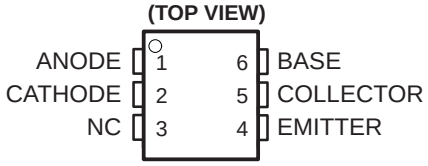
SOES021C – NOVEMBER 1981 – REVISED APRIL 1998

COMPATIBLE WITH STANDARD TTL INTEGRATED CIRCUITS

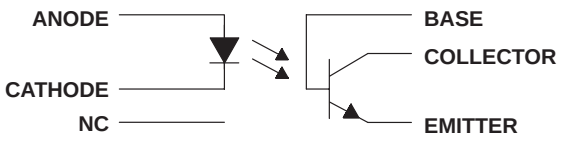
- **Gallium-Arsenide-Diode Infrared Source Optically Coupled to a Silicon npn Phototransistor**
- **High Direct-Current Transfer Ratio**
- **High-Voltage Electrical Isolation**
  1.5-kV, 2.5-kV, or 3.55-kV Rating
- **High-Speed Switching**
  t_r = 7 μs, t_f = 7 μs Typical
- **Typical Applications Include Remote Terminal Isolation, SCR and Triac Triggers, Mechanical Relays and Pulse Transformers**
- **Safety Regulatory Approval**
  UL/CUL, File No. E65085

DCJ† OR 6-TERMINAL DUAL-IN-LINE PACKAGE
(TOP VIEW)



†4N35 only
NC – No internal connection

schematic



absolute maximum ratings at 25°C free-air temperature (unless otherwise noted)†

Input-to-output peak voltage (8-ms half sine wave):	4N35	3.55 kV
	4N36	2.5 kV
	4N37	1.5 kV
Input-to-output root-mean-square voltage (8-ms half sine wave):	4N35	2.5 kV
	4N36	1.75 kV
	4N37	1.05 kV
Collector-base voltage		70 V
Collector-emitter voltage (see Note 1)		30 V
Emitter-base voltage		7 V
Input-diode reverse voltage		6 V
Input-diode forward current: Continuous		60 mA
Peak (1 μs, 300 pps)		3 A
Phototransistor continuous collector current		100 mA
Continuous total power dissipation at (or below) 25°C free-air temperature:		
Infrared-emitting diode (see Note 2)		100 mW
Phototransistor (see Note 3)		300 mW
Continuous power dissipation at (or below) 25°C lead temperature:		
Infrared-emitting diode (see Note 4)		100 mW
Phototransistor (see Note 5)		500 mW
Operating temperature range, T_A		–55°C to 100°C
Storage temperature range, T_{stg}		–55°C to 150°C
Lead temperature 1,6 mm (1/16 inch) from case for 10 seconds		260°C

† Stresses beyond those listed under "absolute maximum ratings" may cause permanent damage to the device. These are stress ratings only, and functional operation of the device at these conditions is not implied. Exposure to absolute-maximum-rated conditions for extended periods may affect device reliability.

NOTES: 1. This value applies when the base-emitter diode is open-circulated.
2. Derate linearly to 100°C free-air temperature at the rate of 1.33 mW/°C.
3. Derate linearly to 100°C free-air temperature at the rate of 4 mW/°C.
4. Derate linearly to 100°C lead temperature at the rate of 1.33 mW/°C. Lead temperature is measured on the collector lead 0.8 mm (1/32 inch) from the case.
5. Derate linearly to 100°C lead temperature at the rate of 6.7 mW/°C.

