FAIRCHILD SEMICONDUCTOR®

September 2006

CNY171, CNY172, CNY173, CNY174, CNY17F1, CNY17F2, CNY17F3, CNY17F4, MOC8101, MOC8102, MOC8103, MOC8104, MOC8105, MOC8106, MOC8107, MOC8108 Phototransistor Optocouplers

Features

- UL recognized (File # E90700)
- VDE recognized
  - Add option V for white package (e.g., CNY17F2VM)
  - File #102497
  - Add option '300' for black package (e.g., CNY17F2300)
  - File #94766
- Current transfer ratio in select groups
- High BV_{CEO}—70V minimum (CNY17X/M, CNY17FX/M, MOC8106/7/8)
- Closely matched current transfer ratio (CTR) minimizes unit-to-unit variation.
- Very low coupled capacitance along with no chip to pin 6 base connection for minimum noise susceptability (CNY17FX/M, MOC810X)

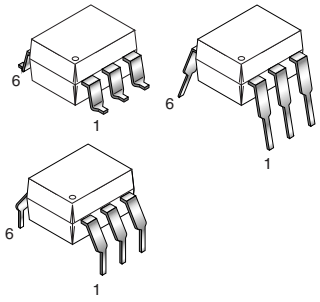
Applications

- Power supply regulators
- Digital logic inputs
- Microprocessor inputs
- Appliance sensor systems
- Industrial controls

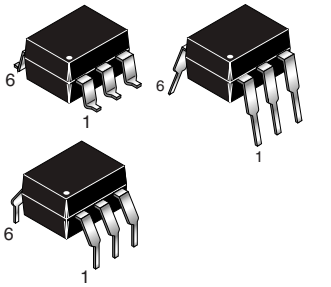
Description

The CNY17, CNY17F and MOC810X devices consist of a Gallium Arsenide IRED coupled with an NPN phototransistor in a dual in-line package.

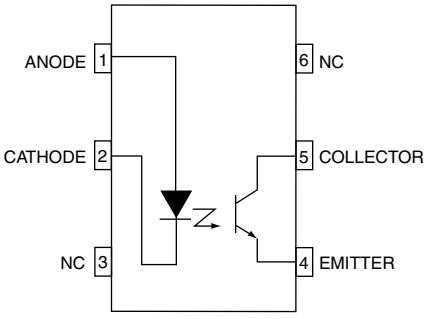
White Package (-M Suffix)



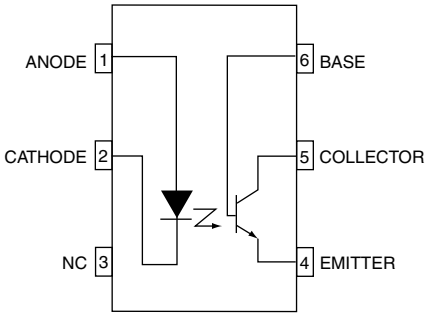
Black Package (No -M Suffix)



Schematic



CNY17F1/2/3/4
CNY17F1M/2M/3M/4M
MOC8101/2/3/4/5/6/7/8



CNY171/2/3/4
CNY171M/2M/3M/4M

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Absolute Maximum Ratings

Symbol	Parameters	Device	Value	Units
TOTAL DEVICE				
T_{STG}	Storage Temperature	M	-40 to +150	°C
		non M	-55 to +150	
T_{OPR}	Operating Temperature	M	-40 to +100	°C
		non M	-55 to +100	
T_{SOL}	Lead Solder Temperature	All	260 for 10 sec	°C
P_D	Total Device Power Dissipation @ 25°C (LED plus detector)	M	250	mW
		non M	250	
	Derate Linearly From 25°C	M	2.94	mW/°C
		non M	3.30	
EMITTER				
I_F	Continuous Forward Current	M	60	mA
		non M	100	
V_R	Reverse Voltage	All	6	V
I_F (pk)	Forward Current - Peak (1 µs pulse, 300 pps)	M	1.5	A
		non M	1.0	
P_D	LED Power Dissipation 25°C Ambient	M	120	mW
		non M	150	
	Derate Linearly From 25°C	M	1.41	mW/°C
		non M	1.8	
DETECTOR				
I_C	Continuous Collector Current	All	50	mA
V_{CEO}	Collector-Emitter Voltage	CNY17X/M, CNY17FX/M, MOC8106/7/8	70	V
		MOC8101/2/3/4/5	30	V
V_{ECO}	Emitter Collector Voltage	All	7	V
P_D	Detector Power Dissipation @ 25°C	M	150	mW
		non M	150	
	Derate Linearly from 25°C	M	1.76	mW/°C
		non M	2.0	

Electrical Characteristics (T_A = 25°C Unless otherwise specified.)[1]

Individual Component Characteristics

Symbol	Parameters	Test Conditions	Device	Min.	Typ.	Max.	Units
EMITTER							
V_F	Input Forward Voltage	I_F = 60mA	CNY17FX/M CNY17X/M	1.0	1.35	1.65	V
		I_F = 10mA	MOC810X	1.0	1.15	1.50	
C_J	Capacitance	V_F = 0 V, f = 1.0MHz	All		18		pF
I_R	Reverse Leakage Current	V_R = 6 V	All		0.001	10	µA
DETECTOR							
BV_{CEO}	Breakdown Voltage Collector to Emitter	I_C = 1.0mA, I_F = 0	MOC8101/2/3/4/5	30	100		V
			MOC8106/7/8 CNY17F1/2/3/4/M CNY171/2/3/4/M	70	100		
BV_{CBO}	Collector to Base	I_C = 10µA, I_F = 0	CNY171/2/3/4/M	70	120		
BV_{ECO}	Emitter to Collector	I_E = 100µA, I_F = 0	All	7	10		
I_{CEO}	Leakage Current Collector to Emitter	V_{CE} = 10 V, I_F = 0	All		1	50	nA
I_{CBO}	Collector to Base	V_{CB} = 10 V, I_F = 0	CNY171/2/3/4/M			20	nA
C_{CE}	Capacitance Collector to Emitter	V_{CE} = 0, f = 1MHz	All		8		pF
C_{CB}	Collector to Base	V_{CB} = 0, f = 1MHz	CNY171/2/3/4/M		20		pF
C_{EB}	Emitter to Base	V_{EB} = 0, f = 1MHz	CNY171/2/3/4/M		10		pF

