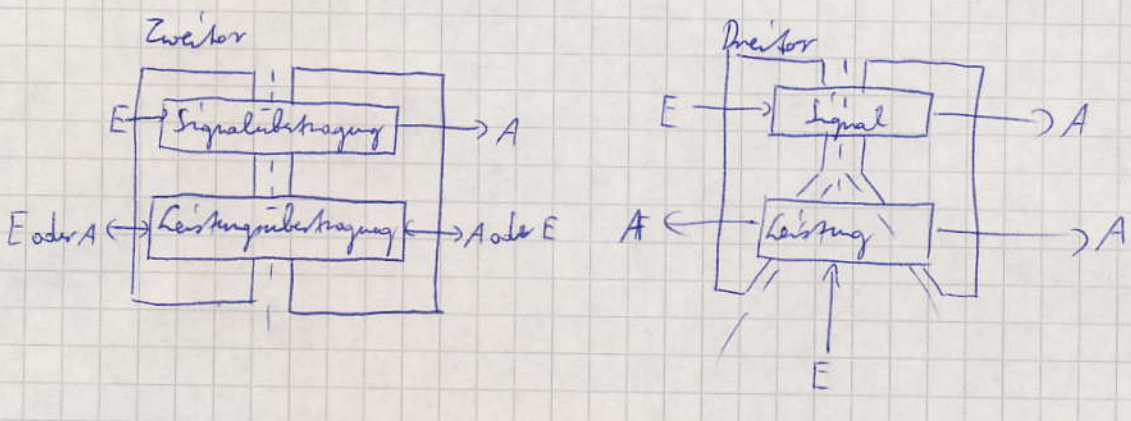
Isolationsverstärker

- Galvanische Trennung des Verstärkers zur Erhöhung von R_{in} bzw. r_{reg}
  - Potentialtrennung
  - Extrem hohe CMRR (160dB)

Struktur



Kopplungsarten	übliche Übertragungsverfahren
Induktiv	AM
Kapazitiv	PWM
Optisch	unmoduliert

a) induktive Kopplung

Folie ~~+ Folie A~~

Aufbau: - Matching zwischen beiden Sekundärwicklungen und beiden Demodulatoren

$U_{dem\,e} = -\frac{R_N}{R_1} U_e$ wegen Symmetrie / Matching: $U_{dem\,a} = U_{dem\,e}$

