Optocoupler—DIP Package
OPIA400, OPIA410 through OPIA413

Features:
- 5,000 Vrms electrical isolation
- Choice of a Single and Dual LED
- Phototransistor or Photo Darlington Sensor
- Low-cost plastic Dual-In-Line (DIP) package

Approval Agency:
- UL Certification No: E58730
- VDE Pending

Description:
The OPIA series optocouplers are designed for applications that use an analog output (Phototransistor or Photo Darlington) in a dual-in-line package. A wide selection of configurations are available. With typical isolation voltage of 5,000 Volts RMS, these products meet typical power system isolation requirements.

Theory of operation: The LED transmitter is used to illuminate the Photosensor providing electrical isolation between two power systems while maintaining the ability to transmit information from one power system to the other. In many applications, analog signal levels may be required to be transmitted between two power systems while maintaining isolation between the power systems up to 5,000 volts RMS. A variety of LED and photosensor configurations are available depending on the system requirements.

The ratio Current Transfer Ratio (CTR) is identified between the output current and input current for analog photosensors. CTR ratios can range from as low as 5 to over 9,000 depending on the device.

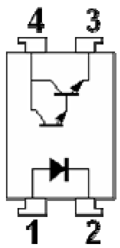
$$CTR = \frac{Photosensor - Current}{LED - Current} = \frac{20mA}{10mA} * 100 = 200$$

All DIP product is shipped in a shipping tube with "TU" identified on the end of the part number.
Example: OPI400DTU is a 4-Pin DIP shipped in a tube (TU).

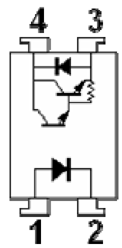
Applications:
- High voltage isolation, up to 5,000 Volts RMS
- PCBoard power system isolation
- Industrial equipment power isolation
- Medical equipment power isolation
- Office equipment

RoHS

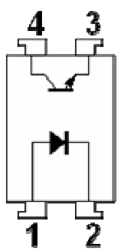
Package Outline Dimensions and Schematics: Top-View



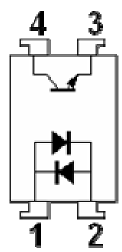
OPIA411



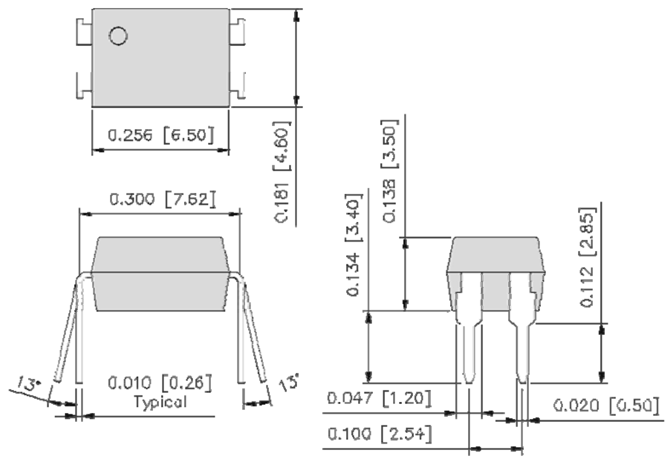
OPIA412



OPIA400
OPIA413



OPIA410



Part Number	Pin #			
	1	2	3	4
OPIA400	A	K	E	C
OPIA410	A-K	K-A	E	C
OPIA411	A	K	E	C
OPIA412	A	K	E	C
OPIA413	A	K	E	C

Analog Output Devices Ordering Information

Part Number	Isolation Voltage Max. (Vrms)	CTR Min/Typ/Max	Typ. Tr / Tf (µs) R_L = 100 ohms	Package	Configuration
OPIA400D	5,000	50 / - / 600	4 / 3	4-Pin DIP	A K—C E
OPIA410D	5,000	60 / - / 600	5 / 4	4-Pin DIP	A K, K A—C E
OPIA411D	5,000	70 / - / -	80 / 72	4-Pin DIP	A K—C E (Dar)
OPIA412D	5,000	600 / - / 9,000	60 / 50	4-Pin DIP	A K—C E (Dar)
OPIA413D	5,000	50 / - / 600	2 / 3	4-Pin DIP	A K—C E
Configuration: Definition of Terms LED Identification—Sensor Identification					
Configuration Information	LED	A = Anode	K = Cathode		
	Sensor	B = Base	C = Collector	E = Emitter	(Dar) = Photodarlington
Packaging	Part Number Suffix: **TU** = Shipped in Tubes				**Example:** OPIA400D<u>TU</u>

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Absolute Maximum Ratings (T_A = 25° C unless otherwise noted)

Storage Temperature	-55° C to +125° C
Operating Temperature	-30° C to +100° C
Isolation voltage (1 minute)	5,000 Vrms
Total Package Power Dissipation	200 mW
Lead Soldering Temperature (1/16" (1.6 mm) from case for 5 seconds with soldering iron)	260° C

Input Diode

Continuous Forward Current	50 mA
Peak Forward current (1 µs pulse width, 300 pps)	1 A
Reverse Voltage OPIA400, OPIA411, OPIA412, OPIA413 OPIA410, OPIA412	 6 V -
Power Dissipation	70 mW

Output Phototransistor

Collector-Emitter Voltage OPIA400, OPIA410 OPIA412 OPIA411 OPIA413	 60 V 300 V 35 V 350 V
Emitter-Collector Voltage OPIA400, OPIA410, OPIA411 OPIA412 OPIA413	 6 V 0.1 V 7 V
Collector Current OPIA400, OPIA410, OPIA413 OPIA412 OPIA411	 50 mA 150 mA 80 mA
Power Dissipation All except the part numbers noted below OPIA412	 150 mW 200 mW