Isolation Characteristics

Symbol	Characteristic	Test Conditions	Device	Min.	Typ.**	Max.	Units
V_{ISO}	Input-Output Isolation Voltage	f = 60 Hz, t = 1 min., $I_{I-O} \le 2\mu A$[4]	Black Package	5300			Vac(rms)*
		f = 60 Hz, t = 1 sec., $I_{I-O} \le 2\mu A$[4]	'M' White Package	7500			Vac(pk)
R_{ISO}	Isolation Resistance	V_{I-O} = 500 VDC[4]	All	10^{11}			Ω
C_{ISO}	Isolation Capacitance	V_{I-O} = Ø, f = 1MHz[4]	Black Package		0.5		pF
			'M' White Package		0.2		

Note:

* 5300 Vac(rms) for 1 minute equates to approximately 9000 Vac (pk) for 1 second

** Typical values at T_A = 25°C

Transfer Characteristics (T_A = 25°C Unless otherwise specified.)(1)

Symbol	DC Characteristics		Test Conditions	Min.	Typ.	Max.	Units
COUPLED							
(CTR)(2)	Output Collector Current	MOC8101	I_F = 10mA, V_{CE} = 10V	50		80	%
		MOC8102		73		117	
		MOC8103		108		173	
		MOC8104		160		256	
		MOC8105		65		133	
		MOC8106		50		150	
		MOC8107		100		300	
		MOC8108		250		600	
		CNY17F1/1M	I_F = 10mA, V_{CE} = 5V	40		80	
		CNY17F2/2M		63		125	
		CNY17F3/3M		100		200	
		CNY17F4/4M		160		320	
		CNY171/1M		40		80	
		CNY172/2M		63		125	
		CNY173/3M		100		200	
		CNY174/4M		160		320	
$V_{CE(sat)}$	Collector-Emitter Saturation Voltage	CNY17XM/FXM	I_C = 2.5mA, I_F = 10mA			0.4	V
		MOC8101/2/3/4/5/6/7/8	I_C = 500µA, I_F = 5.0mA				
		CNY17X/FX	I_F = 10mA, I_C = 2.5mA			0.3	V

Symbol	AC Characteristics(3)		Test Conditions	Min.	Typ.*	Max.	Units
NON-SATURATED SWITCHING TIME							
t_{on}	Turn-On Time	MOC8101/2/3/4/5	I_C = 2.0mA, V_{CC} = 10V, R_L = 100Ω		2	20	µs
		MOC8106/7/8					
		CNY17X/FX				10	
t_{off}	Turn-Off Time	MOC8101/2/3/4/5	I_C = 2.0mA, V_{CC} = 10V, R_L = 100Ω		3	20	
		MOC8106/7/8					
		CNY17X/FX				10	
t_d	Delay Time	CNY17XM/FXM	I_F = 10mA, V_{CC} = 5V, R_L = 75Ω			5.6	µs
t_r	Rise Time	All Devices	I_C = 2.0mA, V_{CC} = 10V, R_L = 100Ω		1		µs
		CNY17XM/FXM	I_F = 10mA, V_{CC} = 5V, R_L = 75Ω			4.0	
t_s	Storage Time	CNY17XM/FXM	I_F = 10mA, V_{CC} = 5V, R_L = 75Ω			4.1	µs
t_f	Fall Time	All Devices	I_C = 2.0mA, V_{CC} = 10V, R_L = 100Ω		2		µs
		CNY17XM/FXM	I_F = 10mA, V_{CC} = 5V, R_L = 75Ω			3.5	

Transfer Characteristics (Continued) (T_A = 25°C Unless otherwise specified.)[1]

Symbol	AC Characteristics[3]		Test Conditions	Min.	Typ.	Max.	Units
SATURATED SWITCHING TIMES							
t_{on}	Turn-on Time	CNY171/F1	I_F = 20mA, V_{CE} = 0.4V			5.5	µs
		CNY172/F2 CNY173/F3 CNY174/F4	I_F = 10mA, V_{CE} = 0.4V			8.0	
t_r	Rise Time	CNY171/F1	I_F = 20mA, V_{CE} = 0.4V			4.0	µs
		CNY172/F1 CNY173/F3 CNY174/F4	I_F = 10mA, V_{CE} = 0.4V			6.0	
		CNY171M/F1M	I_F = 20mA, V_{CC} = 5V, R_L = 1kΩ			4.0	
		CNY172M/3M/4M CNY17F2M/F3M/F4M	I_F = 10mA, V_{CC} = 5V, R_L = 1kΩ			6.0	
t_d	Delay Time	CNY171M/F1M	I_F = 20mA, V_{CC} = 5V, R_L = 1kΩ			5.5	µs
		CNY172M/3M/4M CNY17F2M/F3M/F4M	I_F = 10mA, V_{CC} = 5V, R_L = 1kΩ			8.0	
t_{off}	Turn-off Time	CNY171/F1	I_F = 20mA, V_{CE} = 0.4V			34	µs
		CNY172/F2 CNY173/F3 CNY174/F4	I_F = 10mA, V_{CE} = 0.4V			39	
t_f	Fall Time	CNY171/F1	I_F = 20mA, V_{CE} = 0.4V			20	µs
		CNY172/F2 CNY173/F3 CNY174/F4	I_F = 10mA, V_{CE} = 0.4V			24	
		CNY171M/F1M	I_F = 20mA, V_{CC} = 5V, R_L = 1kΩ			20.0	µs
		CNY172M/3M/4M CNY17F2M/F3M/F4M	I_F = 10mA, V_{CC} = 5V, R_L = 1kΩ			24.0	
t_s	Storage Time	CNY171M/F1M	I_F = 20mA, V_{CC} = 5V, R_L = 1kΩ			34.0	µs
		CNY172M/3M/4M CNY17F2M/F3M/F4M	I_F = 10mA, V_{CC} = 5V, R_L = 1kΩ			39.0	

** All typicals at T_A = 25°C

Notes:

1. Always design to the specified minimum/maximum electrical limits (where applicable).
2. Current Transfer Ratio (CTR) = I_C/I_F x 100%.
3. For test circuit setup and waveforms, refer to Figures 20.
4, For this test, Pins 1 and 2 are common, and Pins 4 are 5 are common.