↳ $U_a = -\frac{R_N}{R_1} U_e$

Problem: Kern nicht integrierbar → Hybridaufbauweise

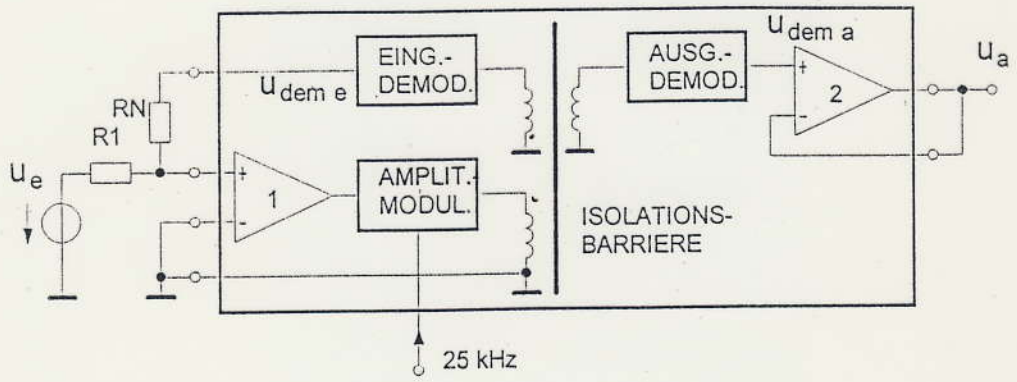
Folie AD 210 + Folie AD 210 spec

b) Kapazitive Kopplung

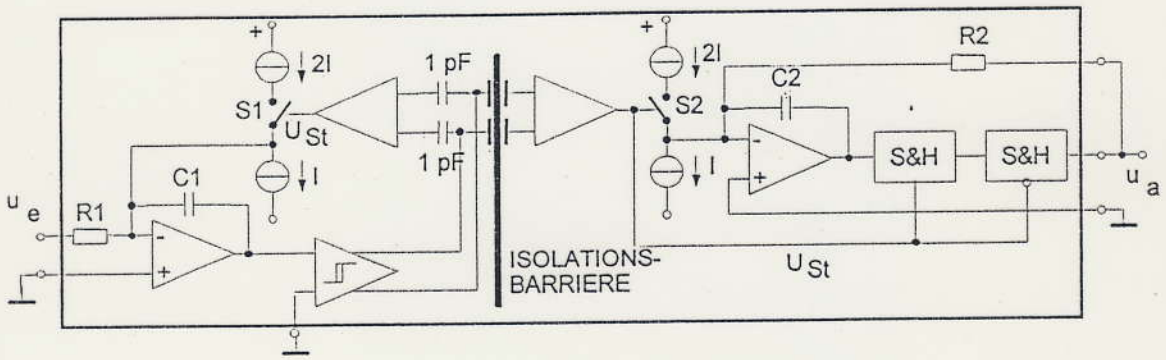
Folie Kopplungen

Funktionsprinzip: OPV integriert ± je nach Schalterstellung

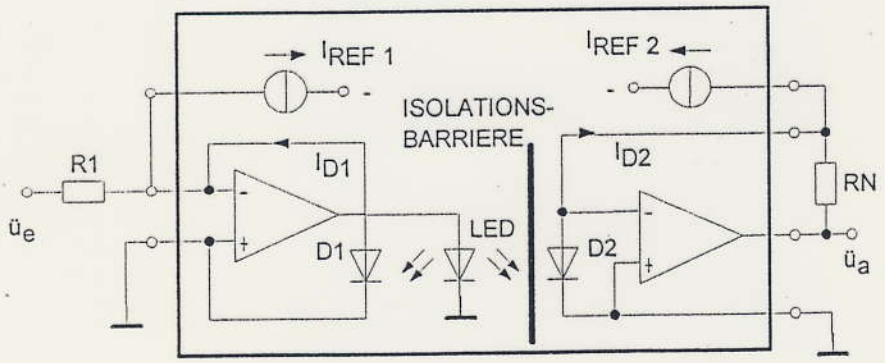
a) Induktive Kopplung



