

## CTC-025 JFET ESD

### Introduction:

The objective of this document is to provide information about the various types of ESD testing and methods, the kind of damage that ESD can cause to equipment, and the results of the ESD testing on InterFET products.

### What is ESD?

We are all familiar with the concept of electrostatic discharge, or ESD, because we often experience it when touching a metal doorknob after walking across a carpeted floor. It can give us quite a jolt, especially during winter when relative humidity is often low.

Electrostatic charge is defined as electric charge at rest. Electrostatic discharge is the spontaneous transfer of that charge. That charge usually travels as a spark between two bodies as they come close to each other, or touch. Electric charge can build up on even an insulative material, one that prevents or limits the flow of electrons.

ESD can create havoc in electronic components and systems. It can damage an expensive component that renders a complicated and expensive system useless. ESD comes with a cost; ESD damage during assembly affects profitability as it impacts production yields, manufacturing costs, product quality and reliability. As electronic devices get smaller and faster, sensitivity to ESD increases.

### Types of damage from ESD

1. Catastrophic damage that renders a device inoperable. This can be a result of damage to a semiconductor junction or connecting metallization.
2. Latent damage of a device can happen in which a device or sensitive circuit fails at some point in the future. It's important to note that static discharge has a cumulative effect.
3. Sensitive components or integrated circuits can be damaged when handled by humans, during assembling in an automated process, or due to user interactions in the end application. ESD damage to ICs can occur at any time, from assembly to board level soldering and user interactions. Significant voltage and current spikes can occur in the end user environment from ESD event that results in system failure.

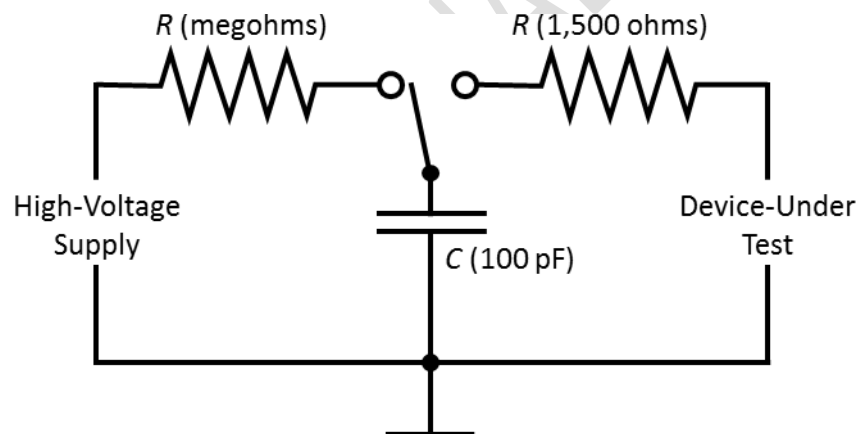
## ESD Classifications and Measurements

ESD events are simulated or characterized by four different models:

- HBM: human body model
- MM: Machine Model
- CDM: charged device model
- IEC 61000-4-2 System level immunity standard by the International Electrotechnical Commission

### Human Body Model (HBM)

The HBM is the oldest model and was originally developed for investigating explosions of gas fixtures and mines. This model is intended to emulate ESD events caused by human handling and is perhaps the most familiar or common. This is the direct transfer of electrostatic charge from a human body to an ESD sensitive device (ESDS). An individual can pick up a charge simply from walking across the floor, and subsequent contact, or proximity, allows discharge of energy. The HBM is referenced in ANSI/ESDA/JEDEC JS-001 “electrostatic discharge sensitivity testing human body model component level” and is represented by the circuit below:



The above capacitor is charged by a high voltage supply through a high megaohm resistor and then switched so the energy is discharged through a 1500 ohm series resistor and the component to ground potential.

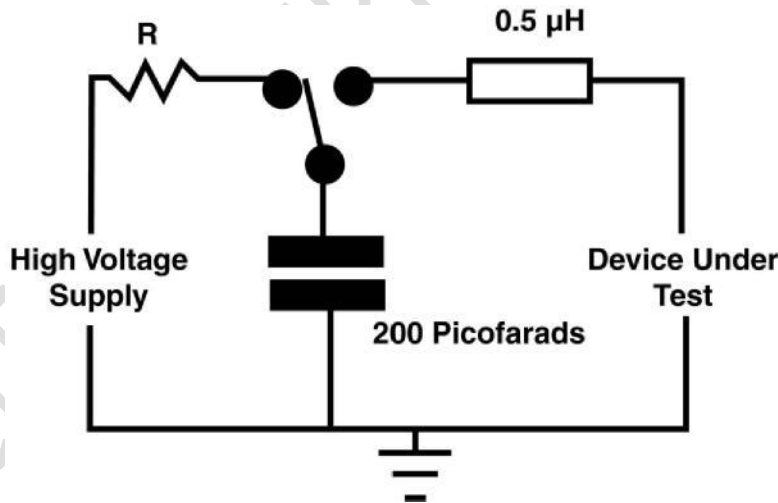
This model addresses handling issues of a part. It is designed to represent the discharge from a person’s finger to the device. A failed device is one that does not meet the datasheet parameters using parametric and functional tests.

The HBM method includes a classification system for defining component sensitivity. This allows comparison of different components according to their sensitivity:

Class	Voltage Range (V)
0Z	< 50
0A	50 to < 125
0B	125 to < 250
1A	250 to < 500
1B	500 to < 1000
1C	1000 to < 2000
2	2000 to < 4000
3A	4000 to < 8000
3B	>= 8000

### Machine Model (MM)

The machine model originated in Japan to create a worst-case version of the human body model and it was intended to emulate ESD events caused by automated handling. This is simulated with a 200 pF capacitor discharged directly into a component with without the 1500 ohm resistor used in the HBM. Series inductance (shown below) is the dominant parasitic element that shapes the oscillating waveform of the MM. Since the inductance has not been uniformly established, the voltage the device can withstand might differ by a factor between two and five in different test setups. For this reason, JEDEC and ESDA recommends qualifying components using the HBM or the CDM described later.