Fig.1 Normalized CTR vs. Forward Current (Black Package)

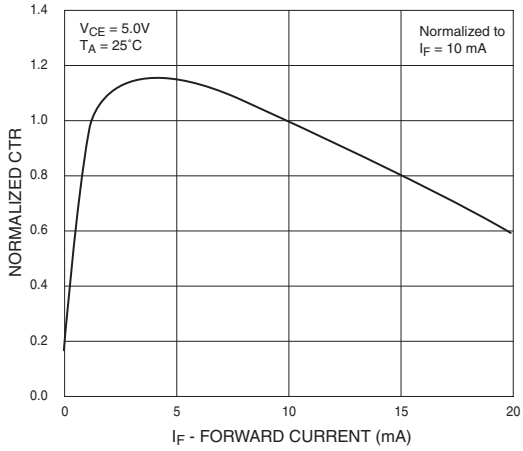


Fig.2 Normalized CTR vs. Forward Current (White Package)

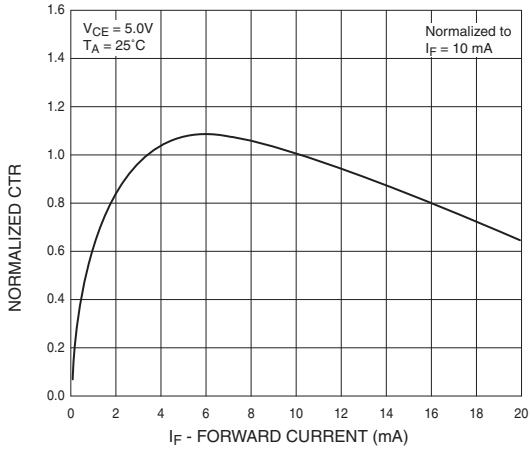


Fig. 3 Normalized CTR vs. Ambient Temperature (Black Package)

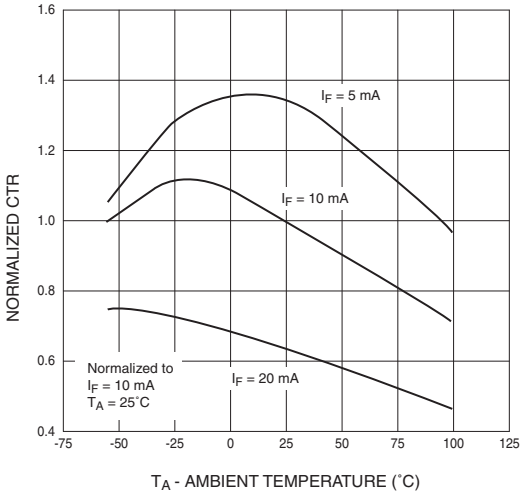


Fig. 4 Normalized CTR vs. Ambient Temperature (White Package)

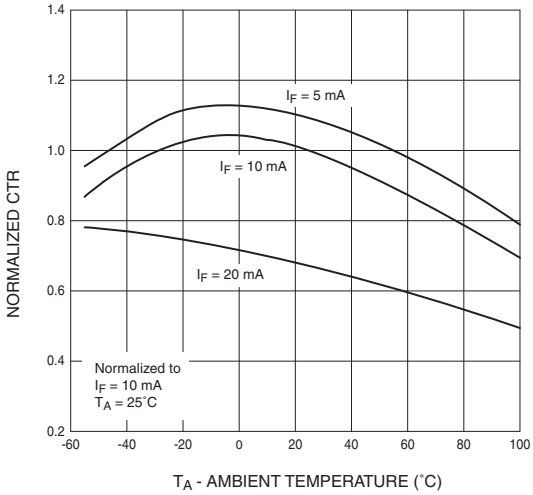


Fig. 5 CTR vs. RBE (Unsaturated) (Black Package)

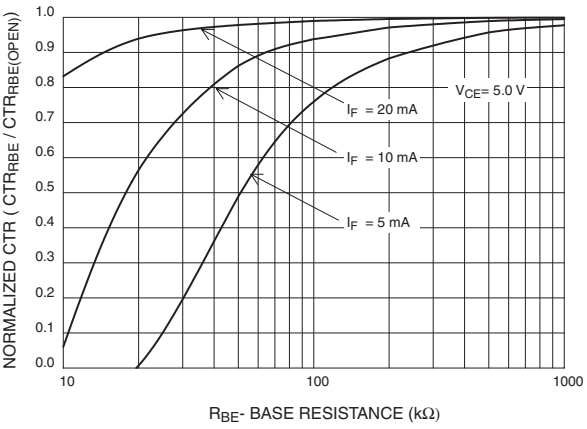


Fig. 6 CTR vs. RBE (Unsaturated) (White Package)

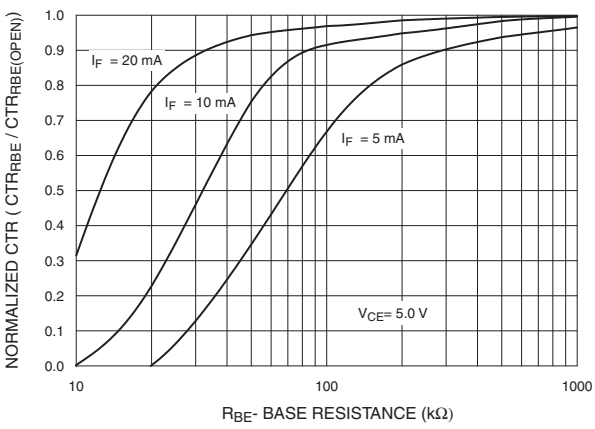


Fig. 7 CTR vs. RBE (Saturated)
(Black Package)

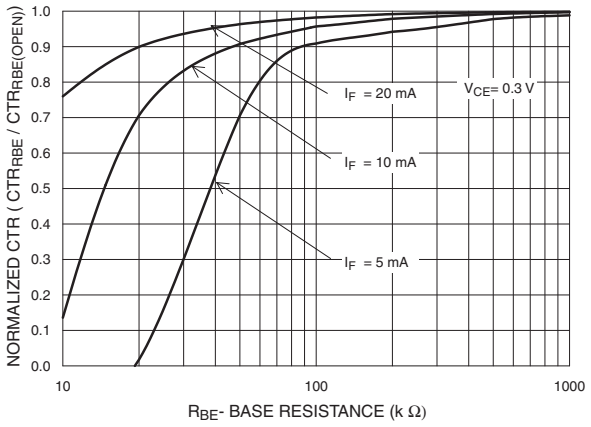


Fig. 8 CTR vs. RBE (Saturated)
(White Package)