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electrical characteristics at 25°C free-air temperature (unless otherwise noted)

PARAMETER		TEST CONDITIONS			MIN	TYP	MAX	UNIT
$V_{(BR)CBO}$	Collector-base breakdown voltage	I_C = 100 µA,	I_E = 0,	I_F = 0	70†			V
$V_{(BR)CEO}$	Collector-emitter breakdown voltage	I_C = 10 mA,	I_B = 0,	I_F = 0	30†			V
$V_{(BR)EBO}$	Emitter-base breakdown voltage	I_E = 100 µA,	I_C = 0,	I_F = 0	7†			V
I_R	Input diode static reverse current	V_R = 6 V					10†	µA
I_{IO}	Input-to-output current	V_{IO} = rated peak value,		t = 8 ms			100	mA
$I_{C(on)}$	On-state collector current	V_{CE} = 10 V,	I_F = 10 mA,	I_B = 0	10†			mA
		V_{CE} = 10 V, T_A = –55°C	I_F = 10 mA,	I_B = 0,	4†			
		V_{CE} = 10 V, T_A = 100°C	I_F = 10 mA,	I_B = 0,	4†			
$I_{C(off)}$	Off-state collector current	V_{CE} = 10 V,	I_F = 0	I_B = 0		1	50	nA
		V_{CE} = 30 V, T_A = 100°C	I_F = 0,	I_B = 0,			500†	µA
h_{FE}	Transistor static forward current transfer ratio	V_{CE} = 5 V,	I_C = 10 mA,	I_F = 0		500		
V_F	Input diode static forward voltage	I_F = 10 mA			0.8†		1.5†	V
		I_F = 10 mA,	T_A = –55°C		0.9†		1.7†	
		I_F = 10 mA,	T_A = 100°C		0.7†		1.4†	
$V_{CE(sat)}$	Collector-emitter saturation voltage	I_C = 0.5 mA,	I_F = 10 mA,	I_B = 0 mA			0.3†	V
r_{IO}	Input-to-output internal resistance	V_{IO} = 500 V,	See Note 6		10^{11}†			Ω
C_{io}	Input-to-output capacitance	V_{IO} = 0,	f = 1 MHz,	See Note 6		1	2.5†	pF

† JEDEC registered data

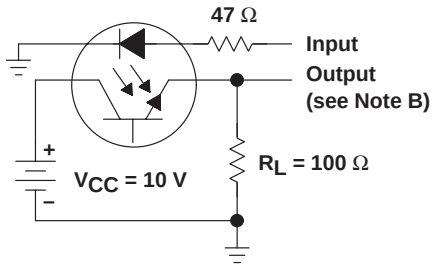
NOTE 6: These parameters are measured between both input-diode leads shorted together and all the phototransistor leads shorted together.

switching characteristics at 25°C free-air temperature†

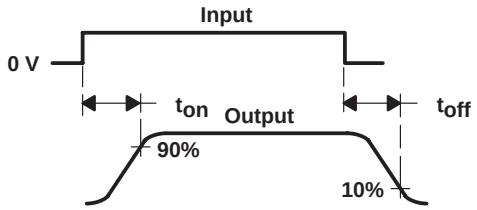
PARAMETER		TEST CONDITIONS		MIN	TYP	MAX	UNIT
t_{on}	Time-on time	V_{CC} = 10 V,	$I_{C(on)}$ = 2 mA,		7	10	µs
t_{off}	Turn-off time	R_L = 100 Ω,	See Figure 1		7	10	

† JEDEC registered data

PARAMETER MEASUREMENT INFORMATION



TEST CIRCUIT



VOLTAGE WAVEFORMS

NOTES: A. The input waveform is supplied by a generator with the following characteristics: Z_O = 50 Ω, t_r ≤ 15 ns, duty cycle ≈ 1%, t_W = 100 µs.
B. The output waveform is monitored on an oscilloscope with the following characteristics: t_r ≤ 12 ns, R_{in} ≥ 1 MΩ, C_{in} ≤ 20 pF.