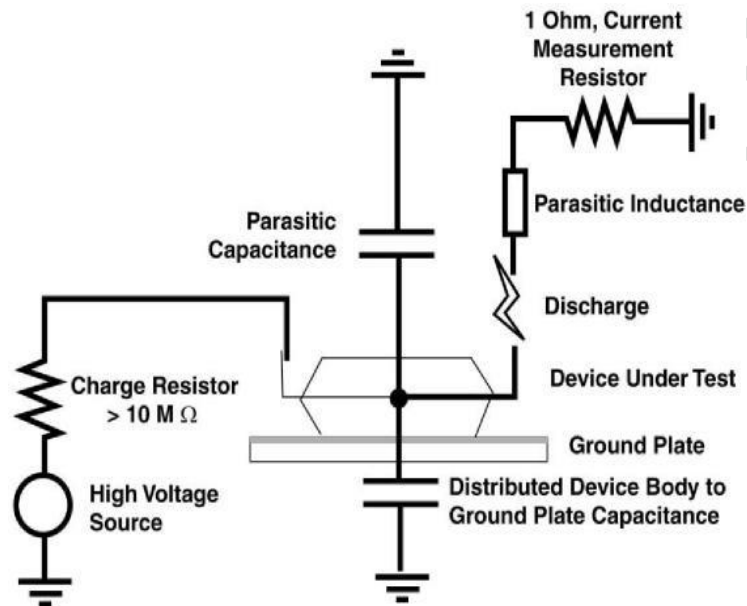


Class	Voltage Range (V)
M1	< 100
M2	100 to < 200
M3	200 to < 400
M4	>= 400

### Charged Device Model (CDM)

The transfer from an ESDS device to a conductive device (at a lower potential) is also an ESD event that can be more damaging than the HBM event. The duration of discharge in the case of the CDM is rather short but the peak current can reach several tens of amperes. This can result in the breakdown of dielectric and do other harm. The CDM model is intended emulate ESD events caused by products charging or discharging

The standard for device testing is specified in JS-002 and is represented below:



In this test, the device under test (DUT) is placed on a field plate with all leads pointing up, thus all pins are treated equally. They are discharged after positive and negative charging.

Both HDM and CDM classifications are helpful as they allow objective comparison and groupings of ESD sensitive components; the designer has an indication of the level of ESD production necessary to support each component.

Class	Voltage Range (V)
C0A	< 125
C0B	125 to < 250
C1	250 to < 500
C2A	500 to < 750
C2B	750 to < 1000
C3	>= 1000

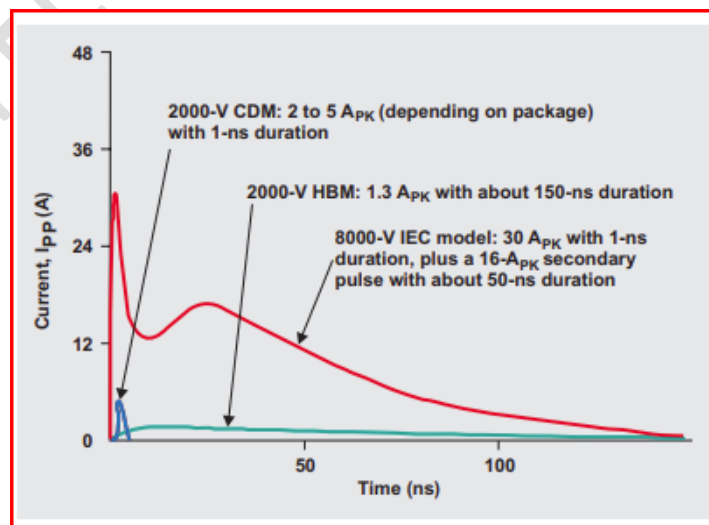
## IEC 61000-4-2

The purpose of the IEC 61000-4-2 standard is to characterize system-level threats. The three models mentioned above allows a circuit designer or component engineer to compare components, with a general understanding of the level of ESD sensitivity for a given part. They serve as guides, not necessarily as absolutes. In the end user application, the levels of both voltages and currents from an ESD strike can be much greater at the system level. The IEC standard is intended to simulate ESD events at the system level in the real world. This standard covers two discharge mechanisms: Contact discharge (where two surfaces at different potential physically touch) and air gap discharge. The range of test levels for both contact discharge and air gap discharge are shown below:

Contact Discharge	Test Voltage (kV)	Air Discharge	Test Voltage (kV)
1	2	1	2
2	4	2	4
3	6	3	8
4	8	4	15

For purpose of comparison of component level with system level models:

Model	HBM	MM	CDM	IEC
Definition	Human body discharging static	Discharge of accumulated static in assembly	Charged device being grounded	Real world system level threats to ESD
Test levels (voltage)	500 - 2000 V	100 - 200 V	250 - 2000 V	2000 -15000 V
Pulse Width (ns) approx.	150	80	1	150
Peak Current at 2kV applied (A)	1.33	-	5	7.5
Rise Time	25 ns	-	< 400 ps	< 1 ns
Number of strikes	2	2	2	20



## How well do JFETs Handle ESD?

Because JFETs are [voltage controlled](#) devices, as well as the lack of any oxidizing layer, and their simple construction, JFETs are much more resistant to ESD than MOSFETs. A positive ESD event on a [JFET](#) is likely to run the JFET in forward bias mode, unlikely to damage the JFET. In the case of a reverse bias event, this will likely surpass the breakdown voltage, however if the current is not too large, damage to the JFET is not incurred.

