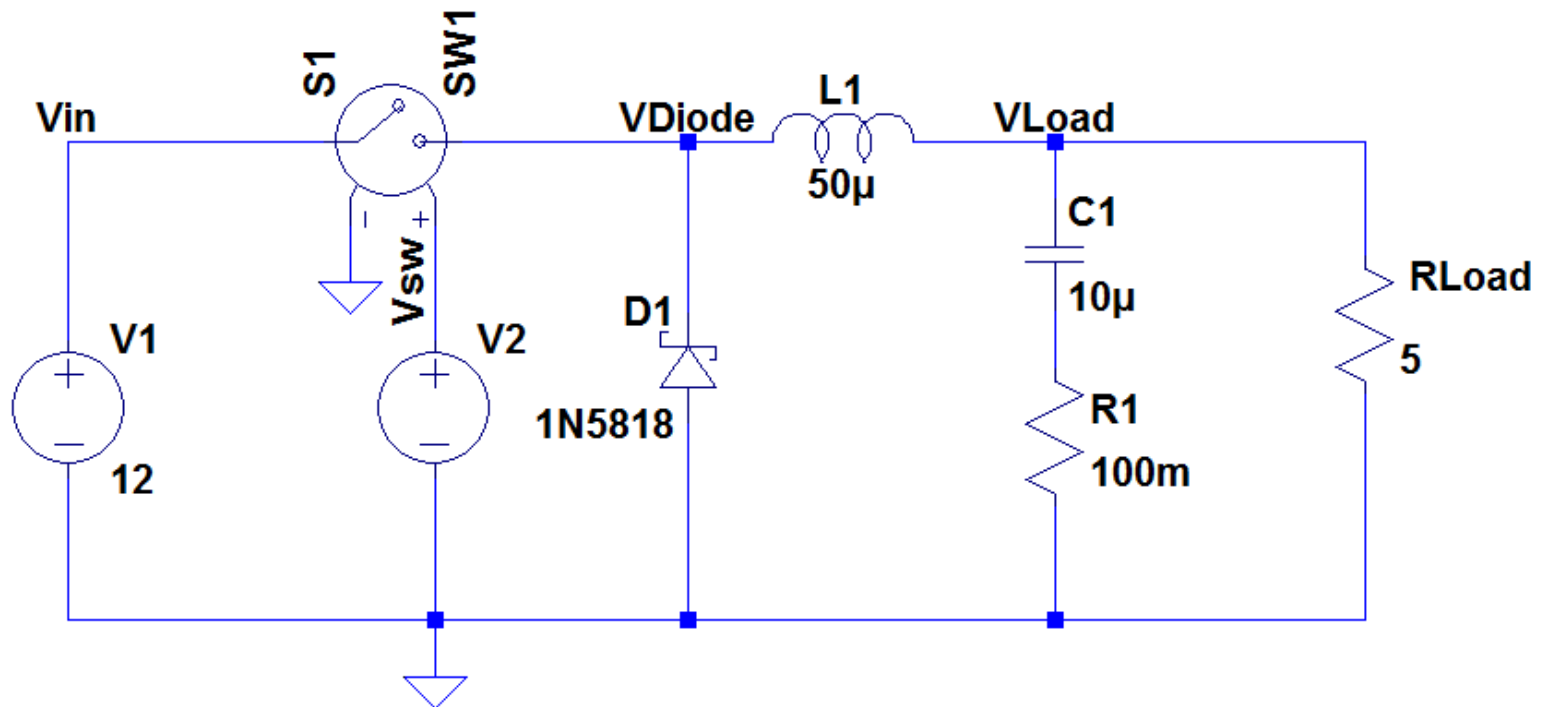


# SMPS Design Spice Simulations

Date: 11-03-2014

# Buck Converter-1



```
.model SW1 SW(Ron=0.01 Roff=1Meg Vt=1.1 Vh=-0.1)
```

```
PULSE(0 12 0 0.00000001 0.00000001 0.000005 0.00001 100000)
```

```
.tran 0 1msec 0 0.1ms
```

