Voltage Clamping Sensor (VCS): VCS600V5Vx

x: the following symbol is used to resemble either t= through hole or s = SMD

Description

Tell-i Technologies' Voltage Clamp Sensor (VCS) is to measure the drain-to-source (MOSFET)/collector-to-emitter (IGBT) of semiconductor power devices with high resolution during ON-state. The VCS is designed to operate using single voltage supply of +5V.

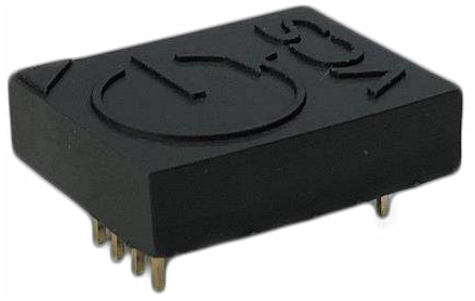


Figure 1- VCS600V5Vt Overview

Features

- Low power consumption
- Input Voltage: 5V
- Up to 600V clamping voltage range
- Fast 50ns Rise time

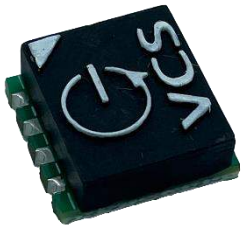


Figure 2 -VCS600V5Vs *Overview*

Applications

- Health monitoring and prognostics
- GaN, SiC High Voltage Switching
- Dynamic R_{DSON} measurement
- Automotive
- Aerospace
- Artificial intelligence (AI)

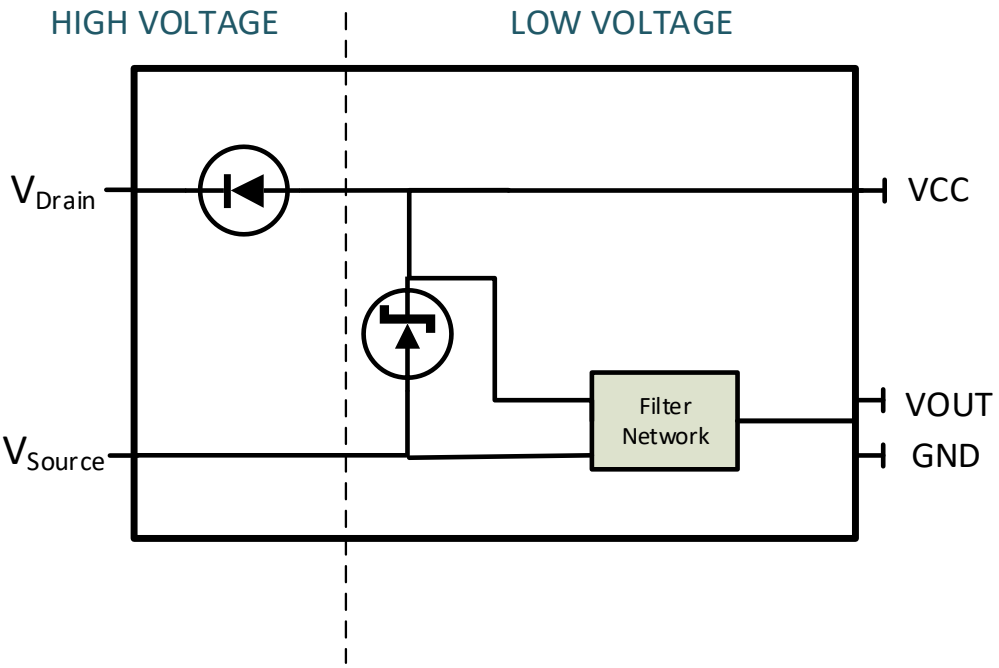
Specifications

Parameter	Conditions	Typ	Max	Unit
Supply Voltage (Vcc)	Operating	5	-	V
Supply Current		7.7	8	mA
Settling Time		50	100	ns
Off-State Voltage		4.7		V
On-State Voltage		TBD	-	V
V_{ds}/V_{ce} Voltage	Clamp max voltage	400	600	V
Operating Temperature	Case max temp.	25	80	°C