Testing results for all InterFET JFET's are listed in the tables below:

## InterFET ESD Results

Part Number	Geometry	Package	Configuration	ESD MM Class	ESD HBM Class
2N2608	P0032F	TO-18	SINGLE	M4	3A
2N2609	P0032F	TO-18	SINGLE	M4	3A
2N3330	P0032F	TO-72	SINGLE	M4	3A
2N3331	P0032F	TO-72	SINGLE	M4	3A
2N3458	N0032H	TO-18	SINGLE	M4	3A
2N3459	N0016H	TO-18	SINGLE	M4	3A
2N3460	N0016H	TO-18	SINGLE	M4	3A
2N3819	N0032H	TO-92	SINGLE	M4	3A
2N3821	N0032H	TO-72	SINGLE	M4	3A
2N3822	N0032H	TO-72	SINGLE	M4	3A
2N3823	N0032H	TO-72	SINGLE	M4	3A
2N3824	N0032H	TO-72	SINGLE	M4	3A
2N3969	N0016H	TO-72	SINGLE	M4	3A
2N3970	N0132S	TO-18	SINGLE	M4	3B
2N3971	N0132S	TO-18	SINGLE	M4	3B
2N3972	N0132S	TO-18	SINGLE	M4	3B
2N4091	N0132S	TO-18	SINGLE	M4	3B
2N4092	N0132S	TO-18	SINGLE	M4	3B
2N4093	N0132S	TO-18	SINGLE	M4	3B
2N4117	N0001H	TO-72	SINGLE	M4	3A
2N4117A	N0001H	TO-72	SINGLE	M4	3A
2N4118	N0001H	TO-72	SINGLE	M4	3A
2N4118A	N0001H	TO-72	SINGLE	M4	3A
2N4119	N0001H	TO-72	SINGLE	M4	3A
2N4119A	N0001H	TO-72	SINGLE	M4	3A
2N4220	N0016H	TO-72	SINGLE	M4	3A
2N4220A	N0016H	TO-72	SINGLE	M4	3A
2N4221	N0016H	TO-72	SINGLE	M4	3A
2N4221A	N0016H	TO-72	SINGLE	M4	3A
2N4222	N0032H	TO-72	SINGLE	M4	3A
2N4222A	N0032H	TO-72	SINGLE	M4	3A
2N4302	N0026S	TO-92	SINGLE	M4	3A
2N4303	N0026S	TO-92	SINGLE	M4	3A
2N4304	N0026S	TO-92	SINGLE	M4	3A
2N4338	N0016H	TO-18	SINGLE	M4	3A
2N4339	N0016H	TO-18	SINGLE	M4	3A

Part Number	Geometry	Package	Configuration	ESD MM Class	ESD HBM Class
2N4340	N0016H	TO-18	SINGLE	M4	3A
2N4341	N0016H	TO-18	SINGLE	M4	3A
2N4391	N0132S	TO-18	SINGLE	M4	3B
2N4392	N0132S	TO-18	SINGLE	M4	3B
2N4393	N0132S	TO-18	SINGLE	M4	3B
2N4416	N0026S	TO-72	SINGLE	M4	3A
2N4416A	N0026S	TO-72	SINGLE	M4	3A
2N4856	N0132S	TO-18	SINGLE	M4	3B
2N4856A	N0132S	TO-18	SINGLE	M4	3B
2N4857	N0132S	TO-18	SINGLE	M4	3B
2N4857A	N0132S	TO-18	SINGLE	M4	3B
2N4858	N0132S	TO-18	SINGLE	M4	3B
2N4858A	N0132S	TO-18	SINGLE	M4	3B
2N4859	N0132S	TO-18	SINGLE	M4	3B
2N4859A	N0132S	TO-18	SINGLE	M4	3B
2N4860	N0132S	TO-18	SINGLE	M4	3B
2N4860A	N0132S	TO-18	SINGLE	M4	3B
2N4861	N0132S	TO-18	SINGLE	M4	3B
2N4861A	N0132S	TO-18	SINGLE	M4	3B
2N4867	N0016H	TO-72	SINGLE	M4	3A
2N4867A	N0016H	TO-72	SINGLE	M4	3A
2N4868	N0016H	TO-72	SINGLE	M4	3A
2N4868A	N0016H	TO-72	SINGLE	M4	3A
2N4869	N0016H	TO-72	SINGLE	M4	3A
2N4869A	N0016H	TO-72	SINGLE	M4	3A
2N5019	P0099F	TO-18	SINGLE	M4	3B
2N5020	P0032F	TO-18	SINGLE	M4	3A
2N5021	P0032F	TO-18	SINGLE	M4	3A
2N5114	P0099F	TO-18	SINGLE	M4	3B
2N5115	P0099F	TO-18	SINGLE	M4	3B
2N5116	P0099F	TO-18	SINGLE	M4	3B
2N5397	N0026L	TO-72	SINGLE	M4	3A
2N5398	N0026L	TO-72	SINGLE	M4	3A
2N5457	N0032H	TO-92	SINGLE	M4	3A
2N5460	P0032F	TO-92	SINGLE	M4	3A
2N5461	P0032F	TO-92	SINGLE	M4	3A
2N5462	P0032F	TO-92	SINGLE	M4	3A
2N5463	P0032F	TO-92	SINGLE	M4	3A
2N5464	P0032F	TO-92	SINGLE	M4	3A
2N5465	P0032F	TO-92	SINGLE	M4	3A



Part Number	Geometry	Package	Configuration	ESD MM Class	ESD HBM Class
2N5484	N0026S	TO-92	SINGLE	M4	3A
2N5485	N0026S	TO-92	SINGLE	M4	3A
2N5486	N0026S	TO-92	SINGLE	M4	3A
2N5949	N0032H	TO-92	SINGLE	M4	3A
2N6449	N0042Y	TO-39	SINGLE	M4	3A
2N6450	N0042Y	TO-39	SINGLE	M4	3A
2N6451	N0132L	TO-72	SINGLE	M4	3B
2N6452	N0132L	TO-72	SINGLE	M4	3B
2N6453	N0132L	TO-72	SINGLE	M4	3B
2N6454	N0132L	TO-72	SINGLE	M4	3B
2N6550	N0450L	TO-46	SINGLE	M4	3B
IF1320ST3	N0132L	SOT-23	SINGLE	M4	3B
IF1320T72	N0132L	TO-72	SINGLE	M4	3B
IF1322AS08	N0132L	SOIC-8	DUAL	M4	3B
IF1322AT71	N0132L	TO-71	DUAL	M4	3B
IF1322S08	N0132L	SOIC-8	DUAL	M4	3B
IF1322T71	N0132L	TO-71	DUAL	M4	3B
IF140AST3	N0014L	SOT-23	SINGLE	M4	3A
IF140AT72	N0014L	TO-72	SINGLE	M4	3A
IF140ST3	N0014L	SOT-23	SINGLE	M4	3A
IF140T72	N0014L	TO-72	SINGLE	M4	3A
IF150AST3	N0014LX	SOT-23	SINGLE	M4	3A
IF150AT72	N0014LX	TO-72	SINGLE	M4	3A
IF150BST3	N0014LX	SOT-23	SINGLE	M4	3A
IF150BT72	N0014LX	TO-72	SINGLE	M4	3A
IF150CST3	N0014LX	SOT-23	SINGLE	M4	3A
IF150CT72	N0014LX	TO-72	SINGLE	M4	3A
IF170AST3	N0132L	SOT-23	SINGLE	M4	3B
IF170AT72	N0132L	TO-72	SINGLE	M4	3B
IF170AT92	N0132L	TO-92	SINGLE	M4	3B
IF170BST3	N0132L	SOT-23	SINGLE	M4	3B
IF170BT72	N0132L	TO-72	SINGLE	M4	3B
IF170BT92	N0132L	TO-92	SINGLE	M4	3B
IF170CST3	N0132L	SOT-23	SINGLE	M4	3B
IF170CT72	N0132L	TO-72	SINGLE	M4	3B
IF170CT92	N0132L	TO-92	SINGLE	M4	3B
IF170DST3	N0132L	SOT-23	SINGLE	M4	3B
IF170DT72	N0132L	TO-72	SINGLE	M4	3B
IF170DT92	N0132L	TO-92	SINGLE	M4	3B
IF3601T39	N3600L	TO-39	SINGLE	M4	3B

