

PROTECTION PRODUCTS

Maximum Ratings

Rating	Symbol	Value	Units
ESD per IEC 61000-4-2 (Air) ESD per IEC 61000-4-2 (Contact)	V_{ESD}	+/- 20 +/- 15	kV
Junction Temperature	T_J	125	°C
Operating Temperature	T_{op}	-40 to +85	°C
Storage Temperature	T_{STG}	-55 to +150	°C

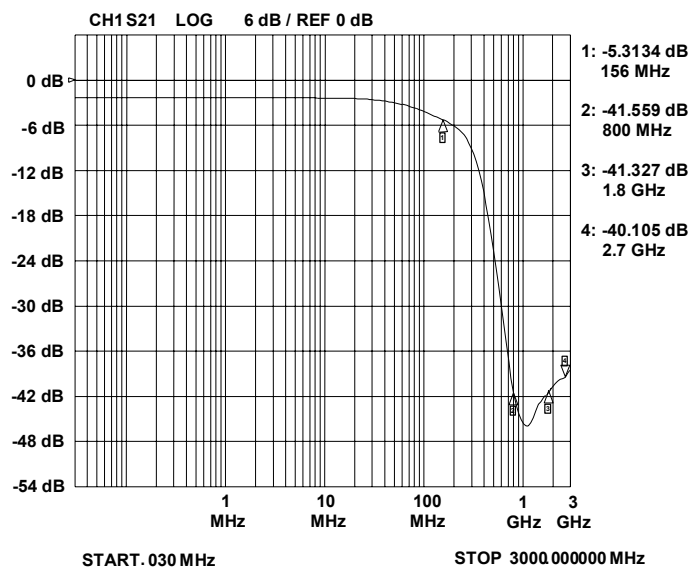
Electrical Characteristics (T=25°C)

Parameter	Symbol	Conditions	Minimum	Typical	Maximum	Units
TVS Reverse Stand-Off Voltage	V_{RWM}				5	V
TVS Reverse Breakdown Voltage	V_{BR}	$I_t = 1mA$	6	8	10	V
TVS Reverse Leakage Current	I_R	$V_{RWM} = 3.3V$			0.1	μA
DC Resistance	R_{DC}			33		Ohms
Filter Cut-Off Frequency	fc	$Z_{Source} = Z_{Load} = 50 \text{ Ohms}$		155		MHz
Inductance	L			28		nH
Total Series Inductance	$L_1 + L_2$	Each Line		56		nH
Capacitance	C_1, C_2, C_3	$V_R = 2.5V, f = 1MHz$	10	12	15	pF
Total Capacitance	$C_1 + C_2 + C_3$	Input to Gnd, Each Line $V_R = 2.5V, f = 1MHz$	30	36	45	pF

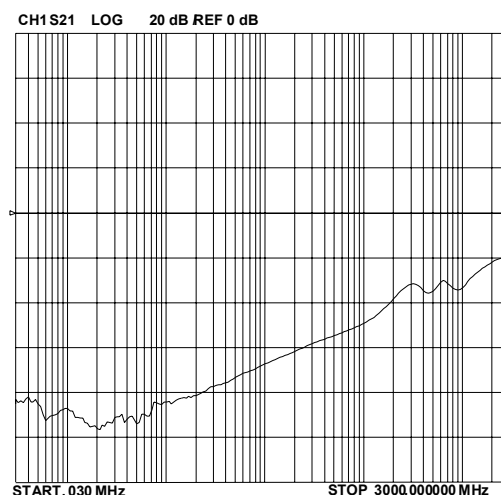
PROTECTION PRODUCTS

Typical Characteristics

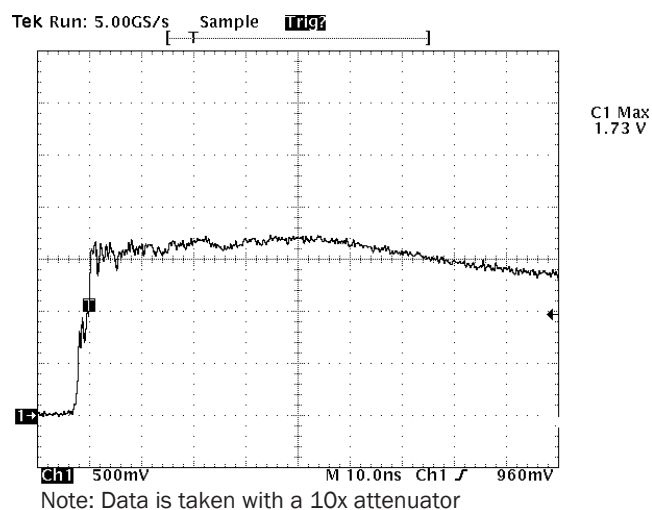
Typical Insertion Loss S21 (Each Line)