Figure 1. Switching Times

TYPICAL CHARACTERISTICS

OFF-STATE COLLECTOR CURRENT vs FREE-AIR TEMPERATURE

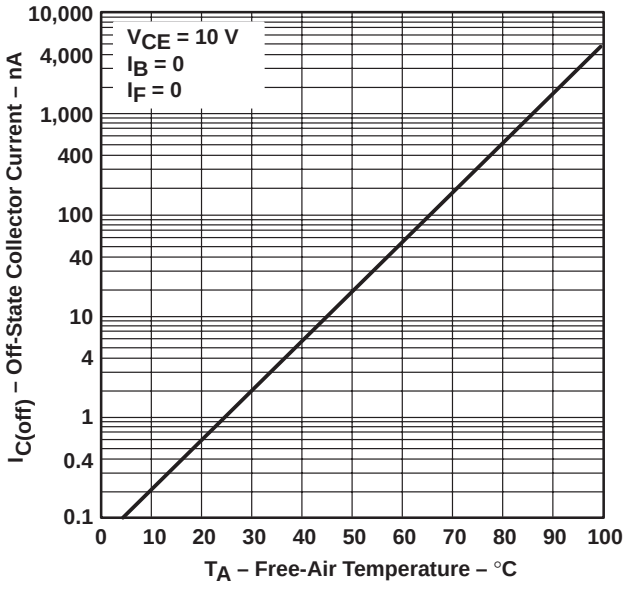


Figure 2

TRANSISTOR STATIC FORWARD CURRENT TRANSFER RATIO (NORMALIZED) vs ON-STATE COLLECTOR CURRENT

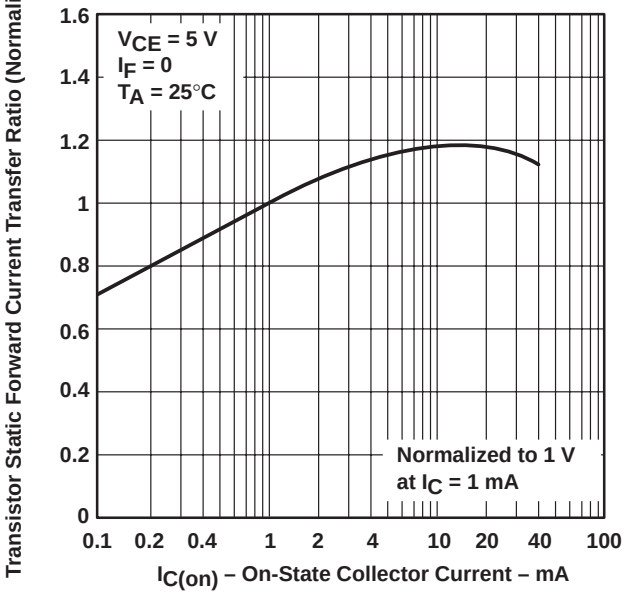


Figure 3

TYPICAL CHARACTERISTICS