Part Number	Geometry	Package	Configuration	ESD MM Class	ESD HBM Class
IF3602T78	N3600L	TO-78	DUAL	M4	3B
IF389AS08	N0132L	SOIC-8	DUAL	M4	3B
IF389AT71	N0132L	TO-71	DUAL	M4	3B
IF389BS08	N0132L	SOIC-8	DUAL	M4	3B
IF389BT71	N0132L	TO-71	DUAL	M4	3B
IF389CS08	N0132L	SOIC-8	DUAL	M4	3B
IF389CT71	N0132L	TO-71	DUAL	M4	3B
IF389DS08	N0132L	SOIC-8	DUAL	M4	3B
IF389DT71	N0132L	TO-71	DUAL	M4	3B
IF4500ST3	N0450L	SOT-23	SINGLE	M4	3B
IF4500T72	N0450L	TO-72	SINGLE	M4	3B
IF4510ST3	N0450H	SOT-23	SINGLE	M4	3B
IF4510T72	N0450H	TO-72	SINGLE	M4	3B
IF4520ST3	N0450S	SOT-23	SINGLE	M4	3B
IF4520T18	N0450S	TO-18	SINGLE	M4	3B
IF9000ST3	N9000L	SOT-23	SINGLE	M4	3B
IF9000T72	N9000L	TO-72	SINGLE	M4	3B
IF9030T52	N0903L	TO-52	SINGLE	M4	3B
IF9034T78	N0903L	TO-78	DUAL	M4	3B
IF9035T78	N0903L	TO-78	DUAL	M4	3B
IFBF510	N0026L	TO-72	SINGLE	M4	3A
IFBF511	N0026L	TO-72	SINGLE	M4	3A
IFBF512	N0026L	TO-72	SINGLE	M4	3A
IFBF513	N0026L	TO-72	SINGLE	M4	3A
IFD89SC5	N0014EU	SC-70-5	SINGLE	M4	3A
IFD89T72	N0014EU	TO-72	SINGLE	M4	3A
IFN105	N0016H	TO-92	SINGLE	M4	3A
IFN112	N0132H	TO-18	SINGLE	M4	3B
IFN113	N0132S	TO-18	SINGLE	M4	3B
IFN146	N0450H	TO-71	DUAL	M4	3B
IFN147	N0450H	TO-18	SINGLE	M4	3B
IFN152	N0132L	TO-18	SINGLE	M4	3B
IFN160A	N107A	SOT-23	SINGLE	M4	3A
IFN160B	N107A	SOT-23	SINGLE	M4	3A
IFN160C	N107A	SOT-23	SINGLE	M4	3A
IFN17	N0016H	TO-92	SINGLE	M4	3A
IFN201	N106A	SOT-23	SINGLE	M4	3A
IFN201A	N106A	SOT-23	SINGLE	M4	3A
IFN202	N106A	SOT-23	SINGLE	M4	3A
IFN363	N0450S	TO-18	SINGLE	M4	3B

Part Number	Geometry	Package	Configuration	ESD MM Class	ESD HBM Class
IFN3954	N0016H	TO-71	DUAL	M4	3A
IFN3955	N0016H	TO-71	DUAL	M4	3A
IFN3956	N0016H	TO-71	DUAL	M4	3A
IFN3957	N0016H	TO-71	DUAL	M4	3A
IFN3958	N0016H	TO-71	DUAL	M4	3A
IFN3993	P0099F	TO-72	SINGLE	M4	3B
IFN3994	P0099F	TO-72	SINGLE	M4	3B
IFN40	N0016H	TO-92	SINGLE	M4	3A
IFN5197	N0016H	TO-71	DUAL	M4	3A
IFN5198	N0016H	TO-71	DUAL	M4	3A
IFN5199	N0016H	TO-71	DUAL	M4	3A
IFN5432	N0903L	TO-52	SINGLE	M4	3B
IFN5433	N0903L	TO-52	SINGLE	M4	3B
IFN5434	N0903L	TO-52	SINGLE	M4	3B
IFN5564	N0072S	TO-71	DUAL	M4	3B
IFN5565	N0072S	TO-71	DUAL	M4	3B
IFN5566	N0072S	TO-71	DUAL	M4	3B
IFN59	N0016H	TO-92	SINGLE	M4	3A
IFN5911	N0030L	TO-78	DUAL	M4	3A
IFN5912	N0030L	TO-78	DUAL	M4	3A
IFN6449	N0042Y	TO-39	SINGLE	M4	3A
IFN6450	N0042Y	TO-39	SINGLE	M4	3A
IFN860	N0450L	TO-71	DUAL	M4	3B
IFNU231	N0016H	TO-71	DUAL	M4	3A
IFNU232	N0016H	TO-71	DUAL	M4	3A
IFNU233	N0016H	TO-71	DUAL	M4	3A
IFNU234	N0016H	TO-71	DUAL	M4	3A
IFNU235	N0016H	TO-71	DUAL	M4	3A
IFNU257	N0030L	TO-78	DUAL	M4	3A
IFNU401	N0016H	TO-71	DUAL	M4	3A
IFNU402	N0016H	TO-71	DUAL	M4	3A
IFNU403	N0016H	TO-71	DUAL	M4	3A
IFNU404	N0016H	TO-71	DUAL	M4	3A
IFNU405	N0016H	TO-71	DUAL	M4	3A
IFNU406	N0016H	TO-71	DUAL	M4	3A
IFNU410	N0016H	TO-71	DUAL	M4	3A
IFNU411	N0016H	TO-71	DUAL	M4	3A
IFNU412	N0016H	TO-71	DUAL	M4	3A
IFNU421	N0001H	TO-78	DUAL	M4	3A
IFNU422	N0001H	TO-78	DUAL	M4	3A