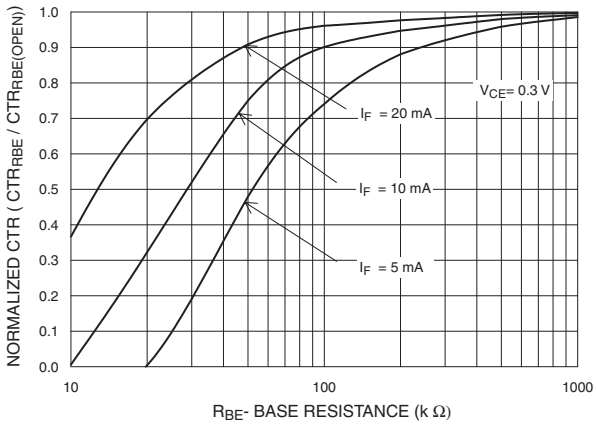


Fig. 9 Switching Speed vs. Load Resistor
(Black Package)

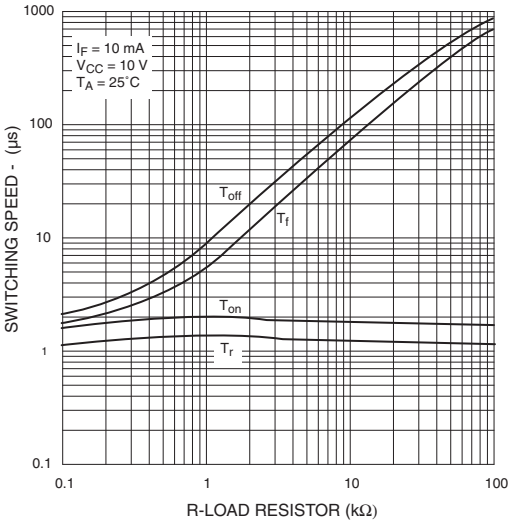


Fig. 10 Switching Speed vs. Load Resistor
(White Package)

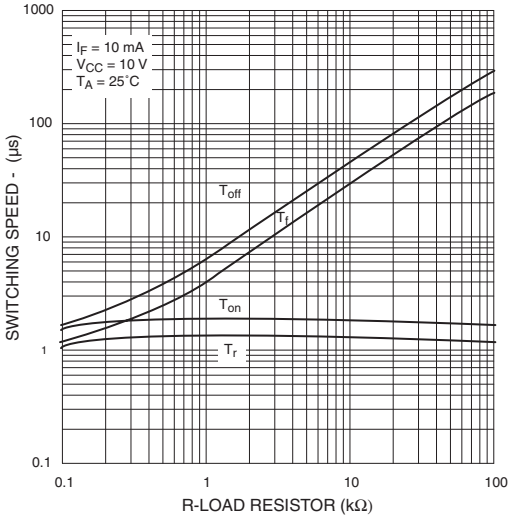


Fig. 11 Normalized t_{on} vs. R_{BE}
(Black Package)

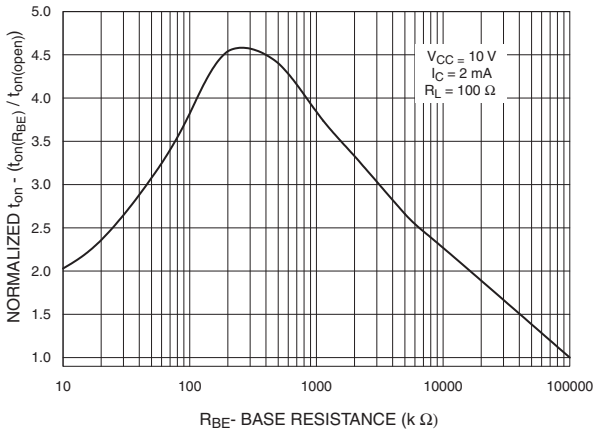


Fig. 12 Normalized t_{on} vs. R_{BE}
(White Package)

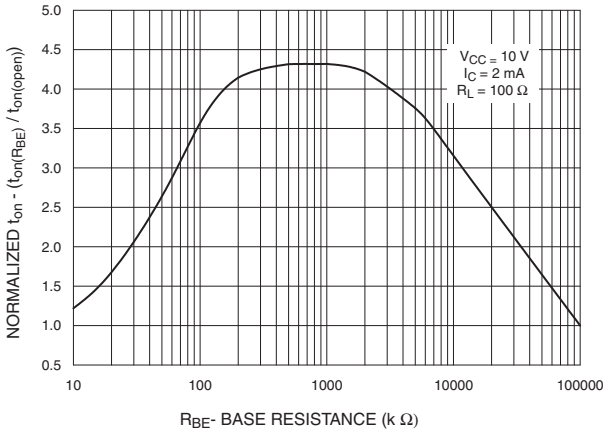


Fig. 13 Normalized t_{off} vs. R_{BE} (Black Package)

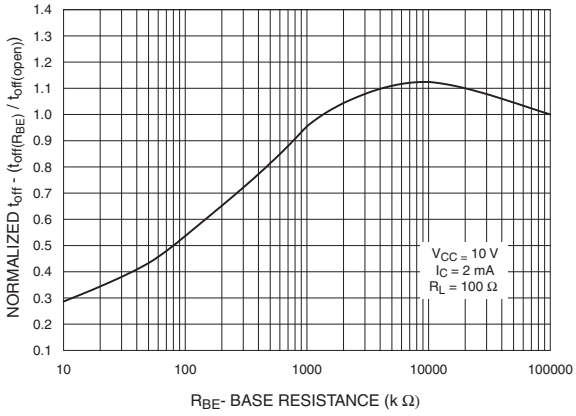


Fig. 14 Normalized t_{off} vs. R_{BE} (White Package)