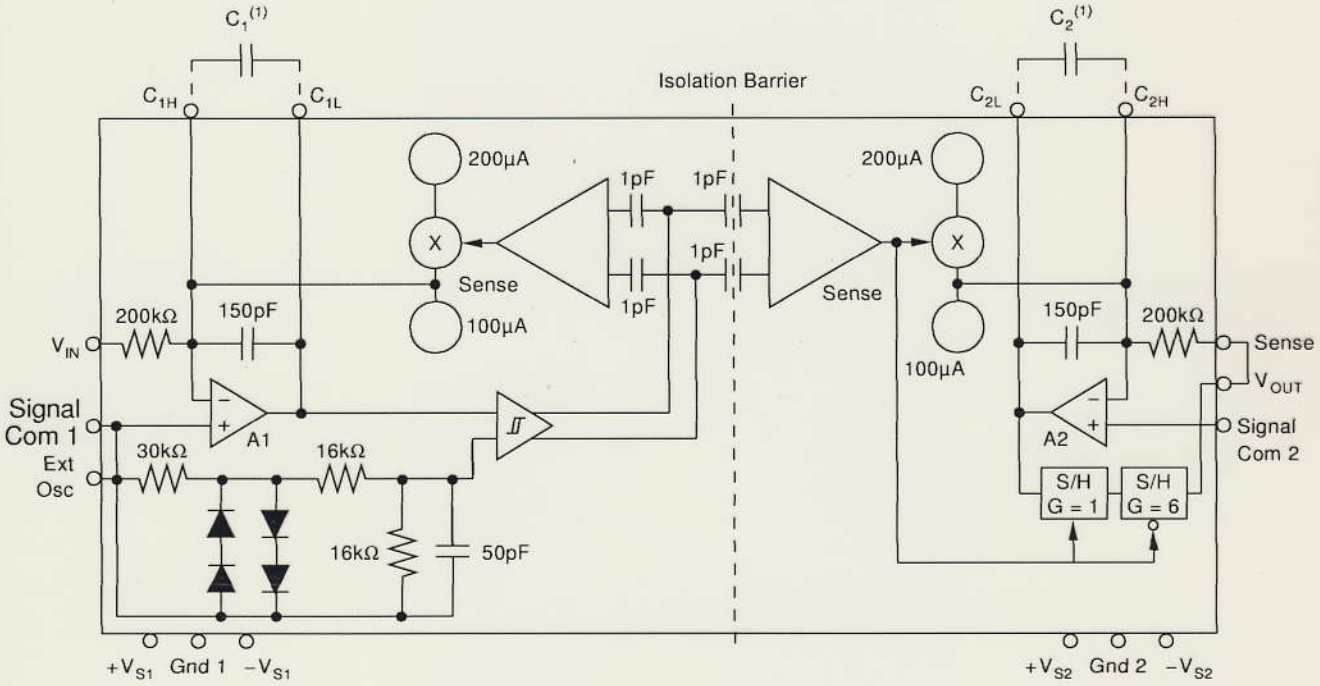
b) Kapazitive Kopplung



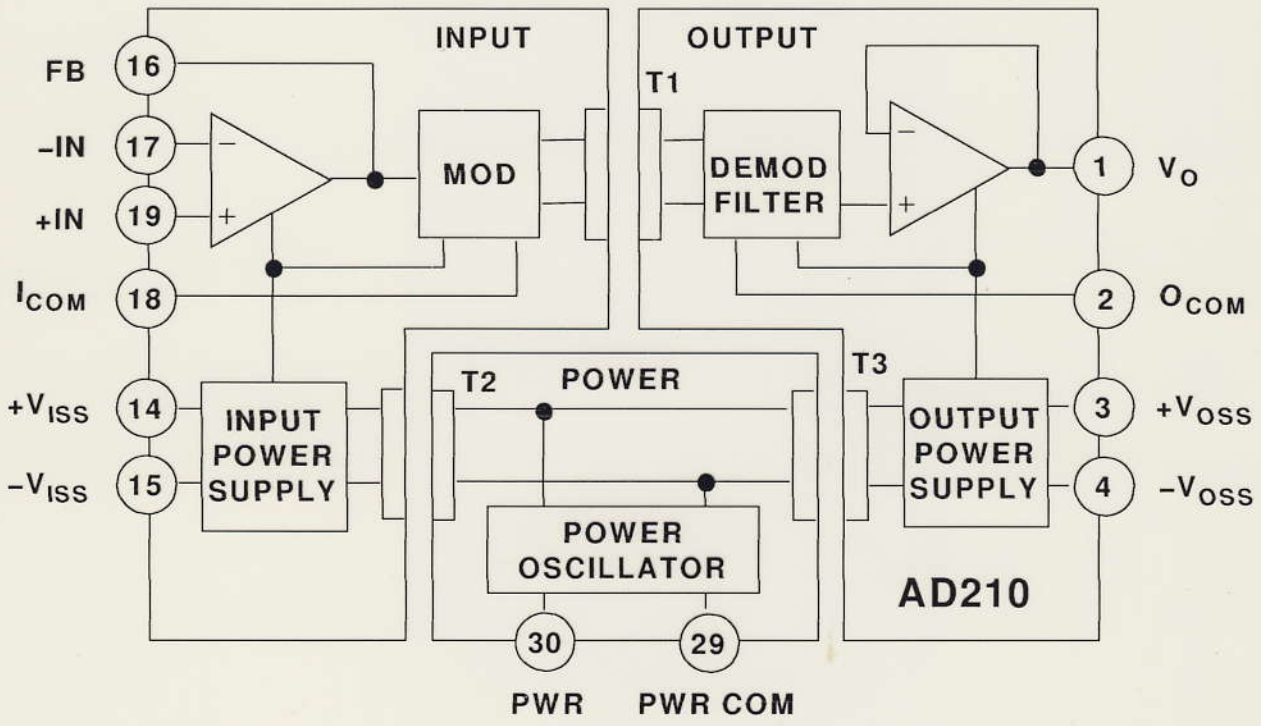
c) Optische Kopplung



ISO121 Texas Instruments (IC, kapazitiv)



AD210 Analog Devices (Hybrid–Schaltkreis, induktiv)



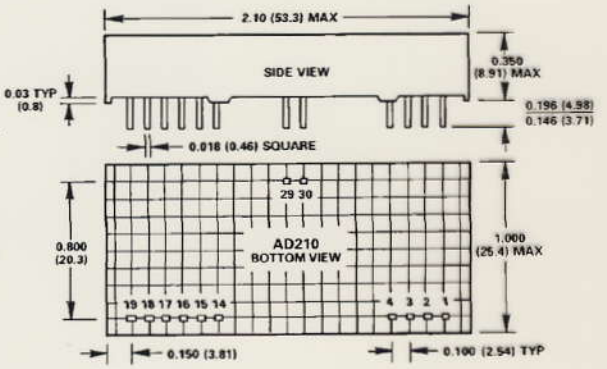
AD210–SPECIFICATIONS (typical @ +25°C, and V_S = +15 V unless otherwise noted)

