OPEN DOTS TECHNOLOGY SPECIFICATION

Maintained by

OPEN DOTS ALLIANCE

REVISION 1.2

ECO No.	Rev.	Date	Description of Change
	1.0	11/18/2015	PRELIMINARY RELEASE
	1.1	1/27/2016	INITIAL RELEASE
	1.2	5/3/2016	WORKING RELEASE

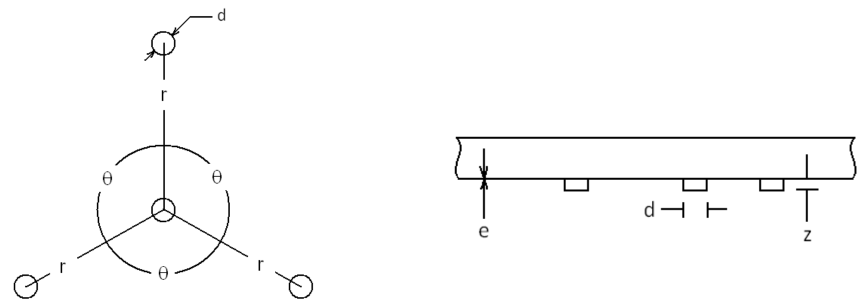

Figure 1. Contact Point Mechanical Configuration

1. Contact Point Pattern

Four electrically independent contacts must be arranged in the pattern of figure 1 to ensure power is delivered to a device resting at any position or orientation on a power surface.

The contact engagement diameter is the diameter of the conducting contact at the surface of engagement and slightly above. This diameter must not exceed the maximum or it will be possible to cause a short between two adjacent electrode strips.

The contacts must be able to make contact over an extension perpendicular to the surface in order to overcome surface non-planarity as well as small particulates.

Contact Point Pattern Mechanical Specifications

Symbol	Parameter	Conditions	Min	Typ	Max	Units
d	Contact Engagement Diameter	Flat contact does not short adjacent pad electrodes	No Scratching		1.8	mm
θ	Angular contact separation	Center contact as vertex	118	120	122	deg
e	Bottom surface flatness	Device engaged with pad			0.1	mm
r	Radial contact separation	Measured center-to-center from center contact	9.63	9.78	9.93	mm
z	Contact Throw	To overcome non-planarity	0.2	0.4		mm

2. Tactile Pull-Down Magnets

Tactile magnetic adhesion is preferred so as to provide users with a consistent and positive Open Dots user experience. However, in some cases magnets are not appropriate or allowed for various reasons. The Open Dots Alliance encourages the use of tactile magnetic adhesion in all allowed cases.

The tactile pull-down magnets are located in a pattern behind the device surface that interfaces with the power surface. In many cases there are three, but in some cases there can be several.

In some cases magnets are used to provide additional force on spring-loaded contacts if the weight of the device alone is not sufficient. They may also allow for engagement with tilted or vertical power surfaces.

It is recommended that the external flux due to the magnets does not erase credit cards stripes.

Tactile Pull-Down Magnets Operation and Compatibility

Item	Consideration
Pull-Down Magnetic flux	Must not erase credit cards or interfere with host device operation
Balance with Pull-Down Magnets	Device shall rest firmly on contact and not easily tip
Pull-Down Magnetic Polarity	The South pole of the magnets shall interface with the Power Surface
Typical Total Pull-Down Force	500 gf

3. Power Receiver

The power receiver is responsible for rectifying the connection made by each contact point to the arbitrary potential of the electrode strips on the power surface. Each pair of diodes rectifies the potential found at each of the four contact points.

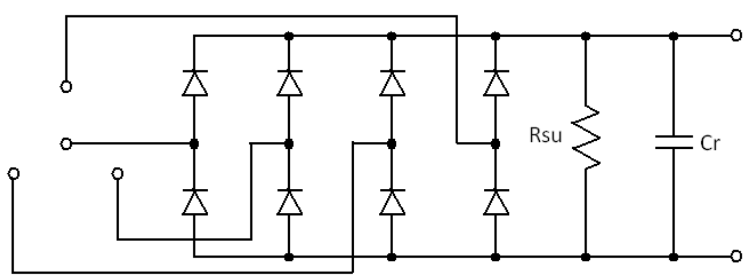

Figure 2

A rectifier capacitor Cr is used to hold the output voltage constant for a short period of time corresponding to the power surface test pulse. A start-up resistor Rsu is provides a small load so that a power surface in sleep mode can detect its presence.

The output of the rectifier connects to the device circuit. The device circuit must meet certain requirements, such as a start-up delay, such that the overall circuit allows a normal power surface startup profile.