Electrical Characteristics

SYMBOL	PARAMETER	MIN	TYP	MAX	UNITS	TEST CONDITIONS
Input Diode						
V_F	Forward Voltage All except those noted below OPIA413	- 1.0	1.2 1.2	1.4 1.3	V	I_F = 20 mA I_F = 10 mA
V_{FM}	Peek Forward Voltage OPIA410, OPIA412 OPIA413	- -	- -	3.5 3.0	V	I_{FM} = 500 mA
I_R	Reverse Current All except those noted below OPIA410 OPIA413	- - -	- - -	10 - 10	µA	V_R = 4 V - V_R = 5 V
C_t	Terminal Capacitance All except those noted below OPIA411	- -	30 30	- 250	pf	V = 0.0 V, f = 1K Hz V = 0.0 V, f = 1K Hz
Output Phototransistor						
I_{CEO}	Collector Dark Current OPIA400, OPIA410 OPIA413	- -	- 10	100 200	nA	I_F = 0 mA, V_{CE} = 20 V I_F = 0 mA, V_{CE} = 300 V
$V_{CE(SAT)}$	Collector-Emitter Saturation Voltage OPIA400 OPIA410 OPIA413	- - -	0.1 0.1 -	0.2 0.3 0.4	V	I_F = 20 mA, I_C = 1 mA I_F = 20 mA, I_C = 1 mA I_F = 8 mA, I_C = 2.4 mA
f_C	Cutt-Off Frequency All except those noted below OPIA400, OPIA410, OPIA413	- -	- 80	- -	K Hz	V_{CC} = 5 V, I_C = 2 mA, R_L = 100 Ω
t_r	Rise Time OPIA400 OPIA410 OPIA413	- - -	4 5 2	18 20 -	µs	V_{CC} = 2 V, I_C = 2 mA, R_L = 100 Ω V_{CC} = 2 V, I_C = 2 mA, R_L = 100 Ω V_{CC} = 10 V, I_C = 2 mA, R_L = 100 Ω
t_f	Fall Time OPIA400 OPIA410 OPIA413	- - -	3 4 3	18 20 -	µs	V_{CC} = 2 V, I_C = 2 mA, R_L = 100 Ω V_{CC} = 2 V, I_C = 2 mA, R_L = 100 Ω V_{CC} = 10 V, I_C = 2 mA, R_L = 100 Ω

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Electrical Characteristics - Continued from Previous Page

SYMBOL	PARAMETER	MIN	TYP	MAX	UNITS	TEST CONDITIONS
Output PhotoDarlington						
I_{CEO}	Collector Dark Current OPIA412 OPIA411	- -	- -	1.0 1.0	µA	I_F = 0 mA, V_{CE} = 200 V I_F = 0 mA, V_{CE} = 10 V
$V_{CE(SAT)}$	Collector-Emitter Saturation Voltage OPIA411 OPIA412	- -	0.8 -	1.0 1.5	V	I_F = 20 mA, I_C = 5 mA I_F = 20 mA, I_C = 5 mA
f_C	Cut-Off frequency OPIA411 OPIA412	1.0 -	6.0 7.0	- -	K Hz	V_{CC} = 2 V, I_C = 20 mA, R_L = 100 Ω V_{CC} = 5 V, I_C = 2 mA, R_L = 100 Ω
t_r	Rise Time OPIA411 OPIA412	- -	80 60	300 300	µs	V_{CC} = 2 V, I_C = 20 mA, R_L = 100 Ω V_{CC} = 2 V, I_C = 20 mA, R_L = 100 Ω
t_f	Fall Time OPIA411 OPIA412	- -	72 50	250 250	µs	V_{CC} = 2 V, I_C = 20 mA, R_L = 100 Ω V_{CC} = 2 V, I_C = 20 mA, R_L = 100 Ω
Coupled Characteristics						
CTR	Current Transfer Ratio OPIA400, OPIA413 OPIA410 OPIA411 OPIA412	50 60 70 600	- - - -	600 600 - 9,000	%	I_F = 5.00 mA, V_{CE} = 5.0 V I_F = 1.00 mA, V_{CE} = 2.0 V I_F = 0.05 mA, V_{CE} = 3.3 V I_F = 1.00 mA, V_{CE} = 2.0 V
C_f	Floating Capacitance	-	0.6	1.0	pF	V = 0.0 V, f = 1M Hz
R_{ISO}	Isolation Resistance	$5X10^{10}$	10^{11}	-	ohm	C500V, 40% to 60%RH

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OPIA400

Fig.6 **Collector Current vs. Collector-Emitter Voltage**

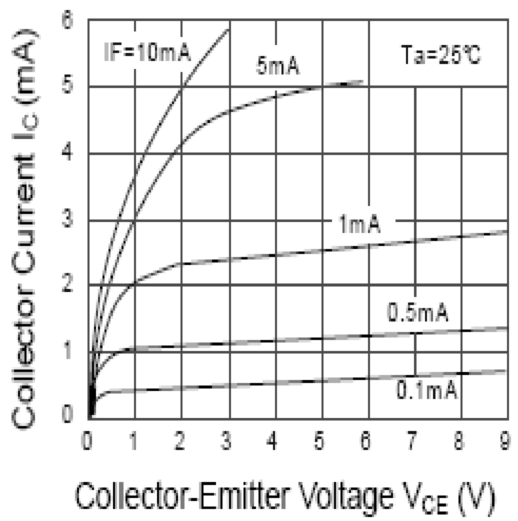


Fig.7 **Relative Current Transfer Ratio vs. Ambient Temperature**

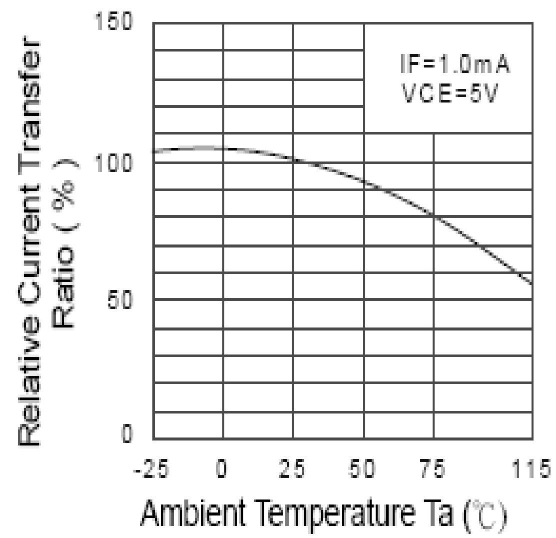


Fig.4 **Forward Current vs. Ambient Temperature**

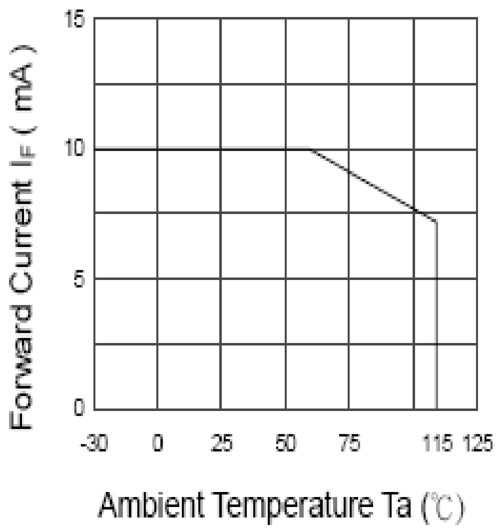
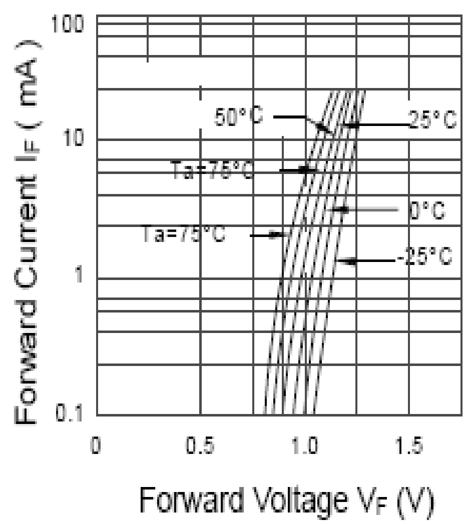