COLLECTOR CURRENT vs MODULATION FREQUENCY

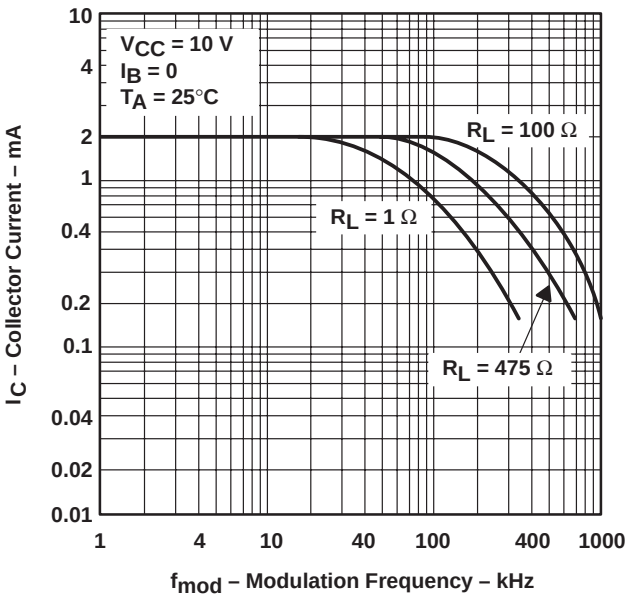


Figure 4

INPUT-DIODE FORWARD CONDUCTION CHARACTERISTICS

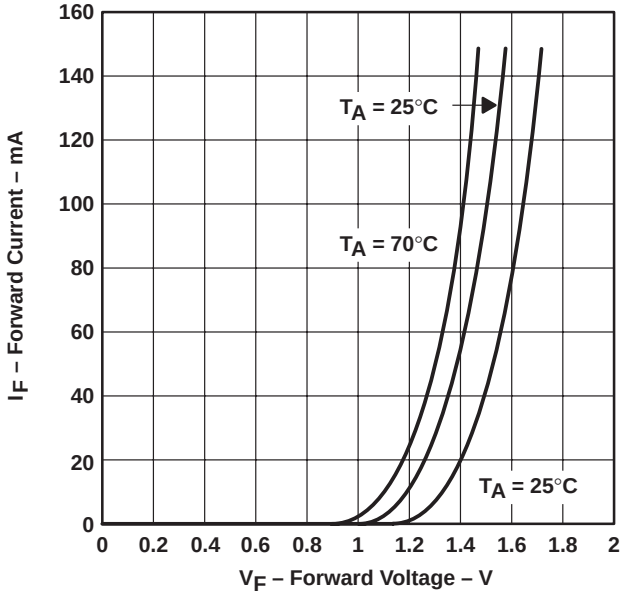


Figure 5

COLLECTOR CURRENT vs INPUT-DIODE FORWARD CURRENT

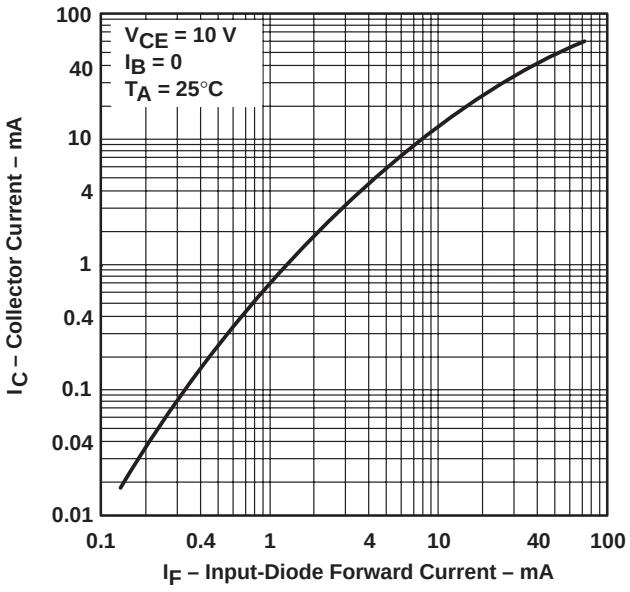
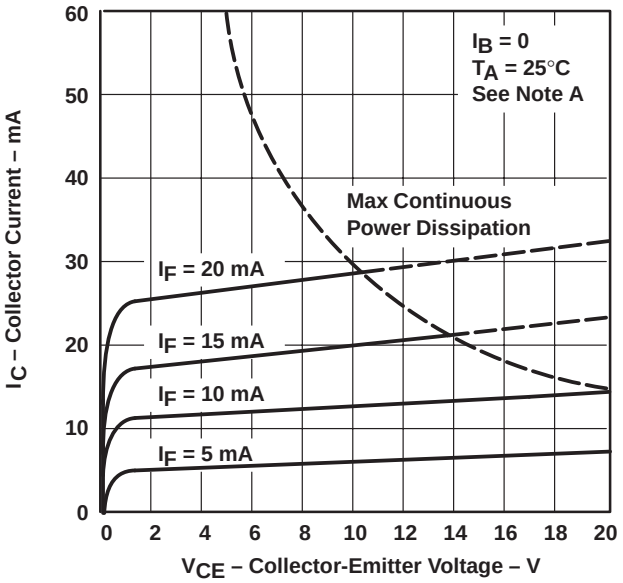