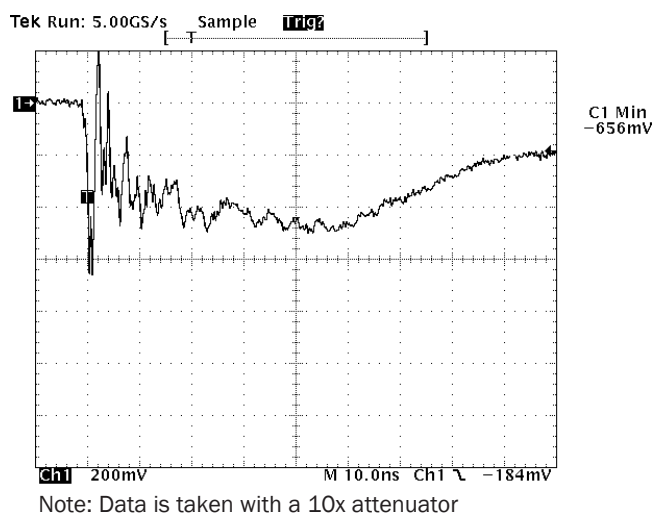
Analog Crosstalk (Each Line)



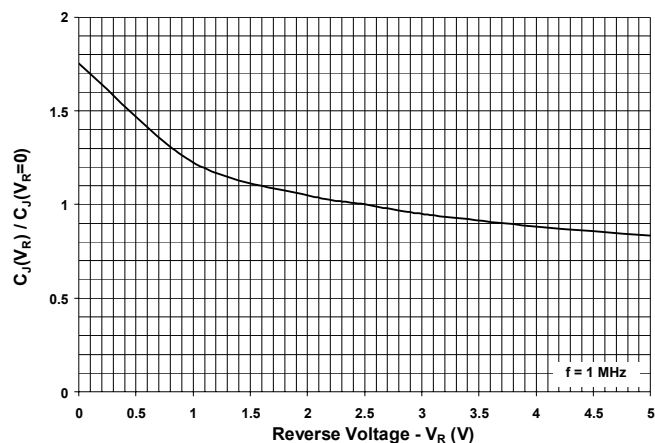
ESD Clamping (+8kV Contact)



ESD Clamping (-8kV Contact)



**Capacitance vs. Reverse Voltage
(Normalized to 2.5 volts)**



PROTECTION PRODUCTS

Device Connection

The EClamp2456P is comprised of six identical circuits each consisting of a low pass filter for EMI/RFI suppression and dual TVS diodes for ESD protection. The device is in a 12-pin SLP package. Electrical connection is made to the 12 pins located at the bottom of the device. A center tab serves as the ground connection. The device has a flow through design for easy layout. Pin connections are noted in Figure 1. All path lengths should be kept as short as possible to minimize the effects of parasitic inductance in the board traces. Recommendations for the ground connection are given below.

Ground Connection Recommendation

Parasitic inductance present in the board layout will affect the filtering performance of the device. As frequency increases, the effect of the inductance becomes more dominant. This effect is given by Equation 1.

Equation 1: The Impedance of an Inductor at Frequency XLF

$$X_{LF}(L, f) = 2 * \pi * f * L$$

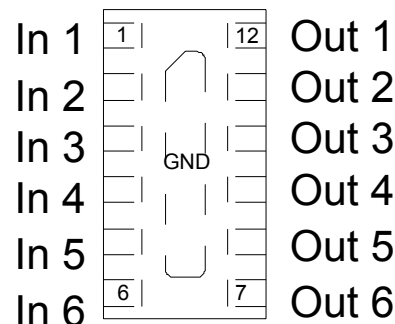
Where:

L = Inductance (H)

f = Frequency (Hz)

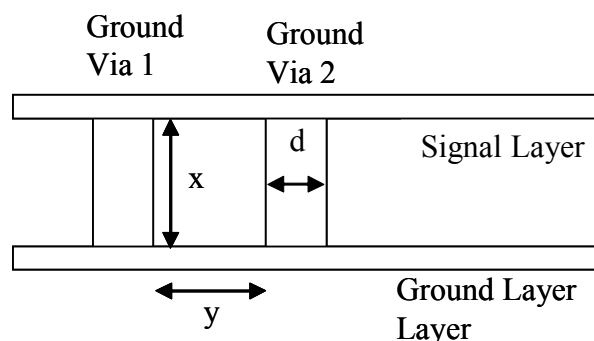
Via connections to the ground plane form rectangular wire loops or ground loop inductance as shown in Figure 2. Ground loop inductance can be reduced by using multiple vias to make the connection to the ground plane. Bringing the ground plane closer to the signal layer (preferably the next layer) also reduces ground loop inductance. Multiple vias in the device ground pad will result in a lower inductive ground loop over two exterior vias. Vias with a diameter d are separated by a distance y run between layers separated by a distance x. The inductance of the loop path is given by Equation 2. Thus, decreasing distance x and y will reduce the loop inductance and result in better high frequency filter characteristics.