Fig.5 **Forward Current vs. Forward Voltage**



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OPIA400

Fig.8 **Collector-Emitter Saturation Voltage vs. Ambient Temperature**

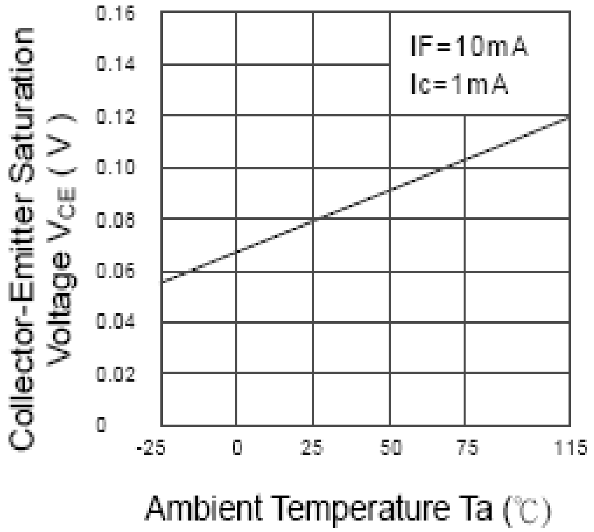


Fig.9 **Collector-Emitter Saturation Voltage vs. Forward Current**

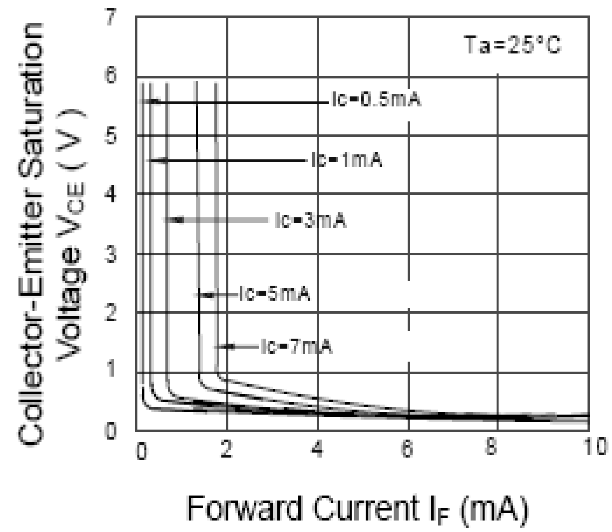


Fig.10 **Response Time vs. Load Resistance**

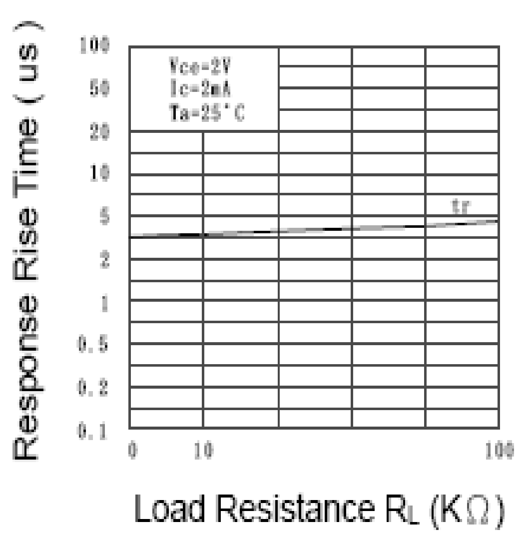
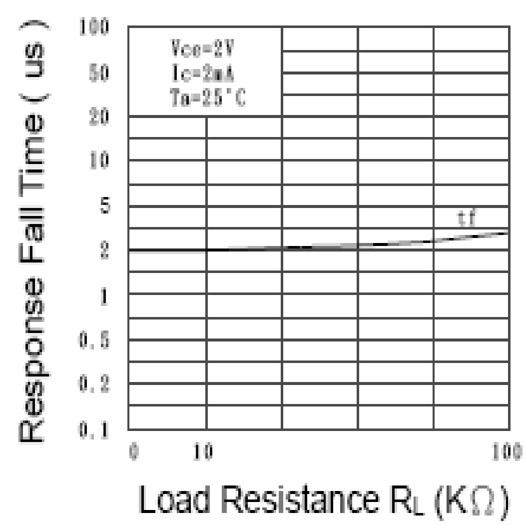