Figure 6

COLLECTOR CURRENT vs COLLECTOR-EMITTER VOLTAGE

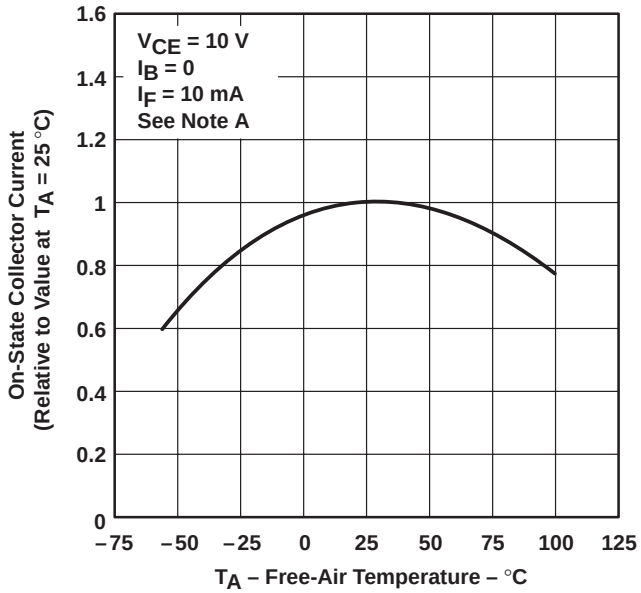


NOTE A. Pulse operation of input diode is required for operation beyond limits shown by dotted lines.