Figure 1 - Pin Identification and Configuration (Top Side View)



Pin	Identification
1 - 6	Input Lines
7 - 12	Output Lines
Center Tab	Ground

Figure 2 - Inductance of Rectangular Wire Loops



Equation 2: Inductance of Rectangular Wire Loop

$$L_{RECT}(d, x, y) = 10.16 * 10^{-9} * \left[x * \ln \left[\frac{2 * y}{d} \right] + y * \ln \left[\frac{2 * x}{d} \right] \right]$$

Where:

d = Diameter of the wire (in)

x = Length of wire loop (in)

y = Breath of wire loop (in)

PROTECTION PRODUCTS

Applications Information

Figure 3 shows the recommended device layout. The ground pad vias have a diameter of 0.008 inches (0.20 mm) while the two external vias have a diameter of 0.010 inches (0.250mm). The internal vias are spaced approximately evenly from the center of the pad. The designer may choose to use more vias with a smaller diameter (such as 0.005 inches or 0.125mm) since changing the diameter of the via will result in little change in inductance (i.e. the log function in Equation 2 is highly insensitive to parameter d) . Figure 4 shows a typical insertion loss (S21) plot for the device using Semtech's filter evaluation board with 50 Ohm traces and the recommended via configuration.

Figure 3 - Recommended Layout Using Ground Vias

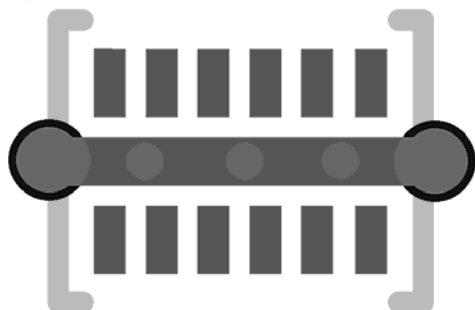
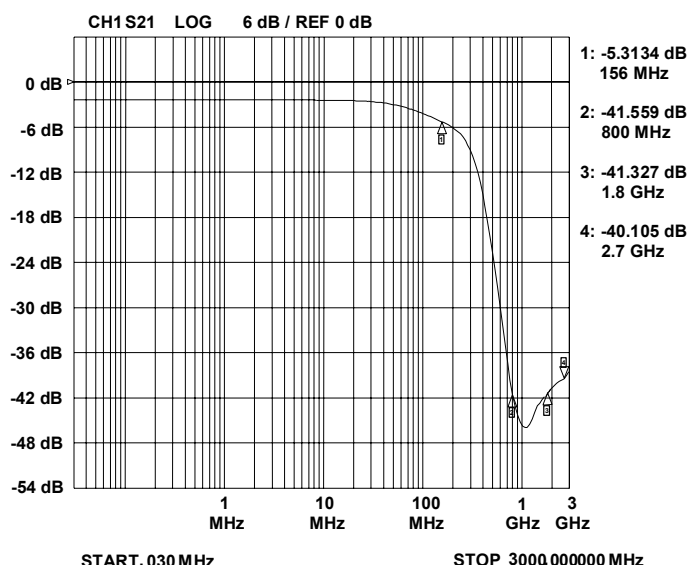


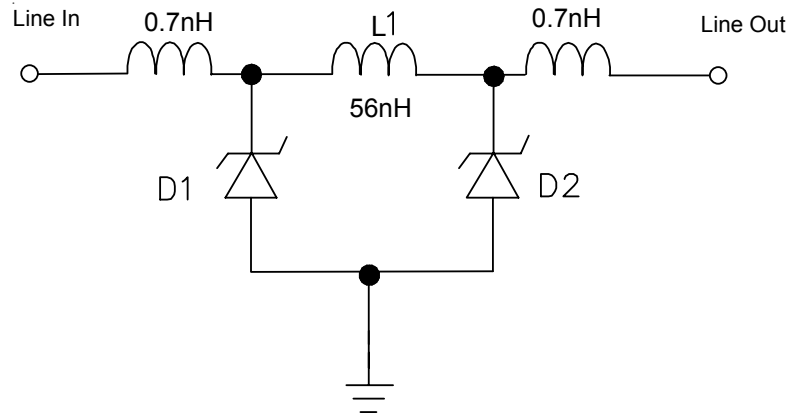
Figure 4 - Filter Characteristics Using Recommended Layout with Internal Vias