Part Number	Geometry	Package	Configuration	ESD MM Class	ESD HBM Class
IFNU423	N0001H	TO-78	DUAL	M4	3A
IFNU424	N0001H	TO-78	DUAL	M4	3A
IFNU425	N0001H	TO-78	DUAL	M4	3A
IFNU426	N0001H	TO-78	DUAL	M4	3A
IFP44	P0099F	TO-18	SINGLE	M4	3B
IFP5020A	P0032F	TO-18	SINGLE	M4	3A
IFP5020B	P0032F	TO-18	SINGLE	M4	3A
J108	N0450S	TO-92	SINGLE	M4	3B
J109	N0450S	TO-92	SINGLE	M4	3B
J110	N0450S	TO-92	SINGLE	M4	3B
J110A	N0450S	TO-92	SINGLE	M4	3B
J111	N0132S	TO-92	SINGLE	M4	3B
J111A	N0132S	TO-92	SINGLE	M4	3B
J112	N0132S	TO-92	SINGLE	M4	3B
J112A	N0132S	TO-92	SINGLE	M4	3B
J113	N0132S	TO-92	SINGLE	M4	3B
J113A	N0132S	TO-92	SINGLE	M4	3B
J174	P0099F	TO-92	SINGLE	M4	3B
J175	P0099F	TO-92	SINGLE	M4	3B
J176	P0099F	TO-92	SINGLE	M4	3B
J177	P0099F	TO-92	SINGLE	M4	3B
J201	N0016H	TO-92	SINGLE	M4	3A
J202	N0016H	TO-92	SINGLE	M4	3A
J203	N0016H	TO-92	SINGLE	M4	3A
J204	N0016H	TO-92	SINGLE	M4	3A
J210	N0026L	TO-92	SINGLE	M4	3A
J211	N0026L	TO-92	SINGLE	M4	3A
J212	N0026L	TO-92	SINGLE	M4	3A
J230	N0016H	TO-92	SINGLE	M4	3A
J231	N0016H	TO-92	SINGLE	M4	3A
J232	N0016H	TO-92	SINGLE	M4	3A
J270	P0099F	TO-92	SINGLE	M4	3B
J271	P0099F	TO-92	SINGLE	M4	3B
J304	N0026S	TO-92	SINGLE	M4	3A
J305	N0026S	TO-92	SINGLE	M4	3A
J308	N0072L	TO-92	SINGLE	M4	3B
J309	N0072L	TO-92	SINGLE	M4	3B
J310	N0072L	TO-92	SINGLE	M4	3B
P1086	P0099F	TO-92	SINGLE	M4	3B
P1087	P0099F	TO-92	SINGLE	M4	3B

Part Number	Geometry	Package	Configuration	ESD MM Class	ESD HBM Class
PN112	N0132H	TO-92	SINGLE	M4	3B
PN113	N0132S	TO-92	SINGLE	M4	3B
PN147	N0450H	TO-92	SINGLE	M4	3B
PN152	N0132L	TO-92	SINGLE	M4	3B
PN2608	P0032F	TO-92	SINGLE	M4	3A
PN2609	P0032F	TO-92	SINGLE	M4	3A
PN3330	P0032F	TO-92	SINGLE	M4	3A
PN3331	P0032F	TO-92	SINGLE	M4	3A
PN3458	N0032H	TO-92	SINGLE	M4	3A
PN3459	N0016H	TO-92	SINGLE	M4	3A
PN3460	N0016H	TO-92	SINGLE	M4	3A
PN363	N0450S	TO-92	SINGLE	M4	3B
PN3821	N0032H	TO-92	SINGLE	M4	3A
PN3822	N0032H	TO-92	SINGLE	M4	3A
PN3823	N0032H	TO-92	SINGLE	M4	3A
PN3824	N0032H	TO-92	SINGLE	M4	3A
PN3970	N0132S	TO-92	SINGLE	M4	3B
PN3971	N0132S	TO-92	SINGLE	M4	3B
PN3972	N0132S	TO-92	SINGLE	M4	3B
PN3993	P0099F	TO-92	SINGLE	M4	3B
PN3994	P0099F	TO-92	SINGLE	M4	3B
PN4091	N0132S	TO-92	SINGLE	M4	3B
PN4092	N0132S	TO-92	SINGLE	M4	3B
PN4093	N0132S	TO-92	SINGLE	M4	3B
PN4117	N0001H	TO-92	SINGLE	M4	3A
PN4117A	N0001H	TO-92	SINGLE	M4	3A
PN4118	N0001H	TO-92	SINGLE	M4	3A
PN4118A	N0001H	TO-92	SINGLE	M4	3A
PN4119	N0001H	TO-92	SINGLE	M4	3A
PN4119A	N0001H	TO-92	SINGLE	M4	3A
PN4220	N0016H	TO-92	SINGLE	M4	3A
PN4220A	N0016H	TO-92	SINGLE	M4	3A
PN4221	N0016H	TO-92	SINGLE	M4	3A
PN4221A	N0016H	TO-92	SINGLE	M4	3A
PN4222	N0032H	TO-92	SINGLE	M4	3A
PN4222A	N0032H	TO-92	SINGLE	M4	3A
PN4338	N0016H	TO-92	SINGLE	M4	3A
PN4339	N0016H	TO-92	SINGLE	M4	3A
PN4340	N0016H	TO-92	SINGLE	M4	3A
PN4341	N0016H	TO-92	SINGLE	M4	3A