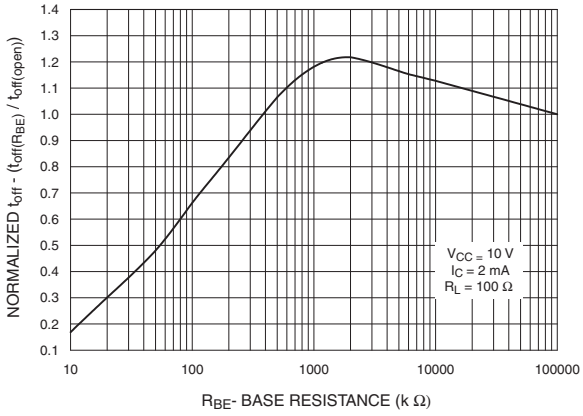


Fig. 15 LED Forward Voltage vs. Forward Current (Black Package)

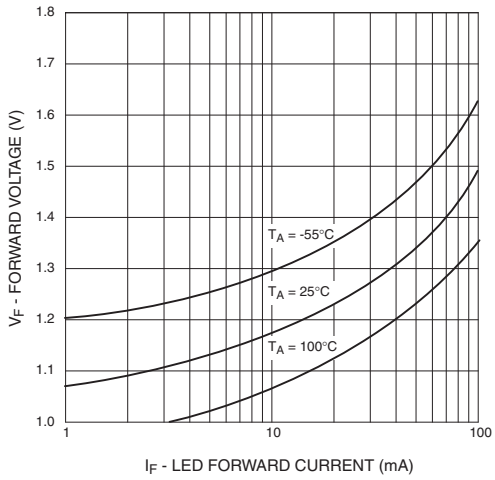


Fig. 16 LED Forward Voltage vs. Forward Current (White Package)

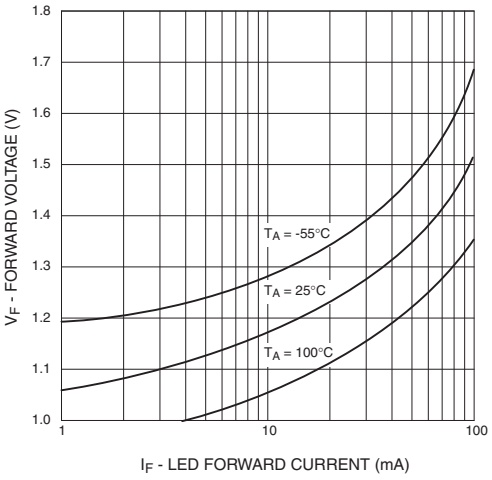


Fig. 17 Collector-Emitter Saturation Voltage vs Collector Current (Black Package)

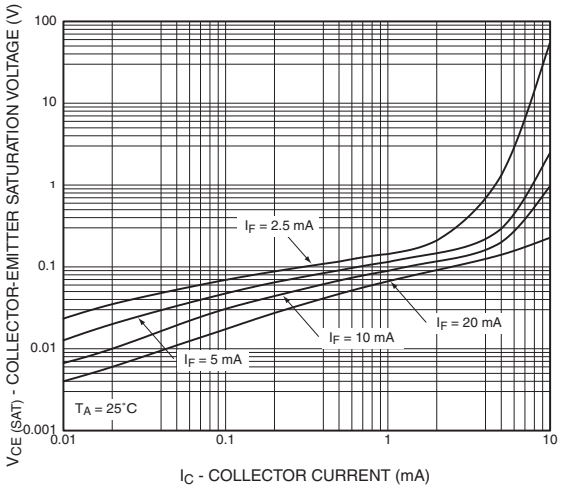


Fig. 18 Collector-Emitter Saturation Voltage vs Collector Current (White Package)

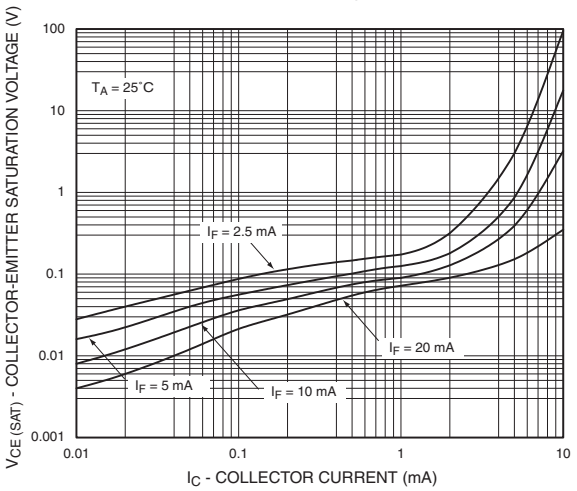
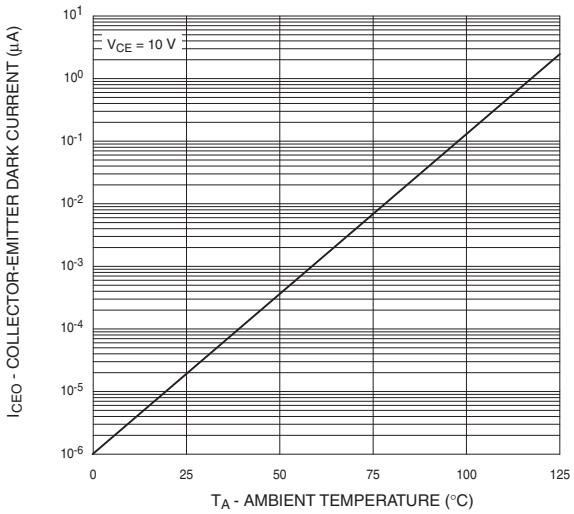


Fig. 19 Dark Current vs. Ambient Temperature (Black Package)