Figure 7

TYPICAL CHARACTERISTICS

**ON-STATE COLLECTOR CURRENT
(RELATIVE TO VALUE AT 25°C)
vs
FREE-AIR TEMPERATURE**

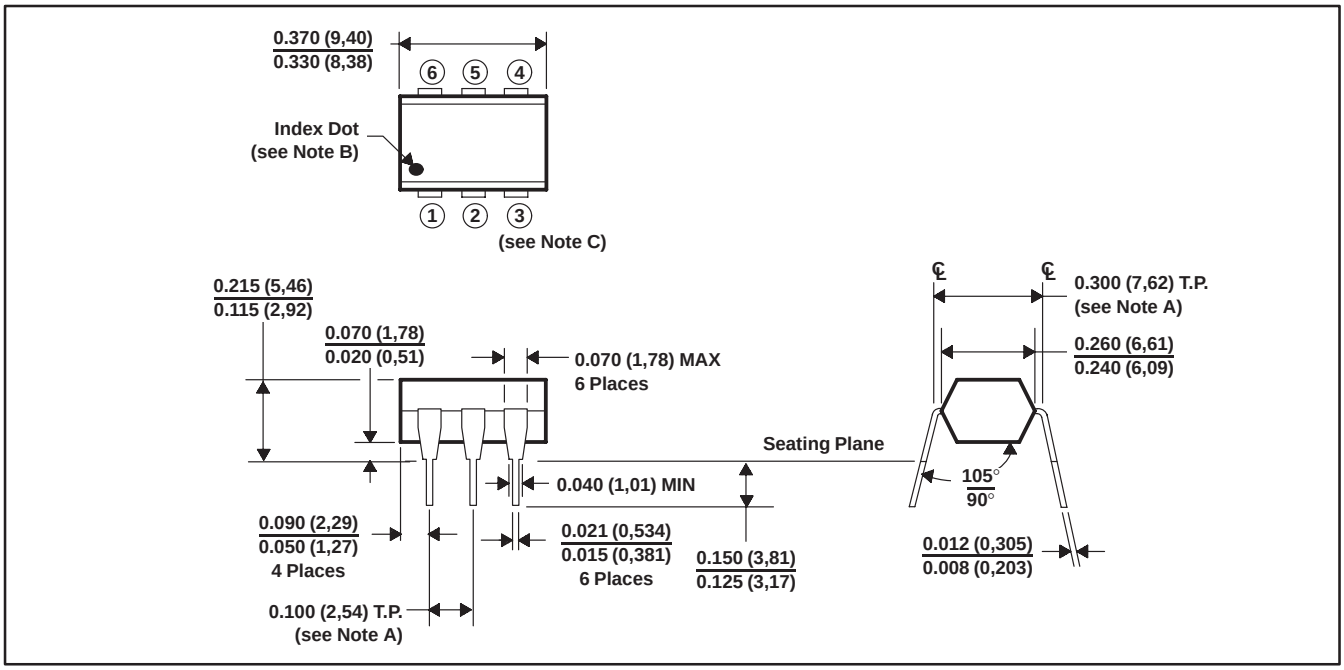


NOTE A. These parameters were measured using pulse techniques, t_w = 1 ms, duty cycle ≤ 2 %.

Figure 8

APPLICATION INFORMATION

The devices consist of a gallium-arsenide infrared-emitting diode and an npn silicon phototransistor. Each device is available in a 6-terminal plastic dual-in-line package, shown in Figure 9, or in a DCJ plastic dual surface-mount optocoupler package (see Mechanical Data).