Part Number	Geometry	Package	Configuration	ESD MM Class	ESD HBM Class
PN4391	N0132S	TO-92	SINGLE	M4	3B
PN4392	N0132S	TO-92	SINGLE	M4	3B
PN4393	N0132S	TO-92	SINGLE	M4	3B
PN44	P0099F	TO-92	SINGLE	M4	3B
PN4416	N0026S	TO-92	SINGLE	M4	3A
PN4416A	N0026S	TO-92	SINGLE	M4	3A
PN4856	N0132S	TO-92	SINGLE	M4	3B
PN4856A	N0132S	TO-92	SINGLE	M4	3B
PN4857	N0132S	TO-92	SINGLE	M4	3B
PN4857A	N0132S	TO-92	SINGLE	M4	3B
PN4858	N0132S	TO-92	SINGLE	M4	3B
PN4858A	N0132S	TO-92	SINGLE	M4	3B
PN4859	N0132S	TO-92	SINGLE	M4	3B
PN4859A	N0132S	TO-92	SINGLE	M4	3B
PN4860	N0132S	TO-92	SINGLE	M4	3B
PN4860A	N0132S	TO-92	SINGLE	M4	3B
PN4861	N0132S	TO-92	SINGLE	M4	3B
PN4861A	N0132S	TO-92	SINGLE	M4	3B
PN4867	N0016H	TO-92	SINGLE	M4	3A
PN4867A	N0016H	TO-92	SINGLE	M4	3A
PN4868	N0016H	TO-92	SINGLE	M4	3A
PN4868A	N0016H	TO-92	SINGLE	M4	3A
PN4869	N0016H	TO-92	SINGLE	M4	3A
PN4869A	N0016H	TO-92	SINGLE	M4	3A
PN5019	P0099F	TO-92	SINGLE	M4	3B
PN5020	P0032F	TO-92	SINGLE	M4	3A
PN5020A	P0032F	TO-92	SINGLE	M4	3A
PN5020B	P0032F	TO-92	SINGLE	M4	3A
PN5021	P0032F	TO-92	SINGLE	M4	3A
PN5114	P0099F	TO-92	SINGLE	M4	3B
PN5115	P0099F	TO-92	SINGLE	M4	3B
PN5116	P0099F	TO-92	SINGLE	M4	3B
PN5397	N0026L	TO-92	SINGLE	M4	3A
PN5398	N0026L	TO-92	SINGLE	M4	3A
PN6451	N0132L	TO-92	SINGLE	M4	3B
PN6452	N0132L	TO-92	SINGLE	M4	3B
PN6453	N0132L	TO-92	SINGLE	M4	3B
PN6454	N0132L	TO-92	SINGLE	M4	3B
PN6550	N0450L	TO-92	SINGLE	M4	3B
PNBF510	N0026L	TO-92	SINGLE	M4	3A

Part Number	Geometry	Package	Configuration	ESD MM Class	ESD HBM Class
PNBF511	N0026L	TO-92	SINGLE	M4	3A
PNBF512	N0026L	TO-92	SINGLE	M4	3A
PNBF513	N0026L	TO-92	SINGLE	M4	3A
PNU304	P0099F	TO-92	SINGLE	M4	3B
PNU305	P0099F	TO-92	SINGLE	M4	3B
PNU306	P0099F	TO-92	SINGLE	M4	3B
PNU308	N0072L	TO-92	SINGLE	M4	3B
PNU309	N0072L	TO-92	SINGLE	M4	3B
PNU310	N0072L	TO-92	SINGLE	M4	3B
PNU311	N0072L	TO-92	SINGLE	M4	3B
PNVCR2N	N0072L	TO-92	SINGLE	M4	3B
PNVCR3P	P0099F	TO-92	SINGLE	M4	3B
PNVCR4N	N0016H	TO-92	SINGLE	M4	3A
PNVCR7N	N0001H	TO-92	SINGLE	M4	3A
SMP105	N0016H	SOT-23	SINGLE	M4	3A
SMP112	N0132H	SOT-23	SINGLE	M4	3B
SMP113	N0132S	SOT-23	SINGLE	M4	3B
SMP146	N0450H	SOIC-8	DUAL	M4	3B
SMP147	N0450H	SOT-23	SINGLE	M4	3B
SMP152	N0132L	SOT-23	SINGLE	M4	3B
SMP17	N0016H	SOT-23	SINGLE	M4	3A
SMP2608	P0032F	SOT-23	SINGLE	M4	3A
SMP2609	P0032F	SOT-23	SINGLE	M4	3A
SMP3330	P0032F	SOT-23	SINGLE	M4	3A
SMP3331	P0032F	SOT-23	SINGLE	M4	3A
SMP3458	N0032H	SOT-23	SINGLE	M4	3A
SMP3459	N0016H	SOT-23	SINGLE	M4	3A
SMP3460	N0016H	SOT-23	SINGLE	M4	3A
SMP363	N0450S	SOT-23	SINGLE	M4	3B
SMP3819	N0032H	SOT-23	SINGLE	M4	3A
SMP3821	N0032H	SOT-23	SINGLE	M4	3A
SMP3822	N0032H	SOT-23	SINGLE	M4	3A
SMP3823	N0032H	SOT-23	SINGLE	M4	3A
SMP3824	N0032H	SOT-23	SINGLE	M4	3A
SMP3954	N0016H	SOIC-8	DUAL	M4	3A
SMP3955	N0016H	SOIC-8	DUAL	M4	3A
SMP3956	N0016H	SOIC-8	DUAL	M4	3A
SMP3957	N0016H	SOIC-8	DUAL	M4	3A
SMP3958	N0016H	SOIC-8	DUAL	M4	3A
SMP3969	N0016H	SOT-23	SINGLE	M4	3A