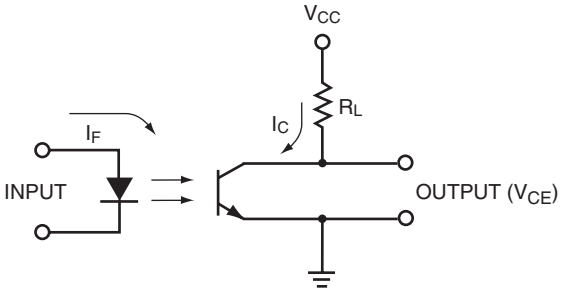


Figure 20. Switching Time Test Circuit

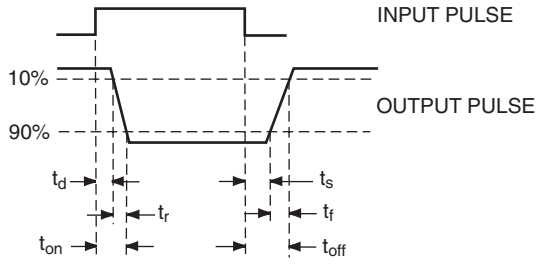
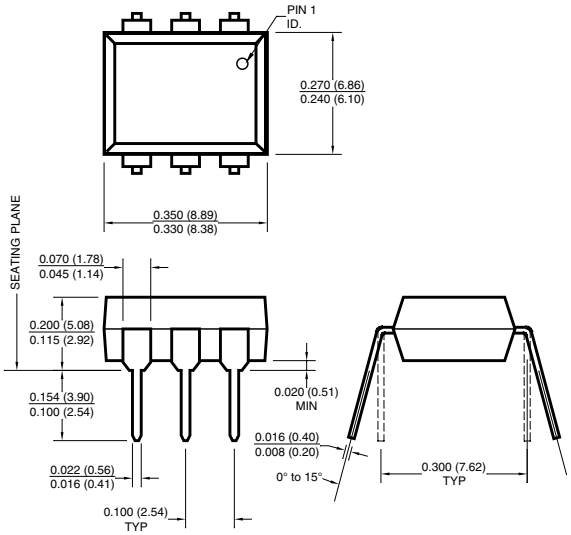


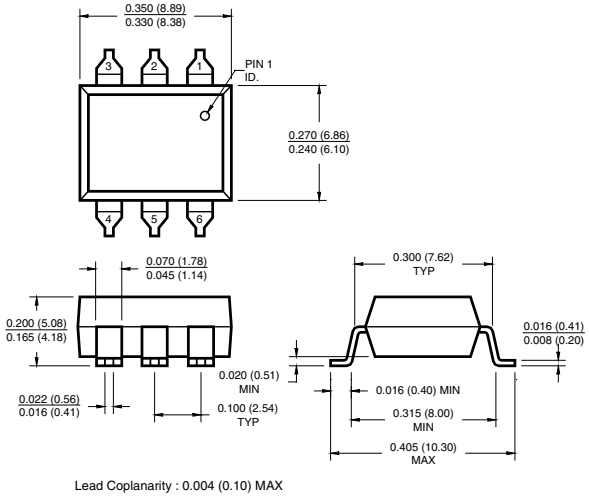
Figure 21. Switching Time Test Circuit

Black Package (No -M Suffix)

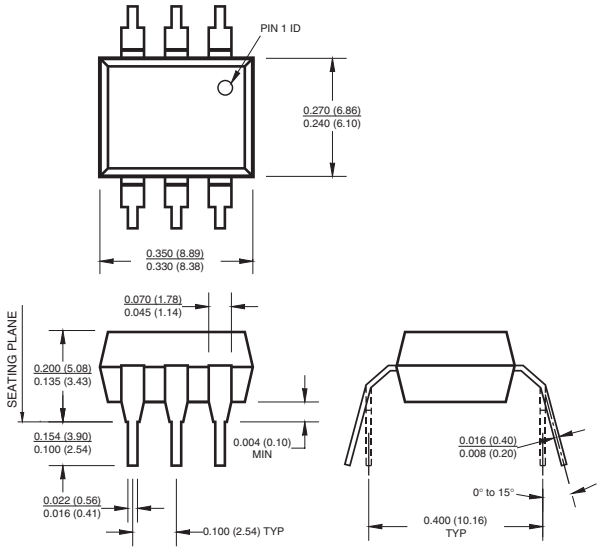
Package Dimensions (Through Hole)



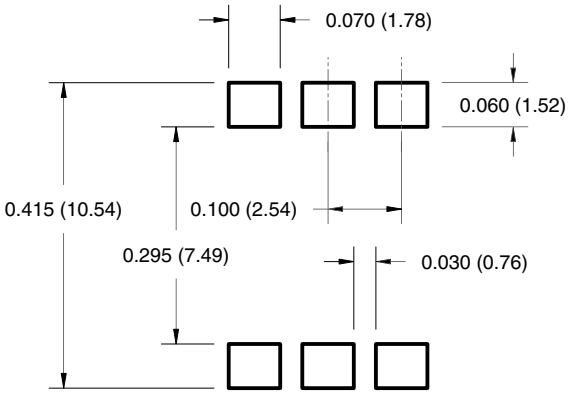
Package Dimensions (Surface Mount)



Package Dimensions (0.4" Lead Spacing)



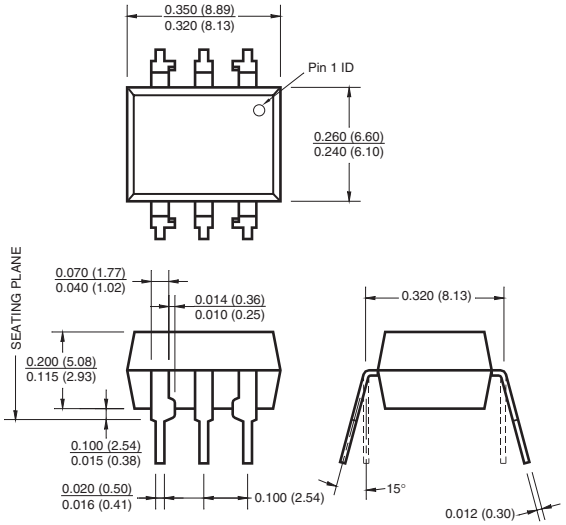
Recommended Pad Layout for Surface Mount Leadform (Black Package Only)



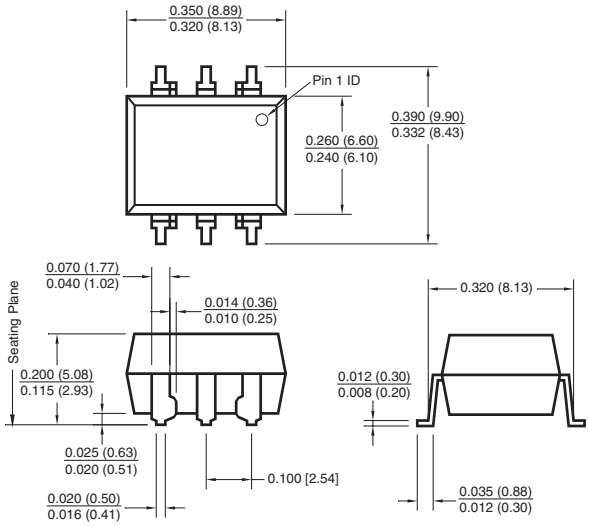
Note:
All dimensions are in inches (millimeters)