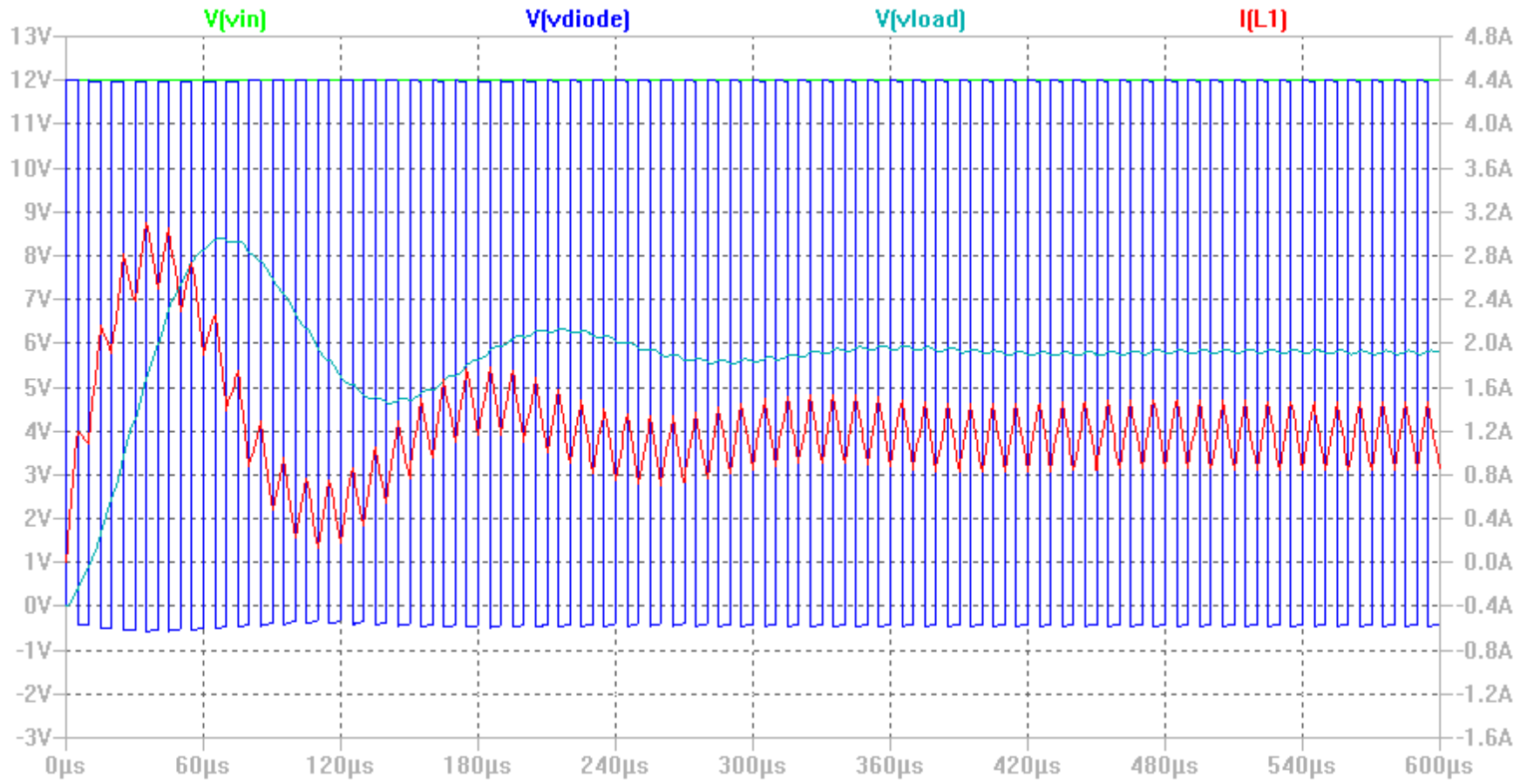
# Points taken from Book

- This is a simple buck converter. You can display:
  - the output voltage  $V(v_{out})$
  - the rectangular pulses at the jct diode-inductor:  $V(SW\_D)$
  - the current in the inductor:  $I(L1)$
  - the current in the capacitor  $C1$ :  $I(C1)$
  - the current in the free-wheel diode  $D1$ :  $I(D1)$
- Change the value of  $L1$  ( $100\mu$  or  $10\mu$ ) and explore CCM and DCM waveforms
- Change the capacitor ESR value and see effects on  $V_{out}$
- Buck convertors are used in ATX power supplies used in PCs.