Model	AD210AN	AD210BN	AD210JN
GAIN			
Range	1 V/V – 100 V/V	*	*
Error	±2% max	±1% max	*
vs. Temperature(0°C to +70°C)	+25 ppm/°C max	*	*
(–25°C to +85°C)	±50 ppm/°C max	*	*
vs. Supply Voltage	±0.002%/V	*	*
Nonlinearity[1]	±0.025% max	±0.012% max	*
INPUT VOLTAGE RATINGS			
Linear Differential Range	±10 V	*	*
Maximum Safe Differential Input	±15 V	*	*
Max. CMV Input-to-Output	*		
ac, 60 Hz, Continuous	2500 V rms	*	1500 V rms
dc, Continuous	±3500 V peak	*	±2000 V peak
Common-Mode Rejection	*		
60 Hz, G = 100 V/V	*		
$R_S \leq 500\ \Omega$ Impedance Imbalance	120 dB	*	*
Leakage Current Input-to-Output	*		
@ 240 V rms, 60 Hz	2 μA rms max	*	*
INPUT IMPEDANCE			
Differential	$10^{12}\ \Omega$	*	*
Common Mode	5 GΩ‖5 pF	*	*
INPUT BIAS CURRENT			
Initial, @ +25°C	30 pA typ (400 pA max)	*	*
vs. Temperature (0°C to +70°C)	10 nA max	*	*
(–25°C to +85°C)	30 nA max	*	*
INPUT DIFFERENCE CURRENT			
Initial, @ +25°C	5 pA typ (200 pA max)	*	*
vs. Temperature(0°C to + 70°C)	2 nA max	*	*
(–25°C to +85°C)	10 nA max	*	*
INPUT NOISE			
Voltage (1 kHz)	18 nV/√Hz	*	*
(10 Hz to 10 kHz)	4 μV rms	*	*
Current (1 kHz)	0.01 pA/√Hz	*	*
FREQUENCY RESPONSE			
Bandwidth (–3 dB)	*		
G = 1 V/V	20 kHz	*	*
G = 100 V/V	15 kHz	*	*
Settling Time (±10 mV, 20 V Step)	*		
G = 1 V/V	150 μs	*	*
G = 100 V/V	500 μs	*	*
Slew Rate (G = 1 V/V)	1 V/μs	*	*
OFFSET VOLTAGE (RTI)[2]			
Initial, @ +25°C	±15 ±45/G) mV max	(±5 ±15/G) mV max	*
vs. Temperature (0°C to +70°C)	(±10 ±30/G) μV/°C	*	*
(–25°C to +85°C)	(±10 ±50/G) μV/°C	*	*
RATED OUTPUT[3]			
Voltage, 2 kΩ Load	±10 V min	*	*
Impedance	1 Ω max	*	*
Ripple (Bandwidth = 100 kHz)	10 mV p-p max	*	*
ISOLATED POWER OUTPUTS[4]			
Voltage, No Load	±15 V	*	*
Accuracy	±10%	*	*
Current	±5 mA	*	*
Regulation, No Load to Full Load	See Text	*	*
Ripple	See Text	*	*
POWER SUPPLY			
Voltage, Rated Performance	+15 V dc ± 5%	*	*
Voltage, Operating	+15 V dc ± 10%	*	*
Current, Quiescent	50 mA	*	*
Current, Full Load – Full Signal	80 mA	*	*
TEMPERATURE RANGE			
Rated Performance	–25°C to +85°C	*	*
Operating	–40°C to +85°C	*	*
Storage	–40°C to +85°C	*	*
PACKAGE DIMENSIONS			
Inches	1.00 × 2.10 × 0.350	*	*
Millimeters	25.4 × 53.3 × 8.9	*	*

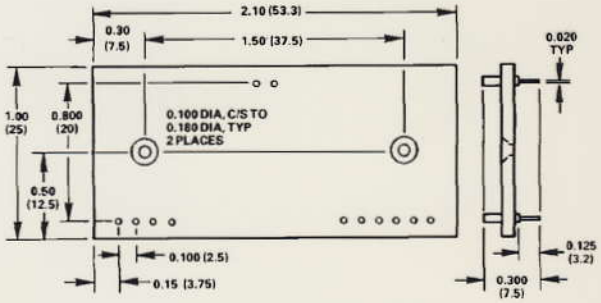
NOTES
*Specifications same as AD210AN.
[1]Nonlinearity is specified as a % deviation from a best straight line..
[2]RTI – Referred to Input.
[3]A reduced signal swing is recommended when both $\pm V_{ISS}$ and $\pm V_{OSS}$ supplies are fully loaded, due to supply voltage reduction.
[4]See text for detailed information.
Specifications subject to change without notice.

