EMC Experiment Demonstration.

"Immunity of an analogue and digital circuit to an electromagnetic field from electrostatic discharge (ESD)."

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The Triboelectric effect.

Contact charging and heat from local friction transfers energy to electrons, causing them to leave their outer valency orbit and locate in the outer valency orbit of another material. Producing charged objects.

The discharge phenomena.

An electrostatic discharge spark can occur between a charged object and a close proximity oppositely charged or conductive object. The electric field collapses, there is a very fast rate of change of current producing a magnetic field and an arising electromagnetic field. These can induce a pulse voltage in nearby circuit loops.

The demonstration.

Circuit immunity to an indirect air electrostatic discharge in close proximity to a calculator (representing a digital circuit) is demonstrated and a pyroelectric infrared (PIR) fire alarm detector (representing an analogue detector) is demonstrated. Digital circuits that are not immune to electromagnetic fields will lock-up and stop working but analogue circuits can recover.

Voltage induced in victim circuits, from Faradays Law is dependant on the rate of change of the source magnetic field; therefore the ESD immunity test is a severe one. The PIR detector is an interesting example of how identifying and solving a product ESD immunity problem, can ultimately generate an extremely robust and immune solution. To solve the immunity problem the FET transistor used in the PIR sensor was in fact re-designed with an integrated RC low pass filter.

The triboelectric series

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Air
Human hands
Catskin
Glass
Mica
Nylon
Wool
Lead
Silk
Aluminium
Paper
Cotton
Steel
Wood
Hard rubber
Nickel/Copper
Brass/Silver
Gold/Platinum
Sulphur
Rayon
Polyester
Orlon
Saran
Polyurethane
Polyethylene
Polypropylene
Polyvinylchloride
Silicon
Teflon

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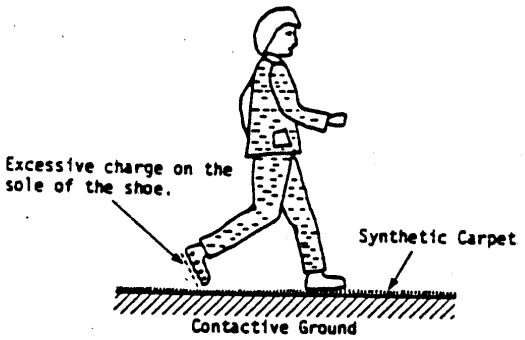
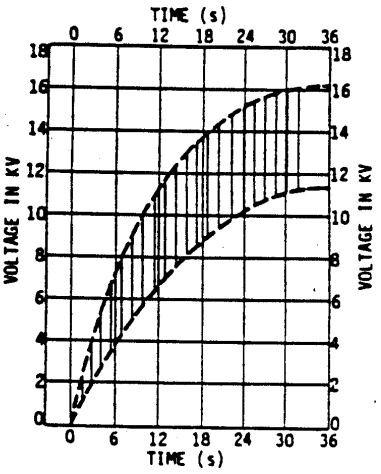
ILLUSTRATION OF CHARGE BUILD-UP