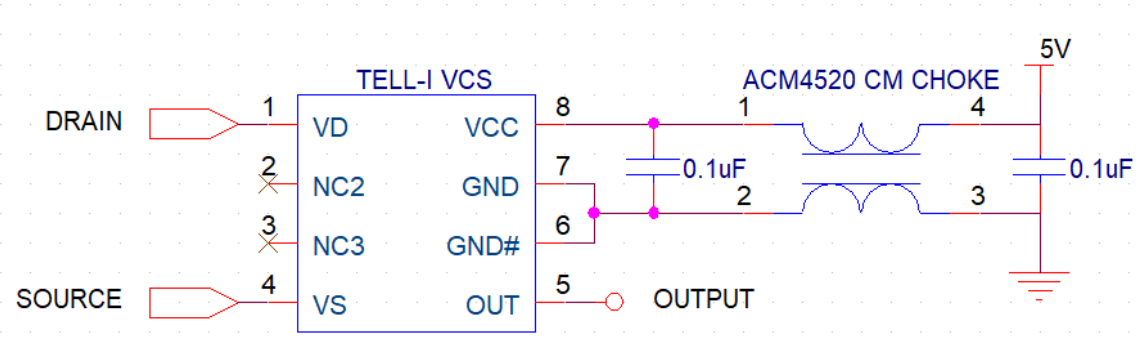
Clamper Circuit Overview

Clamper circuits are designed to change the DC limits of a signal to the desired level without changing the shape of the signal. Positive clampers are used to move and set the negative peak of a signal above 0V. Clampers are created using diodes and passive elements to clamp the high voltage potential from drain-to-source/collector-to-emitter voltages.

Functional Block Diagram

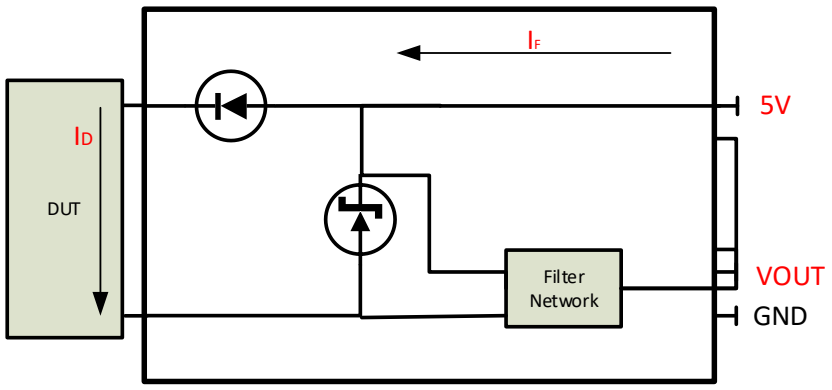


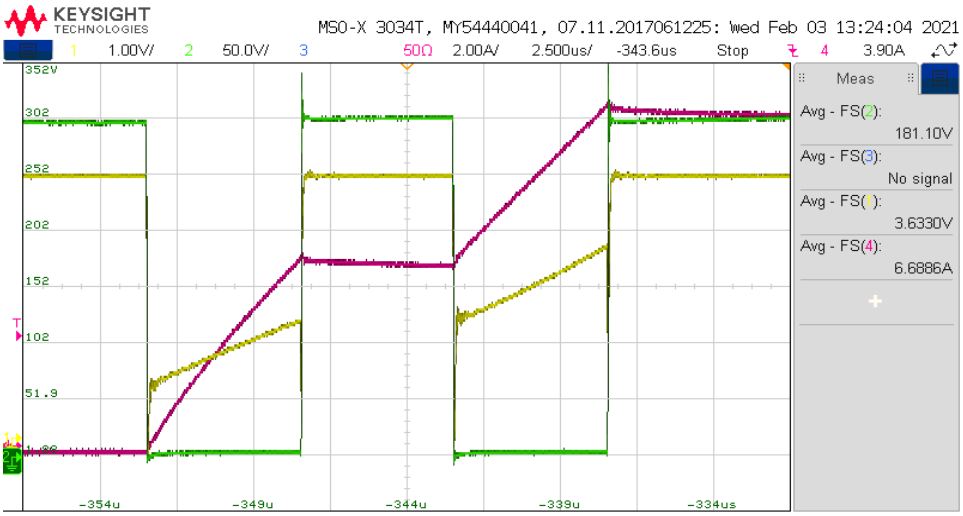
Typical Circuit



Application Example:

(DYNAMIC) R_{DSON} CALCULATION USING VOLTAGE CLAMP SENSOR (VCS)





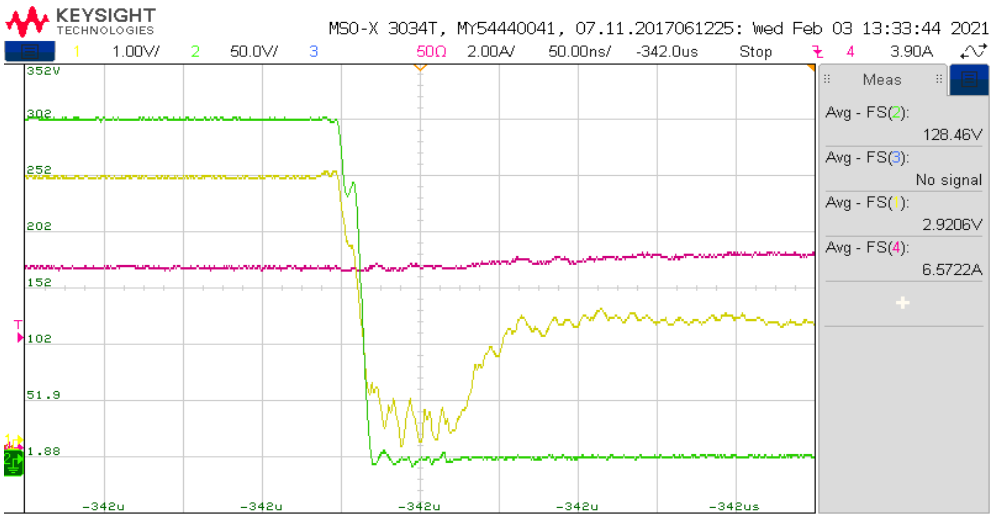


Figure: Double-pulse test: 300VDC, 6A. Green trace: Drain-Source Voltage. Yellow trace: Tell-i VCS output. Red trace: Inductor current. Telli VCS 'settlement time: <100nsec. The device under test: Cree/Wolfspeed 1200V SiC C2M0160120D.

The following steps to calculate dynamic R_{DSON} using Tell-i's VCS is determined using the following characteristics. VCC = 5V, R = 100Ω, ambient temperature = 25°C.

On-state voltage:

$$V_{DSON} = V_{OUT} - V_F \ldots \text{(Eq.1)}$$

where V_F is the forward voltage drop on the clamping circuit diode. V_F can be simplified using the equation below:

$$V_F = 0.91 + (0.175I_F) \ldots \text{(Eq.2)}$$

where I_F is the forward diode current simplified using the equation below:

$$I_F = \frac{5V - V_{OUT}}{100} \ldots \text{(Eq.3)}$$

V_{OUT} can be measured by using a multimeter or reading the value from a microcontroller or an oscilloscope.

On-Resistance Calculation:

Once V_{DSON} has been calculated, dynamic on-resistance can be calculated using Ohm's Law:

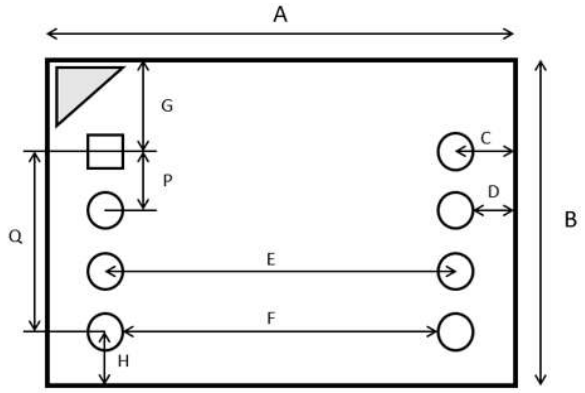
$$R_{DSON} = \frac{V_{DSON}}{I_D} \ldots \text{(Eq.4)}$$