Fig.11 **Response Time vs. Load Resistance**



OPIA410

Fig.1 Current Transfer Ratio vs. Forward Current

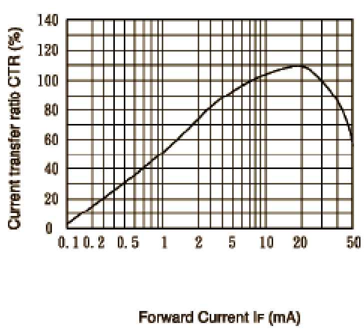


Fig.2 Collector Power Dissipation vs. Ambient Temperature

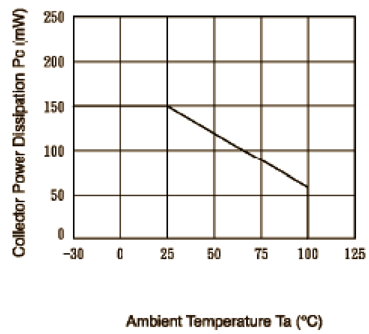


Fig.3 Collector Dark Current vs. Ambient Temperature

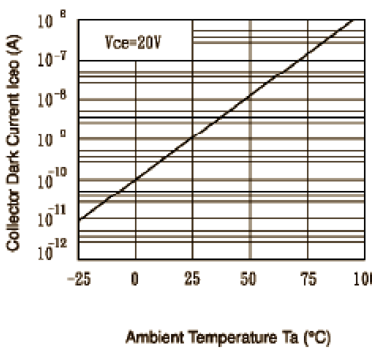


Fig.4 Forward Current vs. Ambient Temperature

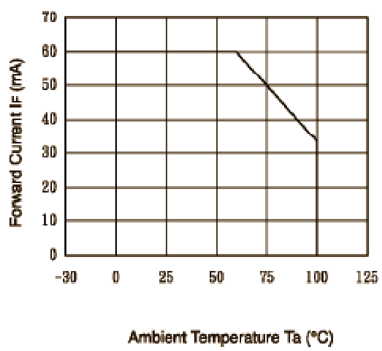


Fig.5 Forward Current vs. Forward Voltage

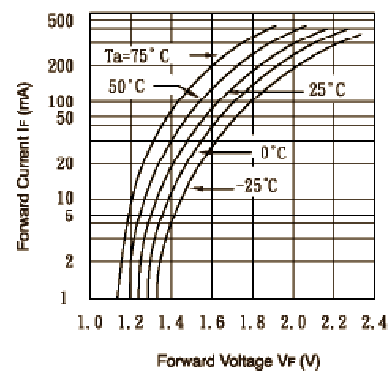


Fig.6 Collector Current vs. Collector-emitter Voltage

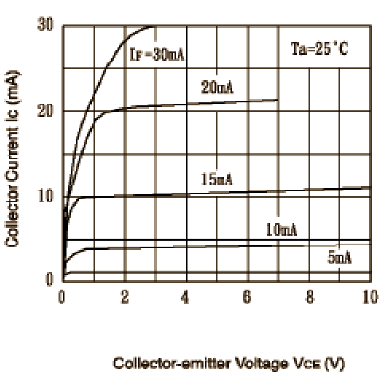


Fig.7 Relative Current Transfer Ratio vs. Ambient Temperature

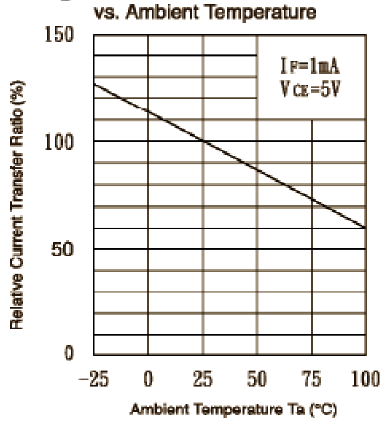
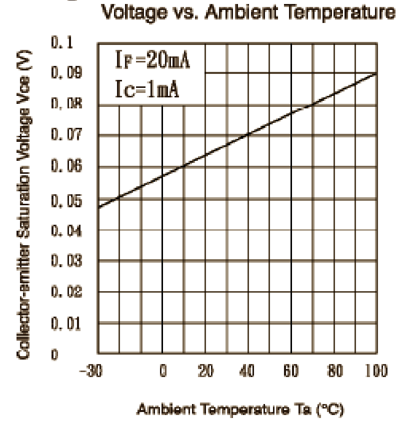


Fig.8 Collector-emitter Saturation Voltage vs. Ambient Temperature



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OPIA410

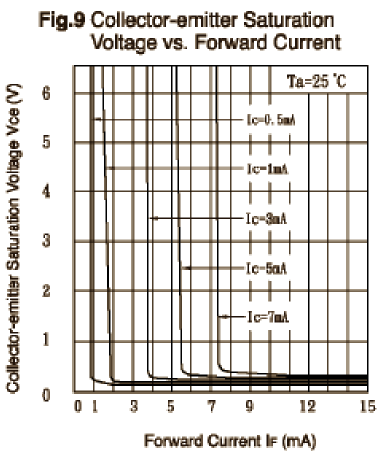

Fig.9 Collector-emitter Saturation Voltage vs. Forward Current
Ta=25 °C
Ic=0.5mA
Ic=1mA
Ic=3mA
Ic=5mA
Ic=7mA
Collector-emitter Saturation Voltage Vce (V)
Forward Current IF (mA)

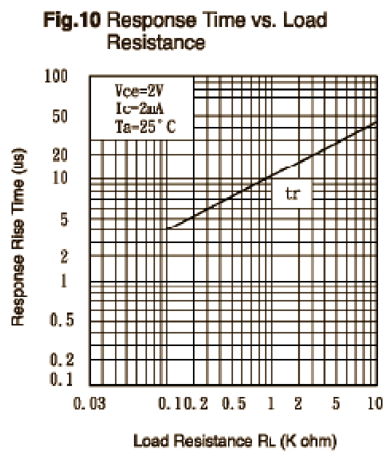

Fig.10 Response Time vs. Load Resistance
Vce=2V
Ic=2mA
Ta=25° C
tr
Response Rise Time (us)
Load Resistance RL (K ohm)

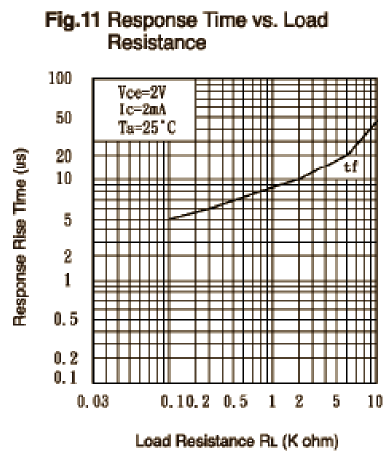

Fig.11 Response Time vs. Load Resistance
Vce=2V
Ic=2mA
Ta=25° C
tf
Response Rise Time (us)
Load Resistance RL (K ohm)