Power surfaces come in two power ranges which are differentiated by the pad voltage. Thus some of the operational requirements are different for power receivers that intend to work only on high-power pads.

Power Receiver Specifications

Symbol	Parameter	Conditions	Min	Typ	Max	Units
Electrical Specifications						
Vin	Input Voltage for normal operation for a low-power device	Measured at pad electrodes 10us before test pulse	13		21	V
Vsdl	Shutdown voltage for low power device		10		12	V
Vin	Input Voltage for normal operation for a high-power device	Measured at pad electrodes 10us before test pulse	18		21	V
Vsdh	Shutdown voltage for high power device		16		17	V
Ton	Startup Delay	Input current <100mA beginning when power surface initially starts	100			ms
Imin	Minimum input current	Vin = 20V, prevent sleep mode			8	mA
Isl	Sleep voltage low Input Current	Typically provided by Rsu and rectifier forward drop			1	µA
Ish	Sleep voltage high input current		53			µA
Tr	Restart time constant	Move device from operating power surface to sleeping power surface	0.3	1	3	sec
Cr	Rectifier capacitance	Fully derated for tolerance, operation voltage, and aging	20	50	200	µF/A
Vd	Max Rectifier Capacitor Voltage Droop over 10 µs	Full Rated Load, Lowest Input Voltage, 10 µs Input Dropout			0.5	V
Cin	Input capacitance	Measured between any two contact points			30	pF
Id	Rectifier Diode Reverse Leakage	Vr = 20V, All operating temps			20	µA
P_{lp}	Max Power Draw, low-v pad	Device detects V_p < 15.5V			20	W
R_c	Contact Power Loss due to Resistance	Device rests on Nickel Plated Electrode			100	mW
η	Receiver Efficiency	From power surface electrodes to rectifier output	98			%
Environmental						
To	Operating temperature	Recommended Minimum Range	-10		50	°C
Ts	Storage temperature		-40		60	°C
Ho	Operating humidity		20		80	%RH
Hs	Storage humidity		5		95	%RH

Quality and Reliability

Vesd	ESD immunity	Pos or Neg, 100pF, 150ohms, >50 hits with no damage	15			kV

4. Power Surface Electrical and Mechanical Interface

Power surfaces are composed of electrode strips with a defined spacing that are energized alternately between two polarities. The electrode strips perform two functions. First they make electrical contact with the contact points of the power receiver. Second, they provide the ferromagnetic interface for magnets aboard the power receiver.

Power surfaces come in two power ranges. They communicate their power range to the device by their nominal DC voltage.

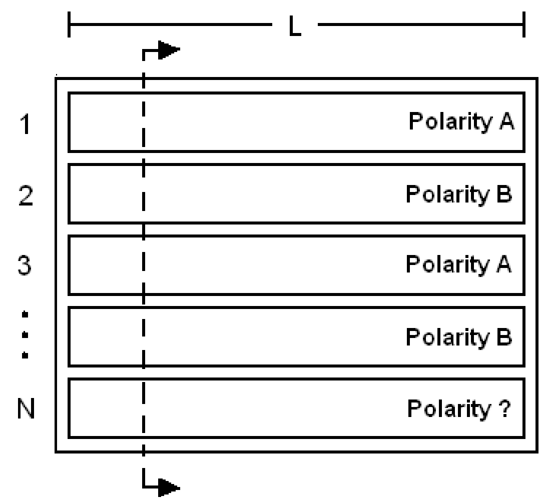

Figure 3. Pad Electrode Mechanical Definition

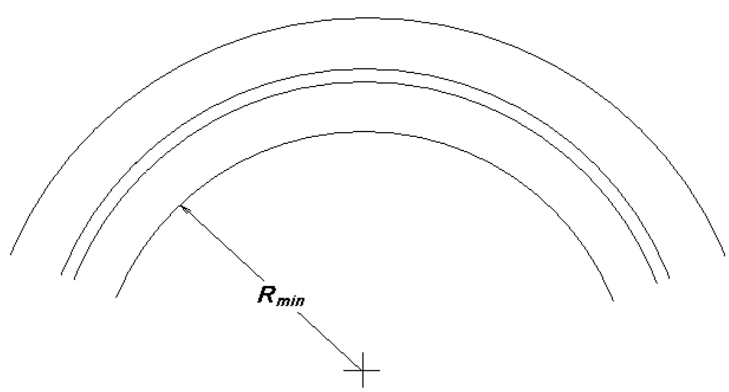

Figure 4. Minimum Radius Defintion

Recommended Power Surface Specifications

Symbol	Parameter	Conditions	Min	Typ	Max	Units
N	Number of strips		2			
Rmin	Minimum Bend Radius		120			mm