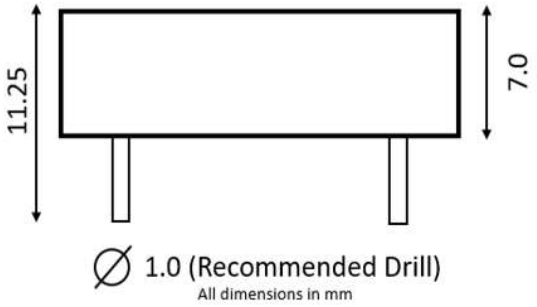
where I_D is the current through the device under test (DUT).

NOTE: Ambient temperature can be assumed when the DUT is tested moderately and DUT R_{DSON} is above 100mΩ. If the DUT is stress tested for long periods of time or R_{DSON} is below 100mΩ, the clamping diode junction temperature will rise. This will lead to V_F value needing calibration. Contact Tell-i Technologies for calibration.

Pin Layout and Package Dimensions

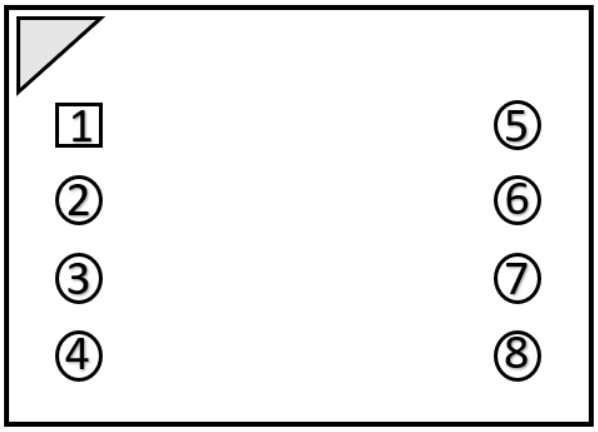
VCS600V5Vt:





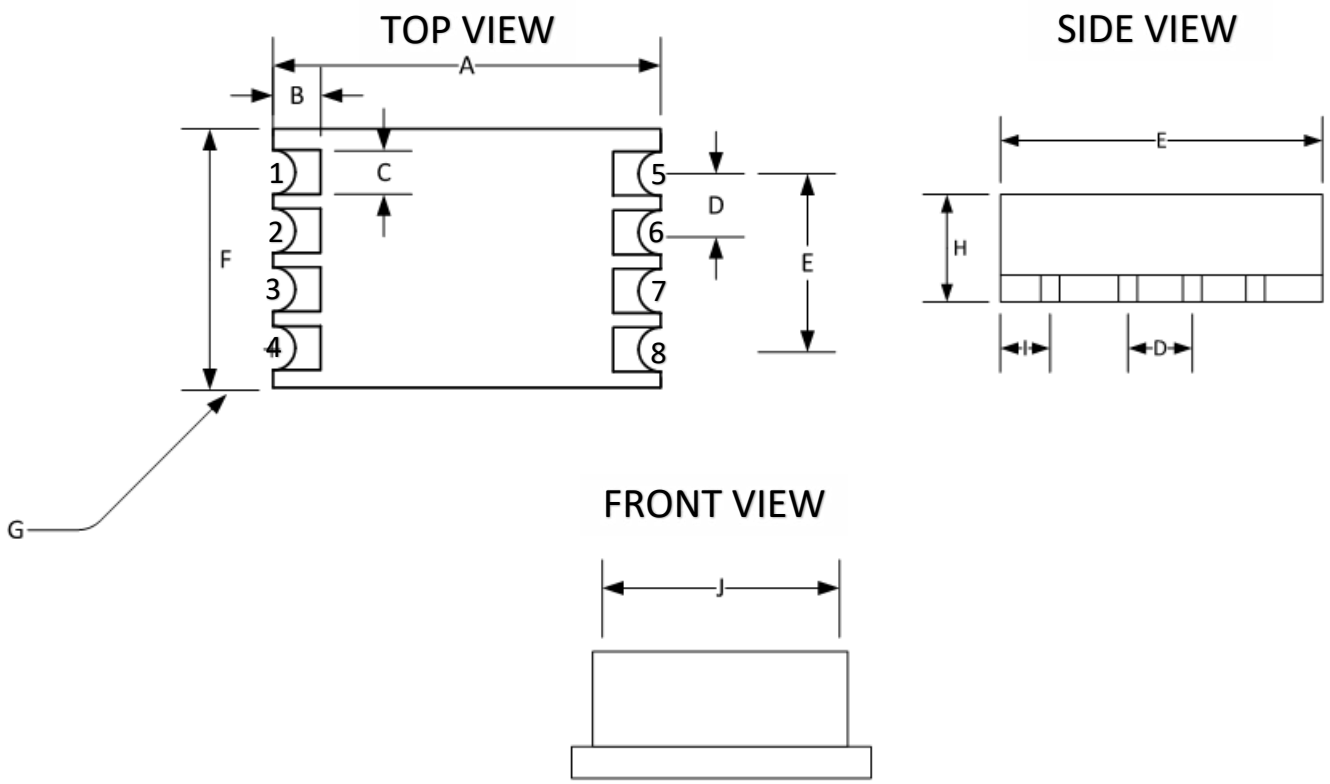
Index	Millimeter	Inches
A	24.00	0.945
B	18.923	0.745
C	3.048	0.120
D	2.032	0.080
E	17.907	0.705
F	15.875	0.625
G	6.147	0.242
H	5.131	0.202
P	2.54	0.100
Q	7.62	0.300