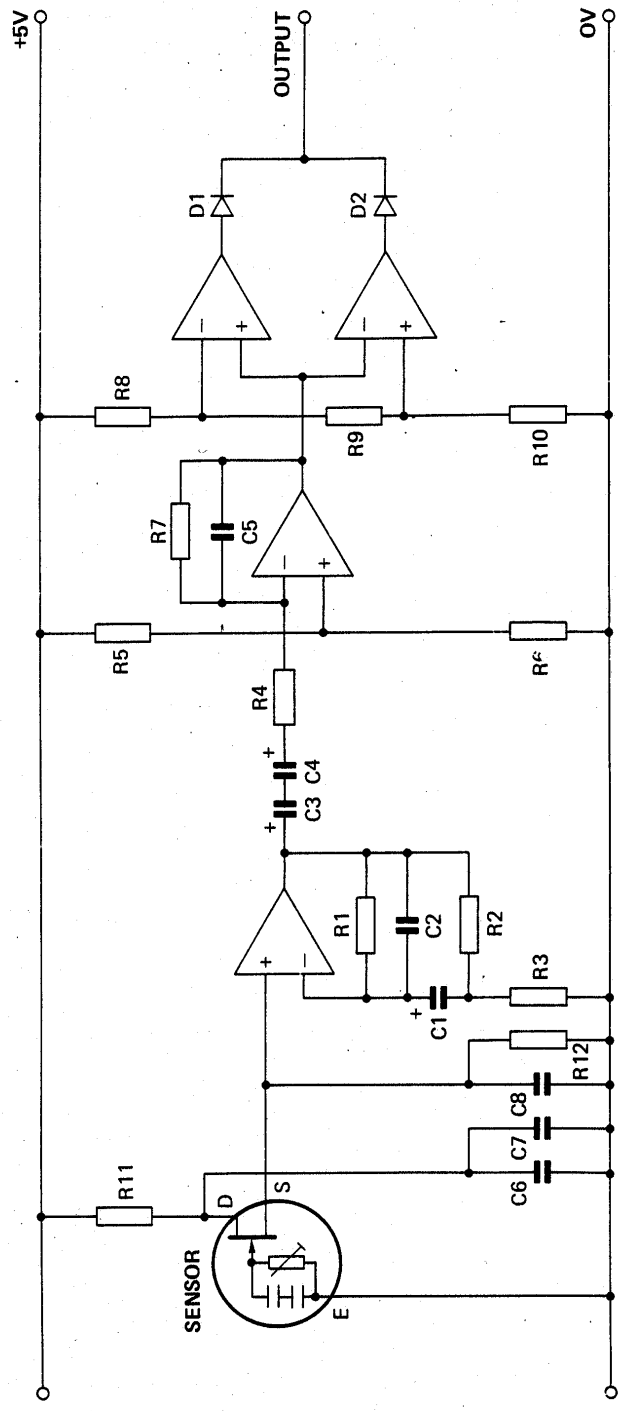
CHARGING PROCESS OF A PERSON



GRAPH OF VOLTAGE BUILD-UP

Some typical electrostatic voltage levels found on personnel engaged in various activities

Activity	Voltage 10 to 20% Humidity (V)	Voltage 65 to 90% Humidity (V)
Walking on carpet	35,000	1,500
Walking on vinyl floor	12,000	250
Working at bench	6,000	100
Handling vinyl envelopes	7,000	600
Packing up polyethylene bag	20,000	1,200
Sliding on foam padded chair	18,000	1,500



Front end signal processing circuitry for a conventional single-channel PIR system.

Analogue circuit used to demonstrate immunity to ESD.

Philips Components

Data sheet	
status	Preliminary specification
date of issue	April 1991

BFR200

N-channel junction field-effect transistor

FEATURES

- Ultra-low leakage performance ($-I_{GSS}$ max. 3 pA); important for use in highly sensitive equipment, such as burglar alarms, infrared sensors, etc.
- Insensitive to radio frequency interference (RFI), owing to an integrated low pass filter.
- Input protected against successive voltage surges by a forward and reverse integrated diode.
- Low LF noise performance (20 nV/√Hz).

DESCRIPTION

Silicon asymmetrical n-channel junction FET in a surface mount SOT143 envelope, with an integrated RC low pass filter and two anti-parallel diodes connected to the gate. It is designed primarily for use as a source follower in infrared detectors, burglar alarms, electret microphones, smoke alarms and radiation detectors.

QUICK REFERENCE DATA

SYMBOL	PARAMETER	MIN.	MAX.	UNIT
V_{DS}	drain-source voltage	-	30	V
I_{DSS}	drain current	0.2	3.5	mA
$-V_{GS(off)}$	gate-source cut-off voltage	0.5	2	V