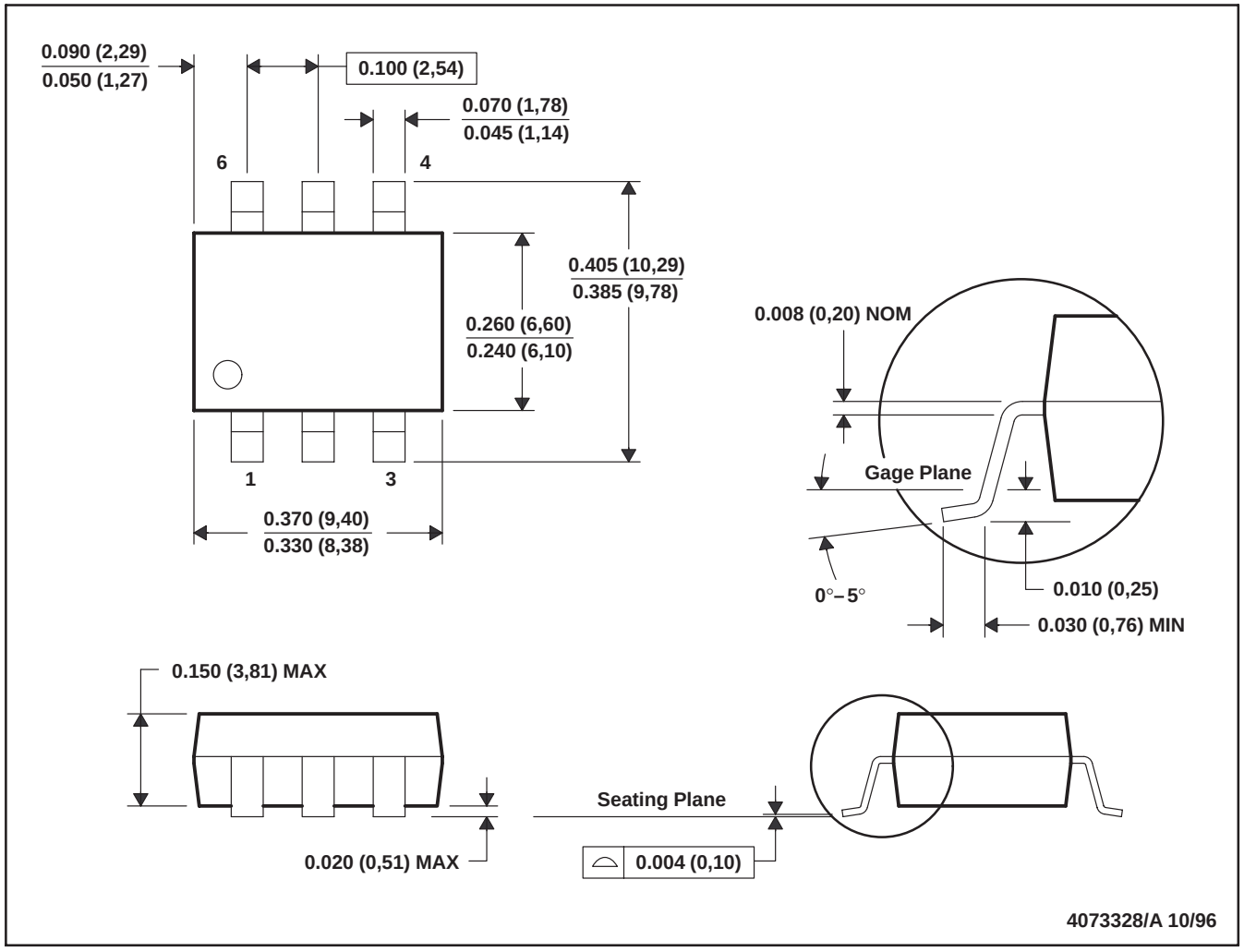


NOTES: A. Terminals are within 0.005 (0,13) radius of true position (T.P.) with maximum material condition and unit installed.
B. Terminal 1 identified by index dot.
C. The dimensions given fall within JEDEC MO-001 AM dimensions.
D. All linear dimensions are in inches (millimeters).

Figure 9. Plastic Dual-in-Line Package

MECHANICAL DATA

DCJ (R-PDSO-G6) **PLASTIC DUAL SMALL-OUTLINE OPTOCOUPLER**



NOTES: A. All linear dimensions are in inches (millimeters)
B. This drawing is subject to change without notice.
C. Terminal 1 identified by index dot.

PACKAGING INFORMATION

Orderable Device	Status (1)	Package Type	Package Drawing	Pins	Package Qty	Eco Plan (2)	Lead/Ball Finish	MSL Peak Temp (3)
4N35	OBSOLETE	PDIP	N	6		TBD	Call TI	Call TI
4N35DCJ	OBSOLETE	OPTO	DCJ	6		TBD	Call TI	Call TI
4N36	OBSOLETE	PDIP	N	6		TBD	Call TI	Call TI
4N37	OBSOLETE	PDIP	N	6		TBD	Call TI	Call TI

(1) The marketing status values are defined as follows:
ACTIVE: Product device recommended for new designs.
LIFEBUY: TI has announced that the device will be discontinued, and a lifetime-buy period is in effect.
NRND: Not recommended for new designs. Device is in production to support existing customers, but TI does not recommend using this part in a new design.
PREVIEW: Device has been announced but is not in production. Samples may or may not be available.
OBSOLETE: TI has discontinued the production of the device.

(2) Eco Plan - The planned eco-friendly classification: Pb-Free (RoHS) or Green (RoHS & no Sb/Br) - please check http://www.ti.com/productcontent for the latest availability information and additional product content details.
TBD: The Pb-Free/Green conversion plan has not been defined.
Pb-Free (RoHS): TI's terms "Lead-Free" or "Pb-Free" mean semiconductor products that are compatible with the current RoHS requirements for all 6 substances, including the requirement that lead not exceed 0.1% by weight in homogeneous materials. Where designed to be soldered at high temperatures, TI Pb-Free products are suitable for use in specified lead-free processes.
Green (RoHS & no Sb/Br): TI defines "Green" to mean Pb-Free (RoHS compatible), and free of Bromine (Br) and Antimony (Sb) based flame retardants (Br or Sb do not exceed 0.1% by weight in homogeneous material)

(3) MSL, Peak Temp. -- The Moisture Sensitivity Level rating according to the JEDEC industry standard classifications, and peak solder temperature.

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