Part Number	Geometry	Package	Configuration	ESD MM Class	ESD HBM Class
SMP3970	N0132S	SOT-23	SINGLE	M4	3B
SMP3971	N0132S	SOT-23	SINGLE	M4	3B
SMP3972	N0132S	SOT-23	SINGLE	M4	3B
SMP3993	P0099F	SOT-23	SINGLE	M4	3B
SMP3994	P0099F	SOT-23	SINGLE	M4	3B
SMP40	N0016H	SOT-23	SINGLE	M4	3A
SMP4091	N0132S	SOT-23	SINGLE	M4	3B
SMP4092	N0132S	SOT-23	SINGLE	M4	3B
SMP4093	N0132S	SOT-23	SINGLE	M4	3B
SMP4117	N0001H	SOT-23	SINGLE	M4	3A
SMP4117A	N0001H	SOT-23	SINGLE	M4	3A
SMP4118	N0001H	SOT-23	SINGLE	M4	3A
SMP4118A	N0001H	SOT-23	SINGLE	M4	3A
SMP4119	N0001H	SOT-23	SINGLE	M4	3A
SMP4119A	N0001H	SOT-23	SINGLE	M4	3A
SMP4220	N0016H	SOT-23	SINGLE	M4	3A
SMP4220A	N0016H	SOT-23	SINGLE	M4	3A
SMP4221	N0016H	SOT-23	SINGLE	M4	3A
SMP4221A	N0016H	SOT-23	SINGLE	M4	3A
SMP4222	N0032H	SOT-23	SINGLE	M4	3A
SMP4222A	N0032H	SOT-23	SINGLE	M4	3A
SMP4302	N0026S	SOT-23	SINGLE	M4	3A
SMP4303	N0026S	SOT-23	SINGLE	M4	3A
SMP4304	N0026S	SOT-23	SINGLE	M4	3A
SMP4338	N0016H	SOT-23	SINGLE	M4	3A
SMP4339	N0016H	SOT-23	SINGLE	M4	3A
SMP4340	N0016H	SOT-23	SINGLE	M4	3A
SMP4341	N0016H	SOT-23	SINGLE	M4	3A
SMP4391	N0132S	SOT-23	SINGLE	M4	3B
SMP4392	N0132S	SOT-23	SINGLE	M4	3B
SMP4393	N0132S	SOT-23	SINGLE	M4	3B
SMP44	P0099F	SOT-23	SINGLE	M4	3B
SMP4416	N0026S	SOT-23	SINGLE	M4	3A
SMP4416A	N0026S	SOT-23	SINGLE	M4	3A
SMP4856	N0132S	SOT-23	SINGLE	M4	3B
SMP4856A	N0132S	SOT-23	SINGLE	M4	3B
SMP4857	N0132S	SOT-23	SINGLE	M4	3B
SMP4857A	N0132S	SOT-23	SINGLE	M4	3B
SMP4858	N0132S	SOT-23	SINGLE	M4	3B
SMP4858A	N0132S	SOT-23	SINGLE	M4	3B



Part Number	Geometry	Package	Configuration	ESD MM Class	ESD HBM Class
SMP4859	N0132S	SOT-23	SINGLE	M4	3B
SMP4859A	N0132S	SOT-23	SINGLE	M4	3B
SMP4860	N0132S	SOT-23	SINGLE	M4	3B
SMP4860A	N0132S	SOT-23	SINGLE	M4	3B
SMP4861	N0132S	SOT-23	SINGLE	M4	3B
SMP4861A	N0132S	SOT-23	SINGLE	M4	3B
SMP4867	N0016H	SOT-23	SINGLE	M4	3A
SMP4867A	N0016H	SOT-23	SINGLE	M4	3A
SMP4868	N0016H	SOT-23	SINGLE	M4	3A
SMP4868A	N0016H	SOT-23	SINGLE	M4	3A
SMP4869	N0016H	SOT-23	SINGLE	M4	3A
SMP4869A	N0016H	SOT-23	SINGLE	M4	3A
SMP5019	P0099F	SOT-23	SINGLE	M4	3B
SMP5020	P0032F	SOT-23	SINGLE	M4	3A
SMP5020A	P0032F	SOT-23	SINGLE	M4	3A
SMP5020B	P0032F	SOT-23	SINGLE	M4	3A
SMP5021	P0032F	SOT-23	SINGLE	M4	3A
SMP5114	P0099F	SOT-23	SINGLE	M4	3B
SMP5115	P0099F	SOT-23	SINGLE	M4	3B
SMP5116	P0099F	SOT-23	SINGLE	M4	3B
SMP5197	N0016H	SOIC-8	DUAL	M4	3A
SMP5198	N0016H	SOIC-8	DUAL	M4	3A
SMP5199	N0016H	SOIC-8	DUAL	M4	3A
SMP5397	N0026L	SOT-23	SINGLE	M4	3A
SMP5398	N0026L	SOT-23	SINGLE	M4	3A
SMP5457	N0032H	SOT-23	SINGLE	M4	3A
SMP5460	P0032F	SOT-23	SINGLE	M4	3A
SMP5461	P0032F	SOT-23	SINGLE	M4	3A
SMP5462	P0032F	SOT-23	SINGLE	M4	3A
SMP5463	P0032F	SOT-23	SINGLE	M4	3A
SMP5464	P0032F	SOT-23	SINGLE	M4	3A
SMP5465	P0032F	SOT-23	SINGLE	M4	3A
SMP5484	N0026S	SOT-23	SINGLE	M4	3A
SMP5485	N0026S	SOT-23	SINGLE	M4	3A
SMP5486	N0026S	SOT-23	SINGLE	M4	3A
SMP5564	N0072S	SOIC-8	DUAL	M4	3B
SMP5565	N0072S	SOIC-8	DUAL	M4	3B
SMP5566	N0072S	SOIC-8	DUAL	M4	3B
SMP59	N0016H	SOT-23	SINGLE	M4	3A
SMP5911	N0030L	SOIC-8	DUAL	M4	3A