Materials

Item	Consideration
Pad Electrode Strips	Option A: 0.381mm minimum thickness cold rolled carbon steel post-plated bright nickel 0.005mm

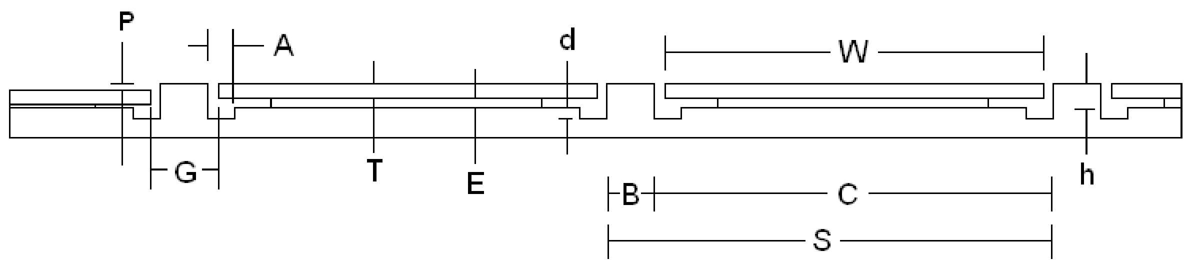

Figure 5. Pad Base Cross Section

Pad Contiguous Active Area Electrode Mechanical Specifications

Symbol	Parameter	Conditions	Min	Typ	Max	Units
A	Burr Relief Width		0.5	0.75	1.5	mm
B	Ridge Width		1.86	1.91	1.96	mm
C	Strip Gap		10.19	10.29	10.39	mm
d	Burr Relief Depth			0.25		mm
h	Strip Pocket Depth			0.53		mm
W	Width of strip		10.09	10.15	10.19	mm
G	Gap Width			1.9		mm
S	Array Spacing	Note: S = W + G = B + C	12.05	12.2	12.35	mm
T	Contact Strip Nominal Thickness	Provide sufficient magnet force	0.381			mm
P	Surface Flatness	After assembly P = h – E - T	-0.1		0.1	mm
E	Nominal Adhesive Thickness	After assembly		0.15		mm

Pad Electrical Specifications

Symbol	Parameter	Conditions	Min	Typ	Max	Units
Vp	Nominal Low Power Pad Voltage	Up to 49 Watts	14.5	15	15.5	V
P_{15}	Available Pad Power	15V pad	20		45	W
Vph	Nominal High Power Pad Voltage	50 Watts and over	19	20	21	V
P_{20}	Available Pad Power	20V pad	45		200	W
ε_r	Pad Efficiency	Measured from AC plug prongs to Power Surface electrodes	80			%

5. Power Surface Control and Safety

The power surface operates in two modes: an operational mode and a sleep mode. In the operational mode, the power surface provides power to the devices resting atop it, and periodically test for foreign objects. In the sleep mode, the power surface tests for the presence of a Open Dots device resting upon it.

The operation test is accomplished by the remove of power from the electrodes for a very short period of time. During this interval the power receivers cease to load the power surface, and thus circuitry can look for the presence of the signatures of foreign objects. These signatures are embodied in the electrical specifications below.

When in sleep mode, a low voltage signal is applied to the electrodes to test for the signature of an Open Dots power receiver. These characteristics are embodied in the specifications below.

Pad Foreign Object and Safety Response

Symbol	Parameter	Conditions	Min	Typ	Max	Units
W_{tp}	Test Pulse Width	Foreign object detection test	3	5	10	µs
P_{tp}	Test Pulse Period	All foreign object detection tests occur at least once per pulse			3	ms
C_{pth}	Capacitance Threshold (pad) For operation mode	Foreign object detection test	2.0		2.5	nF
I_{max}	Current Threshold	Pad shuts down when load of this current persists	100		120	% rated
R_p	Maximum Detect Resistance	Resistance directly across pad			10	kΩ
t_s	Short Circuit Detection Delay	Short applied to pad			4	µs
I_{pk}	Peak current	Peak Current transient that may occur briefly when a short is applied across strips			200	% Rated

Pad Turn-On Characteristics

Symbol	Parameter	Conditions	Min	Typ	Max	Units
V_{dh}	Turn-on Detector High Voltage	Pad Turn-On Test	2.7	2.8	2.9	V
V_{dl}	Turn-On Detector Low Voltage	Pad Turn-On Test	0.6	0.7	0.8	V
NL_{th}	Non-Linearity Threshold = V_{dh} / (4 * V_{dl})	Turn-On begin due to non-linear load detected		0.75		
C_{th}	Over-Capacitance Threshold For sleep mode	Turn-On fail due to too much capacitance	2.0		2.5	nF