OPIA411

Fig. 1 Forward Current vs. Ambient Temperature

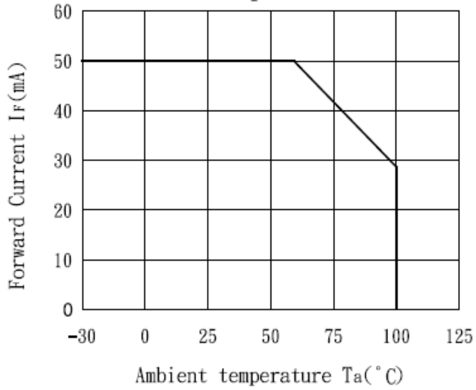

Fig. 2 Collector Power Dissipation vs. Ambient Temperature

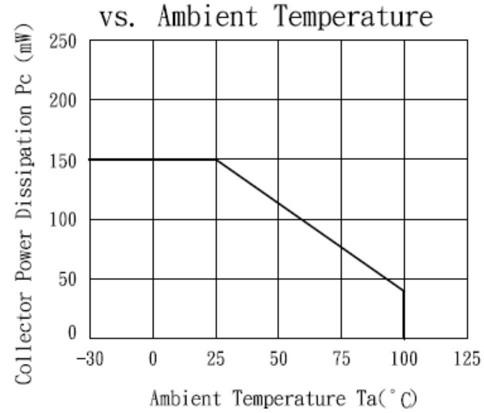

Fig. 3 Collector-emitter Saturation Voltage vs. Forward Current

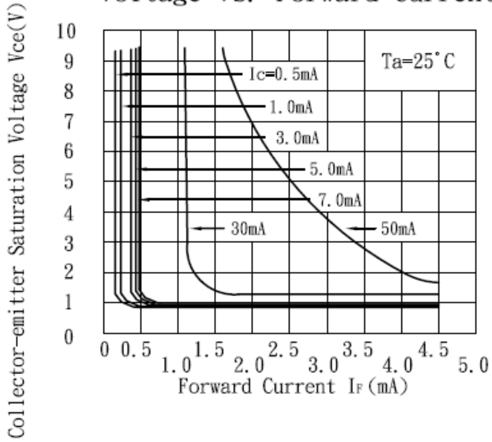

Fig. 4 Forward Current vs. Forward Voltage

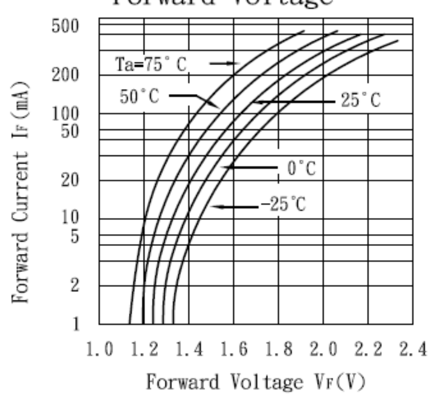

Fig. 5 Current Transfer Ratio vs. Forward Current

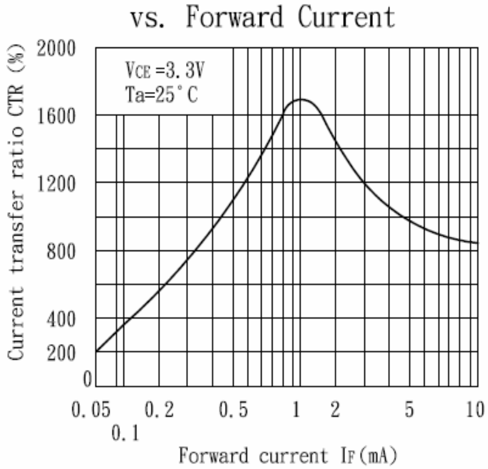

Fig. 6 Collector Current vs. Collector-emitter Voltage

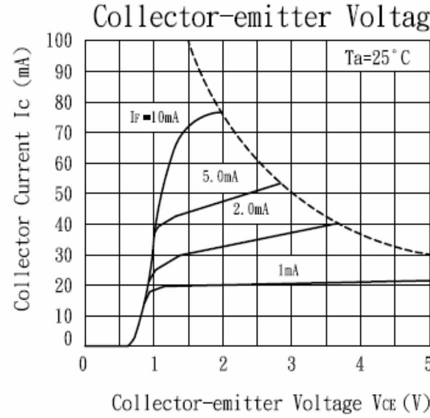

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Fig. 7 Relative Current Transfer Ratio vs. Ambient Temperature

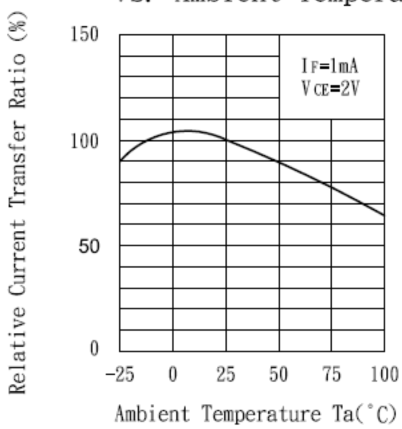


Fig. 7 Collector-emitter Saturation Voltage vs. Ambient Temperature

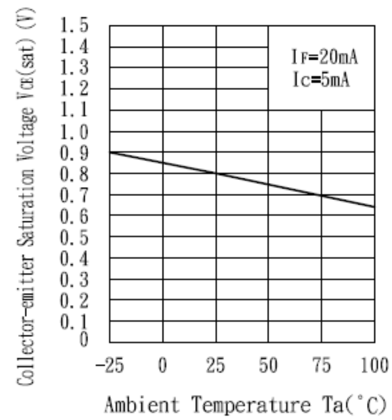


Fig. 9 Collector Dark Current vs. Ambient Temperature

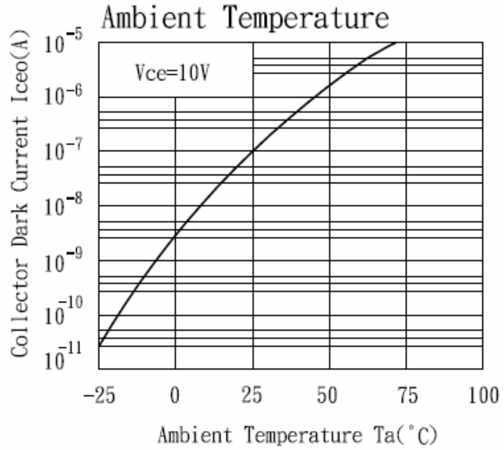
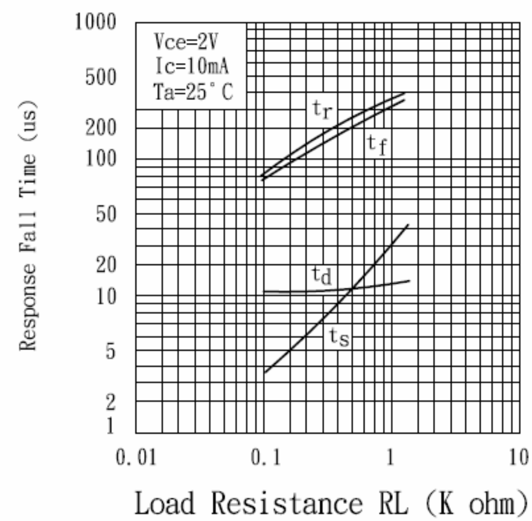


