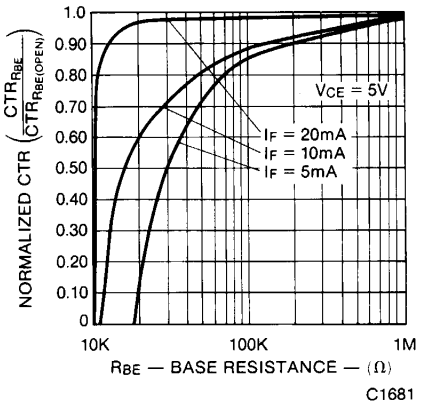


Fig. 5. CTR vs. RBE (Unsaturated)

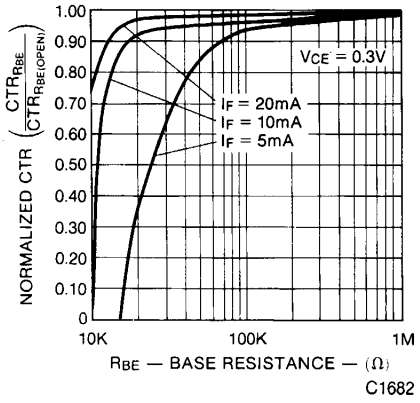


Fig. 6. CTR vs. RBE (Saturated)

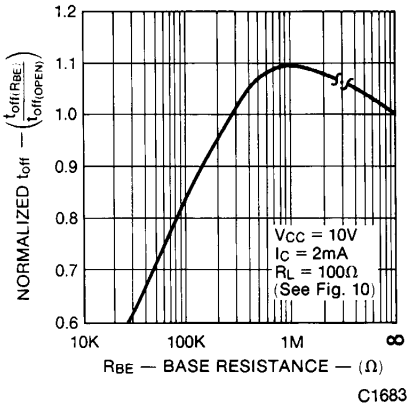


Fig. 7. Normalized T_{OFF} vs. RBE

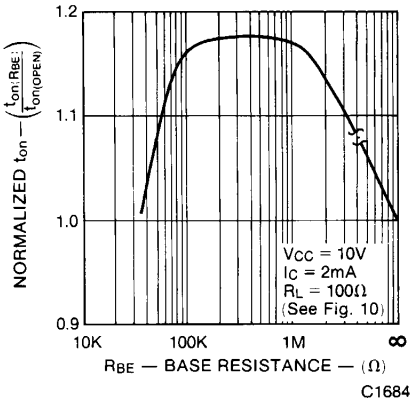


Fig. 8. Normalized T_{ON} vs. RBE

TYPICAL ELECTRO-OPTICAL CHARACTERISTIC CURVES

(25°C Free Air Temperature Unless Otherwise Specified) (Cont'd)

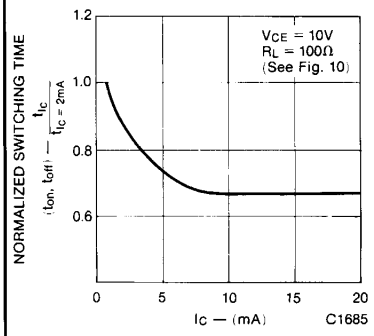


Fig. 9. Switching Time vs. IC

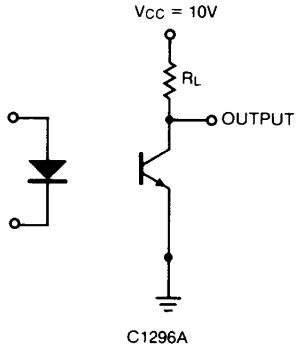


Fig. 10. Switching Time Test Circuit

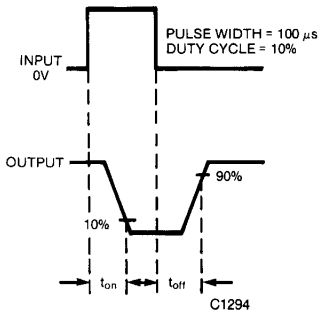
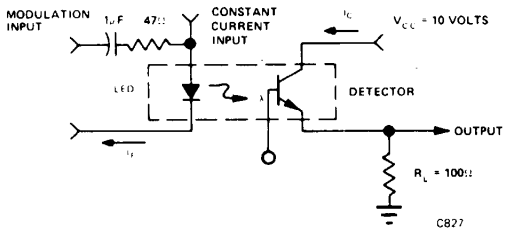


Fig. 11. Switching Time Waveforms

OPERATING SCHEMATICS



Modulation Circuit Used to Obtain Output vs. Frequency Plot

NOTES

1. *The current transfer ratio (I_C/I_F) is the ratio of the detector collector current to the LED input current with V_{CE} at 10 volts.*
2. *The frequency at which i_c is 3 dB down from the 1 kHz value.*
3. *Rise time (t_r) is the time required for the collector current to increase from 10% of its final value, to 90%.*
   Fall time (t_f) is the time required for the collector current to decrease from 90% of its initial value, to 10%.

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