Pin Layout



Pin #	Pin Function
1, 2	V_{drain}
3, 4	V_{source}
5	OUTPUT
6, 7	GND
8	VCC

VCS600V5Vs:

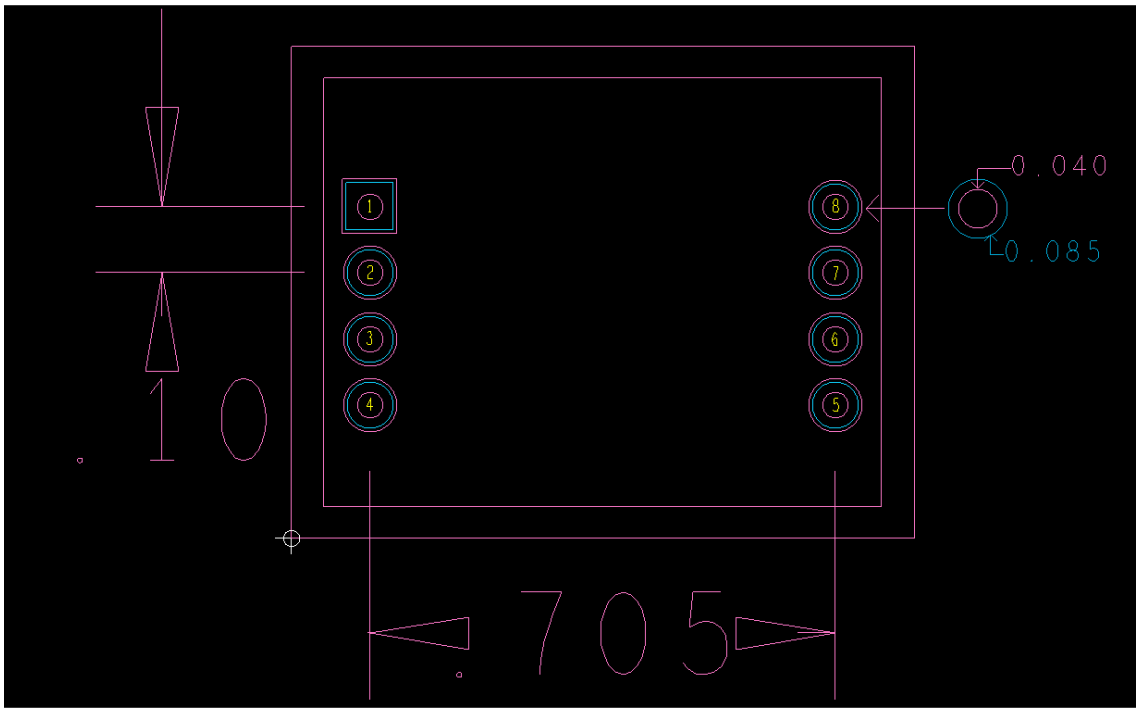


Index	Millimeter	Inches
A	13.06	0.514
B	1.02	0.040
C	1.27	0.050
D	2.54	0.100
E	7.62	0.300
F	12.7	0.500
G	1.02	0.040 Ø
H	29.21	1.150
I	2.54	0.100
J	10.92	0.430

Pin #	Pin Function
1, 2	V_{drain}
3, 4	V_{source}
5	OUTPUT
6, 7	GND
8	VCC
V_{Drain} and V_{Source} can be placed on right side of sensor. Contact Tell-i for more details.	