Fig. 10 Response Time vs. Load Resistance



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OPI412

Fig. 4 Forward Current vs. Ambient Temperature

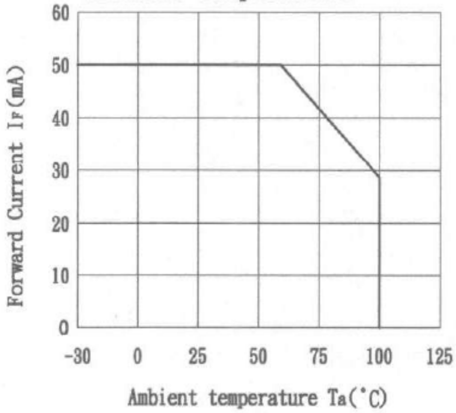

Fig. 5 Forward Current vs. Forward Voltage

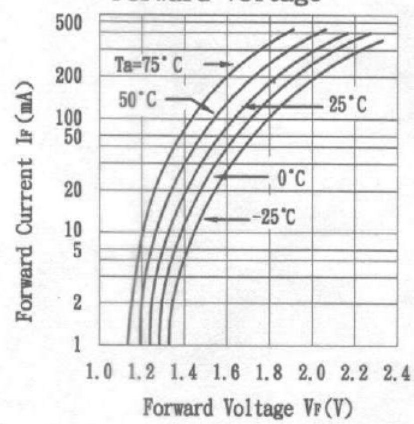

Fig. 2 Collector Power Dissipation vs. Ambient Temperature

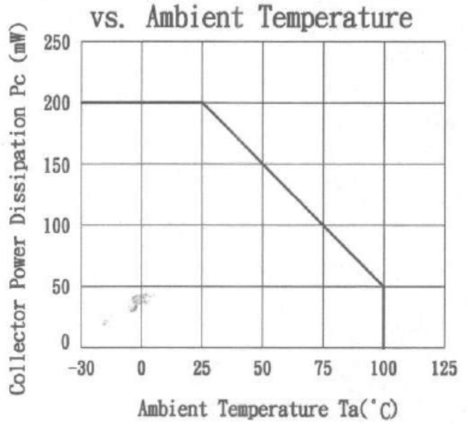

Fig. 3 Collector Dark Current vs. Ambient Temperature

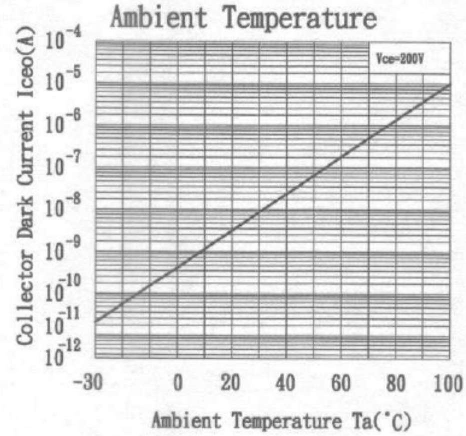

Fig. 6 Collector Current vs. Collector-emitter Voltage

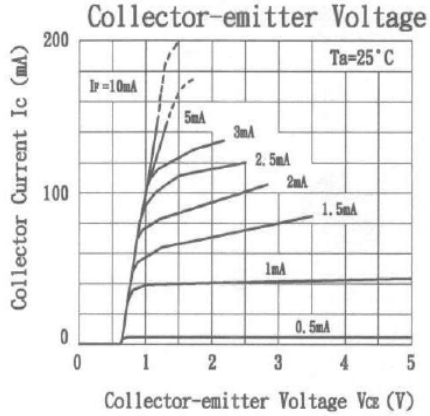

Fig. 7 Relative Current Transfer Ratio vs. Ambient Temperature

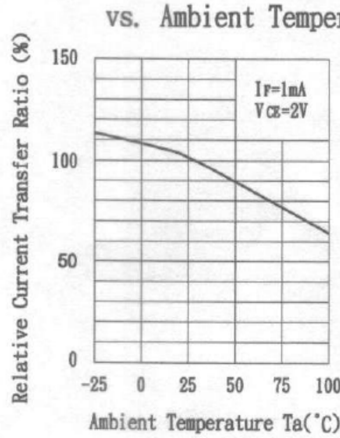

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Fig. 8 Collector-emitter Saturation Voltage vs. Forward Current

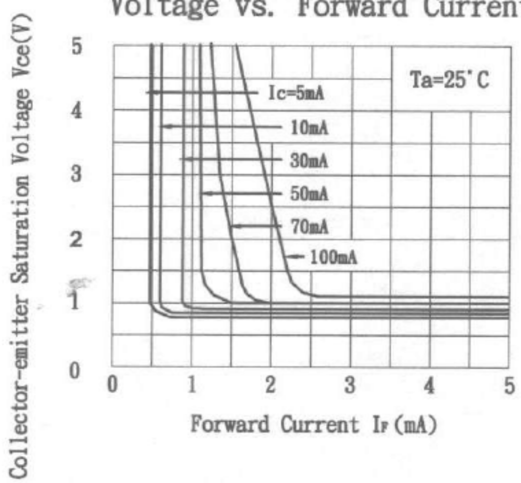
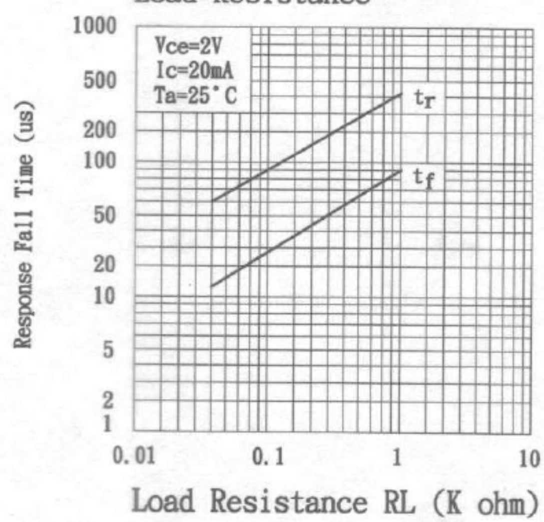