PROTECTION PRODUCTS

Applications Information - Spice Model

EClamp2456P Spice Model & Parameters



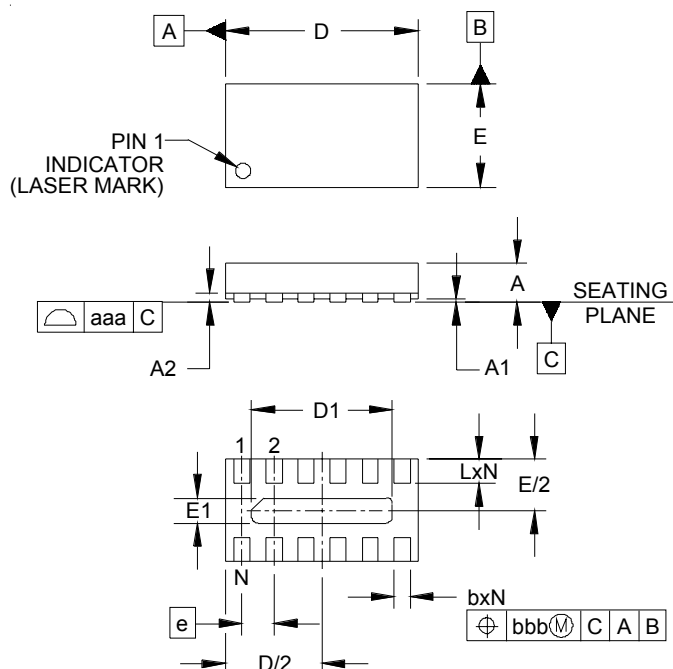
EClamp2456P Spice Model

Table 1 - EClamp2456P Spice Parameters

Parameter	Unit	D1 (TVS)	D2 (TVS)
IS	Amp	4.09E-15	4.09E-15
BV	Volt	7.44	7.44
VJ	Volt	0.744	0.744
RS	Ohm	0.584	0.584
IBV	Amp	1E-3	1E-3
CJO	Farad	31E-12	31E-12
TT	sec	2.541E-9	2.541E-9
M	--	0.23	0.23
N	--	1.1	1.1
EG	eV	1.11	1.11

PROTECTION PRODUCTS

Outline Drawing - SLP3016P12

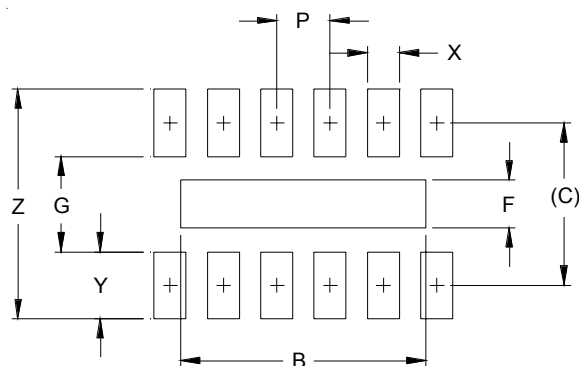


DIMENSIONS						
DIM	INCHES			MILLIMETERS		
	MIN	NOM	MAX	MIN	NOM	MAX
A	.020	.023	.026	0.50	0.58	0.65
A1	.000	.001	.002	0.00	.003	0.05
A2		(.006)			(0.15)	
b	.007	.010	.012	0.20	0.25	0.30
D	.114	.118	.122	2.90	3.00	3.10
D1	.083	.087	.091	2.10	2.20	2.30
E	.059	.063	.067	1.50	1.60	1.70
E1	.010	.016	.020	0.25	0.40	0.50
e		.020 BSC			0.50 BSC	
L	.011	.013	.015	0.28	0.33	0.38
N		12			12	
aaa		.003			0.08	
bbb		.004			0.10	

NOTES:

1. CONTROLLING DIMENSIONS ARE IN MILLIMETERS (ANGLES IN DEGREES).
2. COPLANARITY APPLIES TO THE EXPOSED PAD AS WELL AS THE TERMINALS.