OUTLINE DIMENSIONS

Dimensions shown in inches and (mm).



AC1059 MATING SOCKET



AD210 PIN DESIGNATIONS

Pin	Designation	Function
1	V_O	Output
2	O_{COM}	Output Common
3	$+V_{OSS}$	+Isolated Power @ Output
4	$-V_{OSS}$	–Isolated Power @ Output
14	$+V_{ISS}$	+Isolated Power @ Input
15	$-V_{ISS}$	–Isolated Power @ Input
16	FB	Input Feedback
17	–IN	–Input
18	I_{COM}	Input Common
19	+IN	+Input
29	Pwr Com	Power Common
30	Pwr	Power Input

CAUTION

ESD (electrostatic discharge) sensitive device. Electrostatic charges as high as 4000 V readily accumulate on the human body and test equipment and can discharge without detection. Although the AD210 features proprietary ESD protection circuitry, permanent damage may occur on devices subjected to high energy electrostatic discharges. Therefore, proper ESD precautions are recommended to avoid performance degradation or loss of functionality.

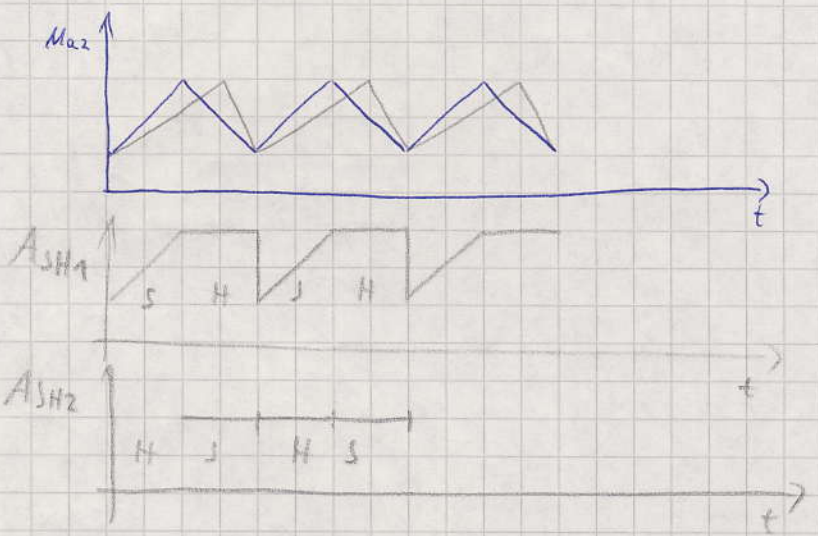
Schmitt-Trigger schaltet bei Erreichen der Umschaltschwellen S_1

- Schaltspannung wird übertragen

Mittelwert über 1 Periode:

$$\bar{S} = -\frac{U_e}{R_1}$$

2 S&H-Schaltungen in Kette eliminieren die Restwelligkeit von U_{a2}



Wieder Mittelwert über 1 Periode (Ausgang)

$$\bar{S} = -\frac{U_a}{R_2}$$

Folie ISO 121

c) optische Kopplung

Folie Prinzip

Folie HPCL-7840

extreme Isolationsspannungen ~~15 kV~~
schnelle CMR 15 kV/µs

Agilent Technologies
Innovating the HP Way

Isolation Amplifier

Technical Data

HCPL-7840

Features

- **15 kV/μs Common-Mode Rejection at V_{CM} = 1000 V**
- **Compact, Auto-Insertable Standard 8-pin DIP Package**
- **0.00025 V/V/°C Gain Drift vs. Temperature**
- **0.3 mV Input Offset Voltage**
- **100 kHz Bandwidth**
- **0.004% Nonlinearity**
- **Worldwide Safety Approval: UL 1577 (3750 Vrms/1 min.) and CSA (pending), VDE 0884 (Option #060 only)**
- **Advanced Sigma-Delta (Σ–Δ) A/D Converter Technology**
- **Fully Differential Circuit Topology**
- **0.8 μm CMOS IC Technology**