Fig. 9 Response Time vs. Load Resistance



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OPIA413

Fig. 1 Current Transfer Ratio Vs. Forward Current

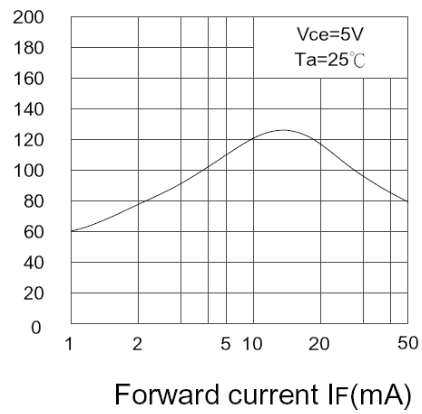

Fig.10 Response Time vs. Load Resistance

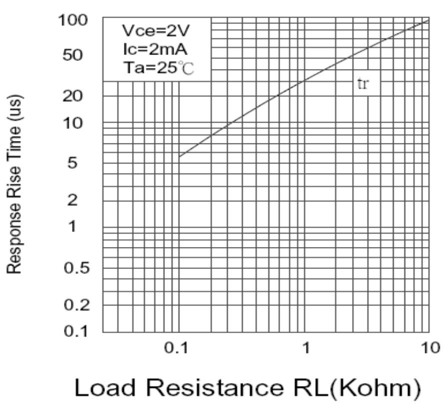

Fig.11 Response Time vs. Load Resistance

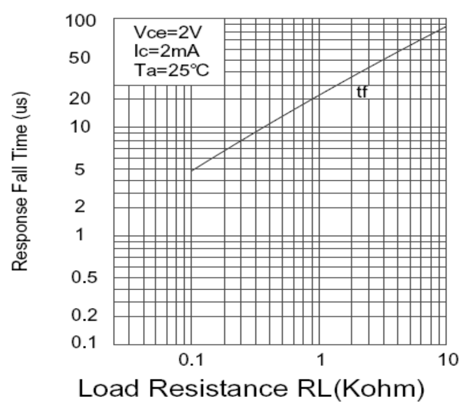

Fig.8 Collector-emitter Saturation Voltage vs. Ambient Temperature

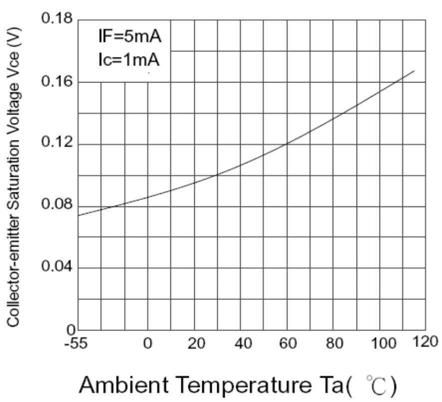

Fig.9 Collector-emitter Saturation Voltage vs. Forward Current

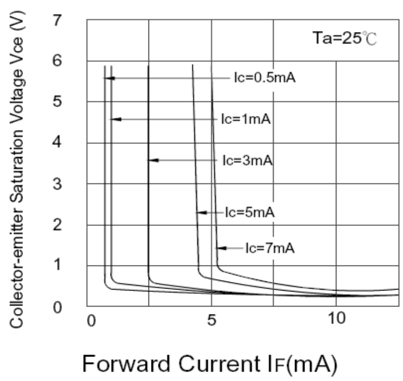

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Fig.4 Forward Current vs. Ambient Temperature

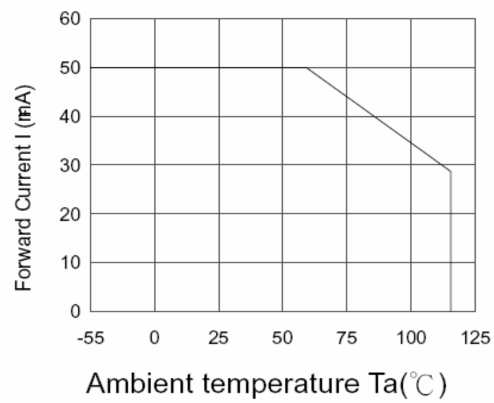


Fig.5 Forward Current vs. Forward Voltage

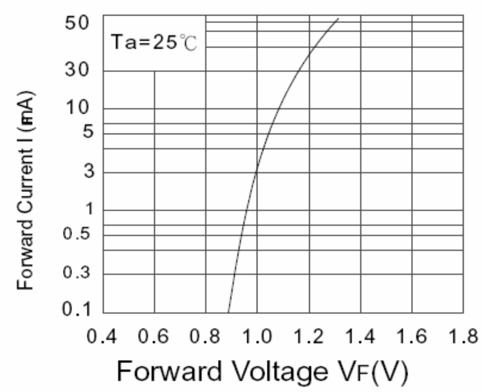


Fig.6 Collector Current vs. Collector-emitter Voltage

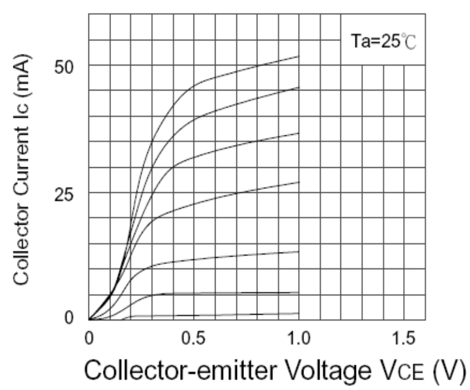


Fig.7 Relative Current Transfer Ratio vs. Ambient Temperature

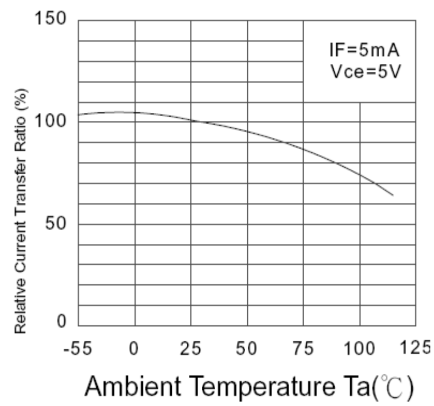


Fig.2 Collector Power Dissipation vs. Ambient Temperature

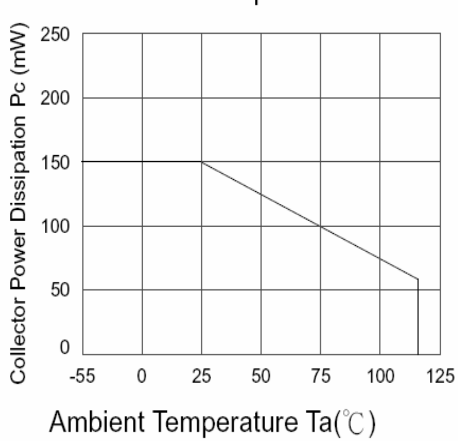
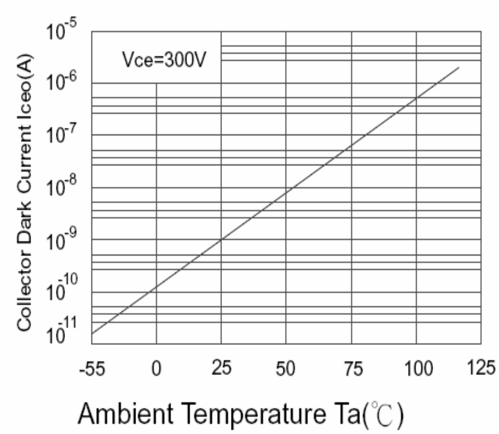