Land Pattern - SLP3016P12



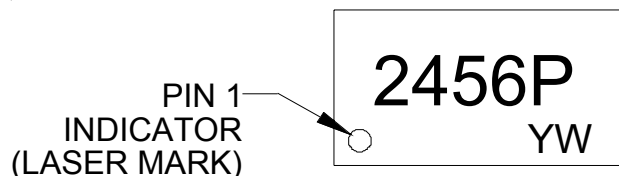
DIMENSIONS		
DIM	INCHES	MILLIMETERS
B	.091	2.30
C	.060	1.52
F	.018	0.45
G	.035	0.89
P	.020	0.50
X	.012	0.30
Y	.025	0.63
Z	.085	2.15

NOTES:

1. THIS LAND PATTERN IS FOR REFERENCE PURPOSES ONLY. CONSULT YOUR MANUFACTURING GROUP TO ENSURE YOUR COMPANY'S MANUFACTURING GUIDELINES ARE MET

PROTECTION PRODUCTS

Marking



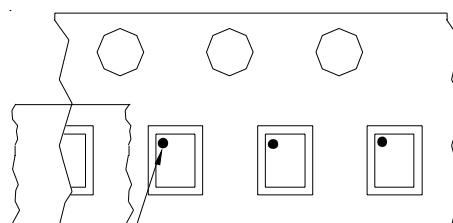
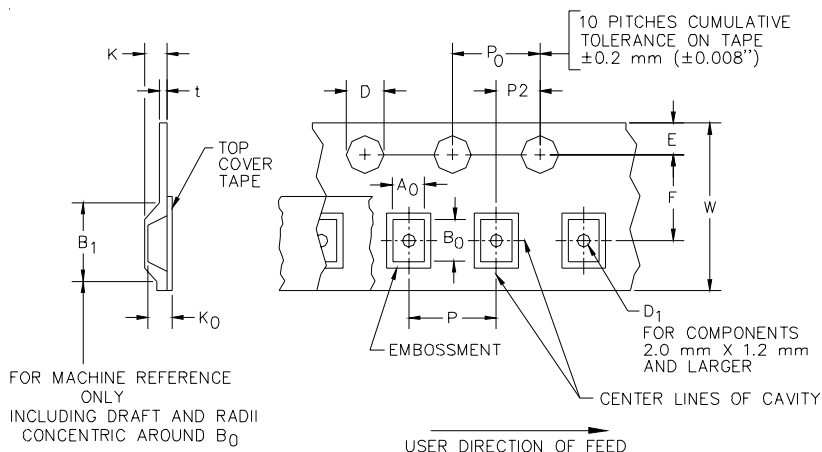
Ordering Information

Part Number	Qty per Reel	Reel Size
EClamp2456P.TCT	3000	7 Inch

This is a lead-free RoHS/WEEE Compliant Device
EMIClamp and EClamp are marks of Semtech Corporation

YW = Date Code (Y=Year, W=Week)

Tape and Reel Specification



Pin 1 Location

User Direction of feed

A0	B0	K0
1.78 +/-0.05 mm	3.18 +/-0.05 mm	0.76 +/-0.05 mm

Device Orientation in Tape

Tape Width	B, (Max)	D	D1	E	F	K (MAX)	P	P0	P2	T(MAX)	W
8 mm	4.2 mm (.165)	1.5 + 0.1 mm - 0.0 mm (0.59 +.005 - .000)	0.8 mm ±0.05 (.031)	1.750±.10 mm (.069±.004)	3.5±0.05 mm (.138±.002)	2.4 mm (.094)	4.0±0.1 mm (.157±.00-4)	4.0±0.1 mm (.157±.00-4)	2.0±0.05mm (.079±.002)	0.4 mm (.016)	8.0 mm + 0.3 mm - 0.1 mm (.312±.012)

Contact Information for Semtech International AG

Taiwan Branch Tel: 886-2-2748-3380
Fax: 886-2-2748-3390

Korea Branch Tel: 82-2-527-4377
Fax: 82-2-527-4376

Shanghai Office Tel: 86-21-6391-0830
Fax: 86-21-6391-0831

Semtech International AG is a wholly-owned subsidiary of Semtech Corporation, which has its headquarters in the U.S.A.

Semtech Switzerland GmbH Tel: 81-3-6408-0950
Japan Branch Fax: 81-3-6408-0951

Semtech Limited (U.K.) Tel: 44-1794-527-600
Fax: 44-1794-527-601

Semtech France SARL Tel: 33-(0)169-28-22-00
Fax: 33-(0)169-28-12-98

Semtech Germany GmbH Tel: 49-(0)8161-140-123
Fax: 49-(0)8161-140-124