Applications

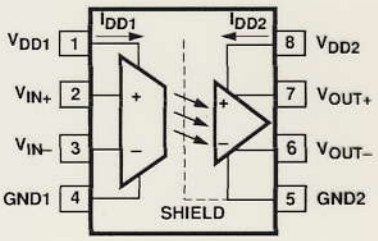
- **Motor Phase and Rail Current Sensing**
- **Inverter Current Sensing**
- **Switched Mode Power Supply Signal Isolation**
- **General Purpose Current Sensing and Monitoring**
- **General Purpose Analog Signal Isolation**

Description

The HCPL-7840 isolation amplifier family was designed for current sensing in electronic motor drives. In a typical implementation, motor currents flow through an external resistor and the resulting analog voltage drop is sensed by the HCPL-7840. A differential output voltage is created on the other side of the HCPL-7840 optical isolation barrier. This differential output voltage is proportional to the motor current and can be converted to a single-ended signal by using an op-amp as shown in the recommended application circuit. Since common-mode voltage swings of several hundred volts in tens of nanoseconds are common in modern switching inverter motor drives, the HCPL-7840 was designed to ignore very high common-mode transient slew rates (of at least 10 kV/μs).

The high CMR capability of the HCPL-7840 isolation amplifier provides the precision and stability needed to accurately monitor motor current in high noise motor control environments, providing for smoother control (less "torque ripple") in various types of motor control applications.

Functional Diagram



The product can also be used for general analog signal isolation applications requiring high accuracy, stability, and linearity under similarly severe noise conditions. For general applications, we recommend the HCPL-7840 (gain tolerance of ± 5%). The HCPL-7840 utilizes sigma delta (Σ-Δ) analog-to-digital converter technology, chopper stabilized amplifiers, and a fully differential circuit topology fabricated using

CAUTION: It is advised that normal static precautions be taken in handling and assembly of this component to prevent damage and/or degradation which may be induced by ESD.

Regulatory Information

The HCPL-7840 is pending approval by the following organizations:

VDE
Approval under VDE 0884/06.92 with V_{IORM} = 891 V_{PEAK} expected prior to product release.

UL
Approval under UL 1577, component recognition program up to V_{ISO} = 3750 Vrms expected prior to product release.

CSA
Approved under CSA Component Acceptance Notice #5, File CA 88324 expected prior to product release.

VDE 0884 Insulation Characteristics*

Description	Symbol	Characteristic	Unit
Installation classification per DIN VDE 0110/1.89, Table 1 for rated mains voltage ≤ 300 Vrms for rated mains voltage ≤ 450 Vrms for rated mains voltage ≤ 600 Vrms		 I-IV I-III I-II	
Climatic Classification		55/100/21	
Pollution Degree (DIN VDE 0110/1.89)		2	
Maximum Working Insulation Voltage	V_{IORM}	891	V_{PEAK}
Input to Output Test Voltage, Method b** V_{IORM} x 1.875 = V_{PR}, 100% Production Test with t_m = 1 sec, Partial discharge < 5 pC	V_{PR}	1670	V_{PEAK}
Input to Output Test Voltage, Method a** V_{IORM} x 1.5 = V_{PR}, Type and Sample Test, t_m = 60 sec, Partial discharge < 5 pC	V_{PR}	1336	V_{PEAK}
Highest Allowable Overvoltage (Transient Overvoltage t_{ini} = 10 sec)	V_{IOTM}	6000	V_{PEAK}
Safety-limiting values—maximum values allowed in the event of a failure. Case Temperature Input Current*** Output Power***	 T_S $I_{S,INPUT}$ $P_{S,OUTPUT}$	 175 400 600	 °C mA mW
Insulation Resistance at T_S, V_{IO} = 500 V	R_S	$>10^9$	Ω

*Insulation characteristics are guaranteed only within the safety maximum ratings which must be ensured by protective circuits within the application. Surface Mount Classification is Class A in accordance with CECC00802.
**Refer to the optocoupler section of the Isolation and Control Components Designer's Catalog, under Product Safety Regulations section, (VDE 0884) for a detailed description of Method a and Method b partial discharge test profiles.
***Refer to the following figure for dependence of P_S and I_S on ambient temperature.