Fig.3 Collector Dark Current vs. Ambient Temperature



Quality / Reliability Requirements

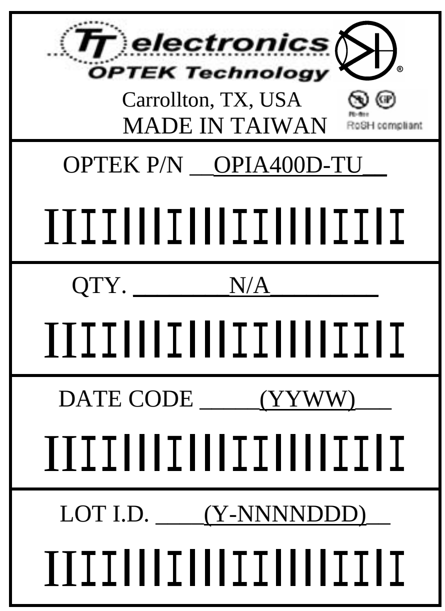
Parameter	Failure Criteria	Conditions
HTRB D $I_{C(OFF)}$	± 10%	11 samples after 500Hrs
	0 Fail	@ VCE = 5.0VDC, Ta = 70°C
HTFB D $I_{C(ON)}$	± 10%	50 samples after 96Hrs
	0 Fail	@ Max P_D, Ta = 25°C
MTTF @ 90% confidence	150,000 Min.	@ 25°C, 25mADC
Moisture Sensitivity Level	MSL 1	per JDEC stnd J-STD-020B
Lead Solderability	0 Fail	per Method 208 of MIL-STD-202.
Glass Transition of body	125°C Min.	DSC test method
Temperature Humidity-Bias	± 20%	85°C, 85%RH, 500Hrs, 80% min Iceo
Temperature Cycle	± 20%	per Method 1010.7 of MIL-STD-883E
High Temperature Storage	± 20%	85°C, 500Hrs
Autoclave	0 Fail	T_A = 121°C, Pressure = 15psi, Humidity = 100%, Time = 96Hrs

Note: This is to be performed when a change occurs to form, fit or function.

Government and Industry Standard Compliance Requirements

European Union's Reduction of Hazardous Substances (RoHS) Directive 2002/95/EC

Label Identification



DESCRIPTION:

Size: 3" (7.4 cm) X 2.2" (5.5 cm)
Lettering shall be black on white background.
Format shall be as:

Notes:

1. The DATE CODE is a 4-digit code for date of manufacture where YY is the last two digits of the year, and WW is week number of manufacture.
2. The LOT I.D. is the manufacturing location lot identification where Y is the year of manufacture, NNNN is a sequential lot identifier, and DDD is the day of the year of manufacture. – or use equivalent label format.

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Packaging Information:

Optek's Optocoupler Part Numbers	Packaging Quantities	Tube		Inner		Small Carton			Medium Carton			Large Carton		
				52 x 7 x 7.5 cm		53.5 x 16 x 17.5 cm			53.5 x 30.7 x 17.5 cm			53.5 x 30.7 x 25 cm		
		Qty	Weight	Qty	Weight	Qty	Weight	Gross Weight	Qty	Weight	Gross Weight	Qty	Weight	Gross Weight
P/H and SMD	**4-PIN** OPIA400D/A, OPIA410D/A - OPIA413D/A	100	44	3,000	1.40	12,000	6.0	6.5	24,000	12.0	12.5	36,000	18.0	18.5
	6-PIN OPIA6XXD/A Series	65	44	1,950	1.50	7,800	6.5	7.0	15,600	12.0	12.5	23,400	18.5	19.0
	8-PIN OPIA8XXD Series and OPID804D	48	44	1,440	1.44	5,760	6.0	6.5	11,520	12.0	12.5	17,290	18.0	18.5
M/F SOP	**4-PIN and 5-PIN** OPIA401B - OPIA404B, OPIA414B, OPIA500B	100	24	6,000	1.60	24,000	6.5	7.0	48,000	13.0	13.5	72,000	19.5	20.0
SSOP	**4-PIN** OPIA405C - OPIA409C	170	--	10,200	--									

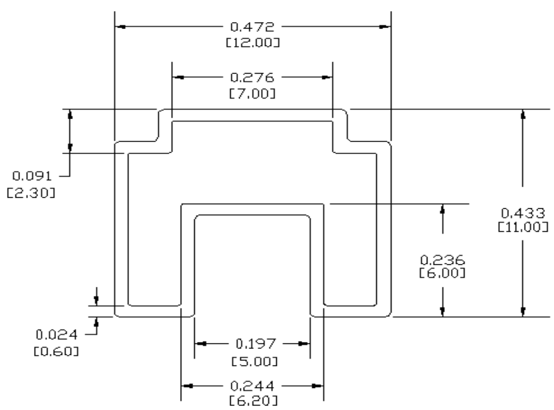
P/H = Pin-Hole Packages (Referred as D = Dual-In-Line Package)

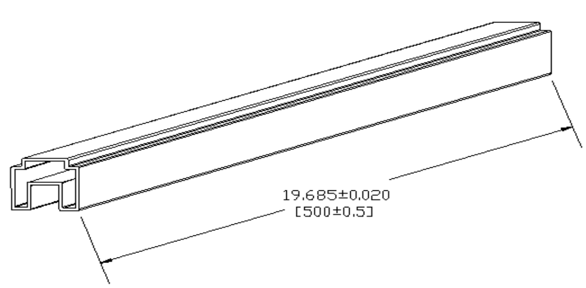
SMD = Standard Surface Mount Packages (Referred as A = 6.5mil SMD)

M/F or SOP = Mini-Flat Packages or Small Outside Packages (Referred as B = 4.40mil SMD w/ 2.54mil Lead-Spacing)

SSOP = Shrink SOP Packages (Referred as C = 3.60mil SMD with 1.27mil Lead-Spacing)

Tube Packaging Specifications (TU):





DIMENSIONS ARE IN: INCHES

TOLERANCE: ± 0.008 INCHES

Quantity: 4-pin: 100pcs/tube

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