White Package (-M Suffix)

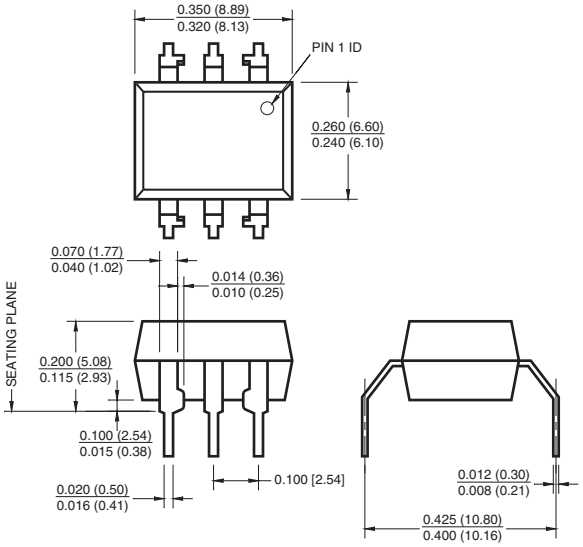
Package Dimensions (Through Hole)



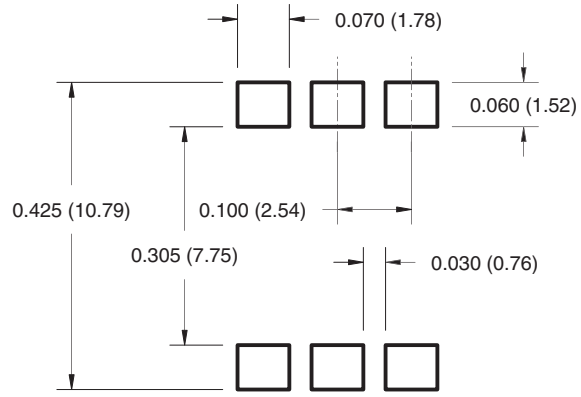
Package Dimensions (Surface Mount)



Package Dimensions (0.4” Lead Spacing)



Recommended Pad Layout for Surface Mount Leadform (White Package Only)

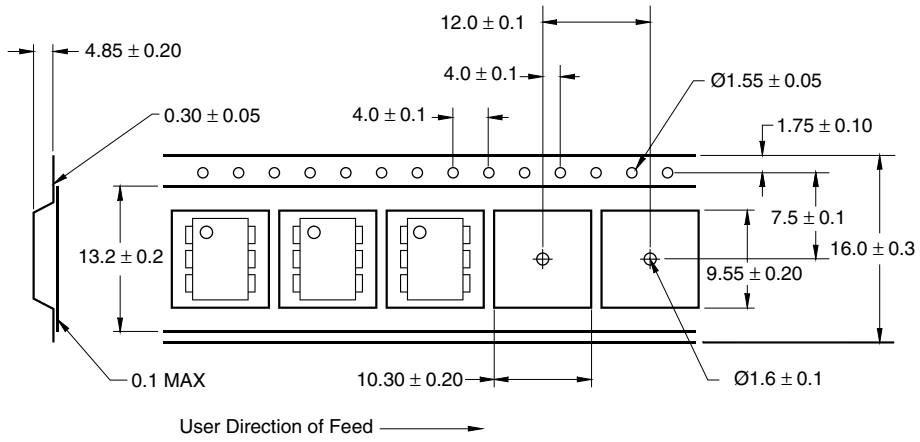


Note:
All dimensions are in inches (millimeters)

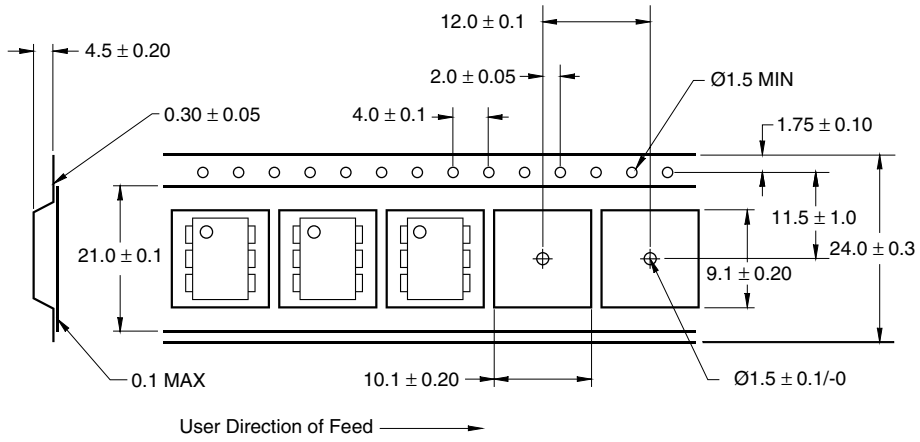
Ordering Information

Black Package Part Number Example (No Suffix)	White Package Part Number Example (M Suffix)	Description
CNY171S	CNY171SM	Surface Mount Lead Bend
CNY171SD	CNY171SR2M	Surface Mount; Tape and reel
CNY171W	CNY171TM	0.4" Lead Spacing
CNY171300	CNY171VM	VDE Approved
CNY171300W	CNY171TVM	VDE Approved, 0.4" Lead Spacing
CNY1713S	CNY171SVM	VDE Approved, Surface Mount
CNY1713SD	CNY171SR2VM	VDE Approved, Surface Mount, Tape & Reel

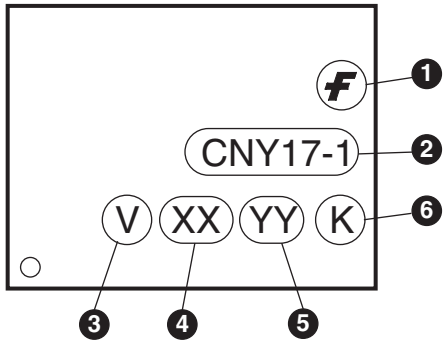
Carrier Tape Specifications (Black Package, No Suffix)