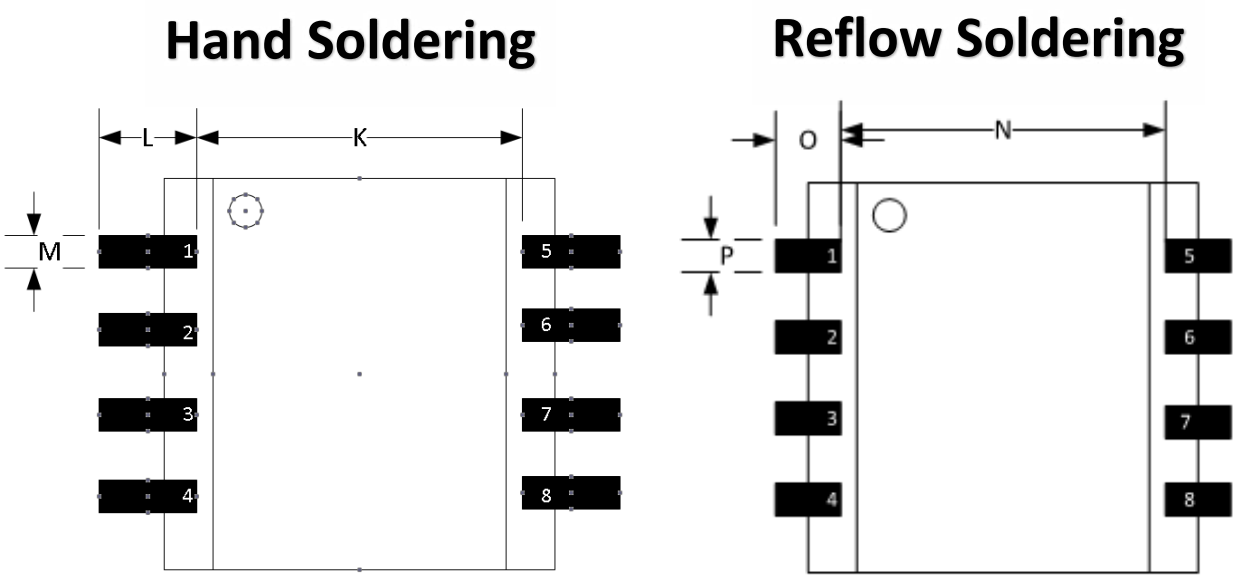
PCB Footprint

VCS600V5Vt:



NOTE: If detailed dimensions are needed, contact Tell-i Technologies for more information.

VCS600V5Vs: Tell-i's VCS600V5Vt uses castellated holes to become an SMD component. The castellated holes are small and need specific PCB footprint for soldering. Recommendation of hand soldering and oven/reflow soldering is shown below.



Index	Millimeters	Inches
K	10.92	0.430
L	1.52	0.060
M	1.27	0.050
N	10.92	0.430
O	2.29	0.090
P	1.27	0.050