Part Number	Geometry	Package	Configuration	ESD MM Class	ESD HBM Class
SMP5912	N0030L	SOIC-8	DUAL	M4	3A
SMP5949	N0032H	SOT-23	SINGLE	M4	3A
SMP6451	N0132L	SOT-23	SINGLE	M4	3B
SMP6452	N0132L	SOT-23	SINGLE	M4	3B
SMP6453	N0132L	SOT-23	SINGLE	M4	3B
SMP6454	N0132L	SOT-23	SINGLE	M4	3B
SMP6550	N0450L	SOT-23	SINGLE	M4	3B
SMP860	N0450L	SOIC-8	DUAL	M4	3B
SMPBF510	N0026L	SOT-23	SINGLE	M4	3A
SMPBF511	N0026L	SOT-23	SINGLE	M4	3A
SMPBF512	N0026L	SOT-23	SINGLE	M4	3A
SMPBF513	N0026L	SOT-23	SINGLE	M4	3A
SMPJ108	N0450S	SOT-23	SINGLE	M4	3B
SMPJ109	N0450S	SOT-23	SINGLE	M4	3B
SMPJ110	N0450S	SOT-23	SINGLE	M4	3B
SMPJ110A	N0450S	SOT-23	SINGLE	M4	3B
SMPJ111	N0132S	SOT-23	SINGLE	M4	3B
SMPJ111A	N0132S	SOT-23	SINGLE	M4	3B
SMPJ112	N0132S	SOT-23	SINGLE	M4	3B
SMPJ112A	N0132S	SOT-23	SINGLE	M4	3B
SMPJ113	N0132S	SOT-23	SINGLE	M4	3B
SMPJ113A	N0132S	SOT-23	SINGLE	M4	3B
SMPJ174	P0099F	SOT-23	SINGLE	M4	3B
SMPJ175	P0099F	SOT-23	SINGLE	M4	3B
SMPJ176	P0099F	SOT-23	SINGLE	M4	3B
SMPJ177	P0099F	SOT-23	SINGLE	M4	3B
SMPJ201	N0016H	SOT-23	SINGLE	M4	3A
SMPJ202	N0016H	SOT-23	SINGLE	M4	3A
SMPJ203	N0016H	SOT-23	SINGLE	M4	3A
SMPJ204	N0016H	SOT-23	SINGLE	M4	3A
SMPJ210	N0026L	SOT-23	SINGLE	M4	3A
SMPJ211	N0026L	SOT-23	SINGLE	M4	3A
SMPJ212	N0026L	SOT-23	SINGLE	M4	3A
SMPJ230	N0016H	SOT-23	SINGLE	M4	3A
SMPJ231	N0016H	SOT-23	SINGLE	M4	3A
SMPJ232	N0016H	SOT-23	SINGLE	M4	3A
SMPJ270	P0099F	SOT-23	SINGLE	M4	3B
SMPJ271	P0099F	SOT-23	SINGLE	M4	3B
SMPJ304	N0026S	SOT-23	SINGLE	M4	3A
SMPJ305	N0026S	SOT-23	SINGLE	M4	3A

Part Number	Geometry	Package	Configuration	ESD MM Class	ESD HBM Class
SMPJ308	N0072L	SOT-23	SINGLE	M4	3B
SMPJ309	N0072L	SOT-23	SINGLE	M4	3B
SMPJ310	N0072L	SOT-23	SINGLE	M4	3B
SMPP1086	P0099F	SOT-23	SINGLE	M4	3B
SMPP1087	P0099F	SOT-23	SINGLE	M4	3B
SMPU231	N0016H	SOIC-8	DUAL	M4	3A
SMPU232	N0016H	SOIC-8	DUAL	M4	3A
SMPU233	N0016H	SOIC-8	DUAL	M4	3A
SMPU234	N0016H	SOIC-8	DUAL	M4	3A
SMPU235	N0016H	SOIC-8	DUAL	M4	3A
SMPU257	N0030L	SOIC-8	DUAL	M4	3A
SMPU304	P0099F	SOT-23	SINGLE	M4	3B
SMPU305	P0099F	SOT-23	SINGLE	M4	3B
SMPU306	P0099F	SOT-23	SINGLE	M4	3B
SMPU308	N0072L	SOT-23	SINGLE	M4	3B
SMPU309	N0072L	SOT-23	SINGLE	M4	3B
SMPU310	N0072L	SOT-23	SINGLE	M4	3B
SMPU311	N0072L	SOT-23	SINGLE	M4	3B
SMPU401	N0016H	SOIC-8	DUAL	M4	3A
SMPU402	N0016H	SOIC-8	DUAL	M4	3A
SMPU403	N0016H	SOIC-8	DUAL	M4	3A
SMPU404	N0016H	SOIC-8	DUAL	M4	3A
SMPU405	N0016H	SOIC-8	DUAL	M4	3A
SMPU406	N0016H	SOIC-8	DUAL	M4	3A
SMPU410	N0016H	SOIC-8	DUAL	M4	3A
SMPU411	N0016H	SOIC-8	DUAL	M4	3A
SMPU412	N0016H	SOIC-8	DUAL	M4	3A
SMPU421	N0001H	SOIC-8	DUAL	M4	3A
SMPU422	N0001H	SOIC-8	DUAL	M4	3A
SMPU423	N0001H	SOIC-8	DUAL	M4	3A
SMPU424	N0001H	SOIC-8	DUAL	M4	3A
SMPU425	N0001H	SOIC-8	DUAL	M4	3A
SMPU426	N0001H	SOIC-8	DUAL	M4	3A
SMPU430	N0072L	SOIC-8	DUAL	M4	3B
SMPU431	N0072L	SOIC-8	DUAL	M4	3B
SMPVCR11N	N0026S	SOIC-8	DUAL	M4	3A
SMPVCR2N	N0072L	SOT-23	SINGLE	M4	3B
SMPVCR3P	P0099F	SOT-23	SINGLE	M4	3B
SMPVCR4N	N0016H	SOT-23	SINGLE	M4	3A
SMPVCR7N	N0001H	SOT-23	SINGLE	M4	3A

Part Number	Geometry	Package	Configuration	ESD MM Class	ESD HBM Class
U304	P0099F	TO-18	SINGLE	M4	3B
U305	P0099F	TO-18	SINGLE	M4	3B
U306	P0099F	TO-18	SINGLE	M4	3B
U308	N0072L	TO-52	SINGLE	M4	3B
U309	N0072L	TO-52	SINGLE	M4	3B
U310	N0072L	TO-52	SINGLE	M4	3B
U311	N0072L	TO-72	SINGLE	M4	3B
U430	N0072L	TO-78	DUAL	M4	3B
U431	N0072L	TO-78	DUAL	M4	3B
VCR11N	N0026S	TO-71	DUAL	M4	3A
VCR2N	N0072L	TO-18	SINGLE	M4	3B
VCR3P	P0099F	TO-18	SINGLE	M4	3B
VCR4N	N0016H	TO-18	SINGLE	M4	3A
VCR7N	N0001H	TO-72	SINGLE	M4	3A