Carrier Tape Specifications (White Package, M Suffix)

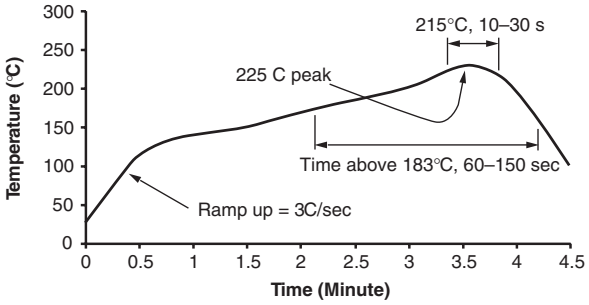


Marking Information (Black package non 'M' suffix)



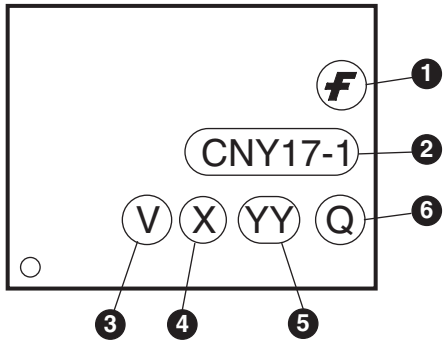
Definitions	
1	Fairchild logo
2	Device number
3	VDE mark (Note: Only appears on parts ordered with VDE option – See order entry table)
4	Two digits year code, e.g., '03'; One digit year code for 'M' version, e.g. '5'
5	Two digit work week ranging from '01' to '53'
6	Assembly package code

Reflow Profile (Black Package, No Suffix)



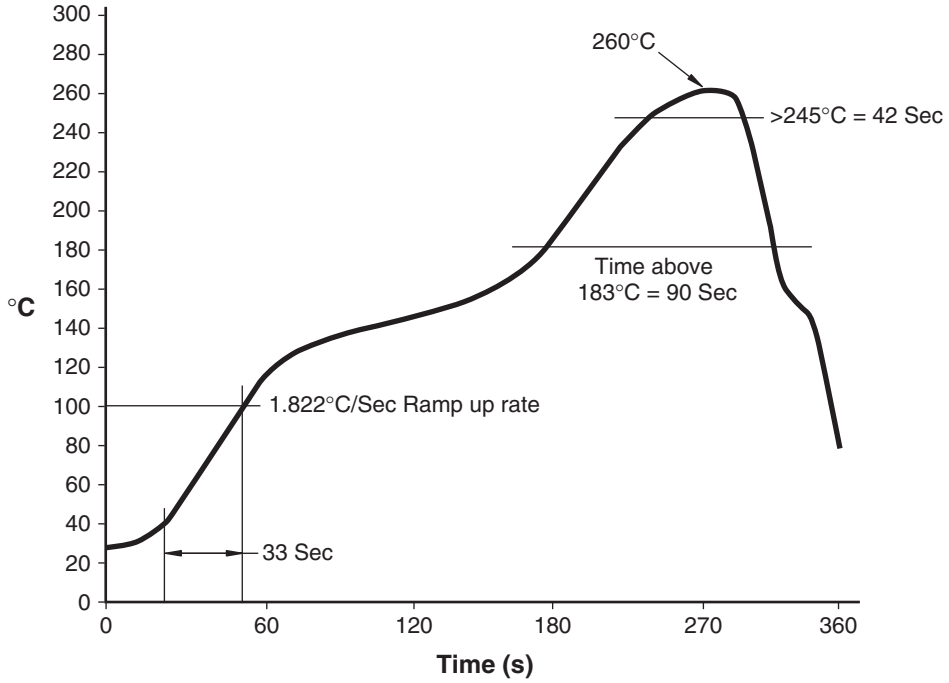
- Peak reflow temperature: 225°C (package surface temperature)
- Time of temperature higher than 183°C for 60–150 seconds
- One time soldering reflow is recommended

Marking Information (White package M suffix)



Definitions	
1	Fairchild logo
2	Device number
3	VDE mark (Note: Only appears on parts ordered with VDE option – See order entry table)
4	Single digit year code, e.g. '5'
5	Two digit work week ranging from '01' to '53'
6	Assembly package code

Reflow Profile (White Package, M Suffix)



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CoolFET™	I^2C™	PACMAN™	SuperFET™	
CROSSVOLT™	*i-Lo*™	POP™	SuperSOT™-3	
DOME™	ImpliedDisconnect™	Power247™	SuperSOT™-6	
EcoSPARK™	IntelliMAX™	PowerEdge™	SuperSOT™-8	
E^2CMOS™	ISOPLANAR™	PowerSaver™	SyncFET™	
EnSigna™	LittleFET™	PowerTrench®	TCM™	
FACT™	MICROCOUPLER™	QFET®	TinyBoost™	
FAST®	MicroFET™	QS™	TinyBuck™	
FASTr™	MicroPak™	QT Optoelectronics™	TinyPWM™	
FPS™	MICROWIRE™	Quiet Series™	TinyPower™	
FRFET™	MSX™	RapidConfigure™	TinyLogic®	
	MSXPro™	RapidConnect™	TINYOPTO™	
Across the board. Around the world.™		µSerDes™	TruTranslation™	
The Power Franchise®		ScalarPump™	UHC™	
Programmable Active Droop™				

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2. A critical component is any component of a life support device or system whose failure to perform can be reasonably expected to cause the failure of the life support device or system, or to affect its safety or effectiveness.

PRODUCT STATUS DEFINITIONS

Definition of Terms

Datasheet Identification	Product Status	Definition
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Preliminary	First Production	This datasheet contains preliminary data, and supplementary data will be published at a later date. Fairchild Semiconductor reserves the right to make changes at any time without notice to improve design.
No Identification Needed	Full Production	This datasheet contains final specifications. Fairchild Semiconductor reserves the right to make changes at any time without notice to improve design.
Obsolete	Not In Production	This datasheet contains specifications on a product that has been discontinued by Fairchild semiconductor. The datasheet is printed for reference information only.

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