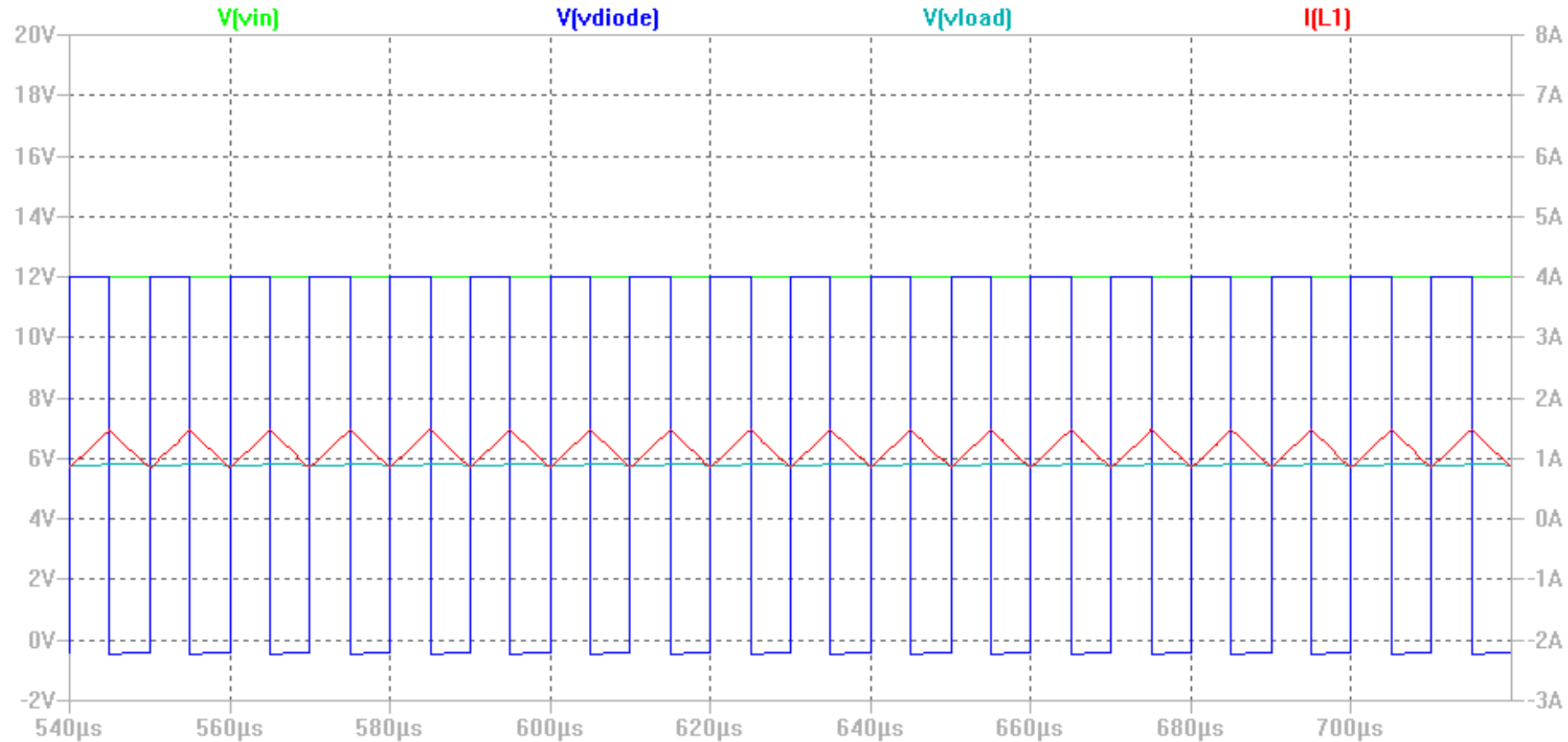
# Design parameters

- $V_{in} = 12V$
- $V_{sw} = 12V$  ( $R_{on}=0.01$   $R_{off}=1Meg$   $V_t=1.1$   $V_h=-0.1$ )
- $L = 50\mu H$
- $C = 10\mu F$  ESR = 100mohm
- Diode = 1N5818
- $R_{load} = 5\ \Omega$

# Transient response

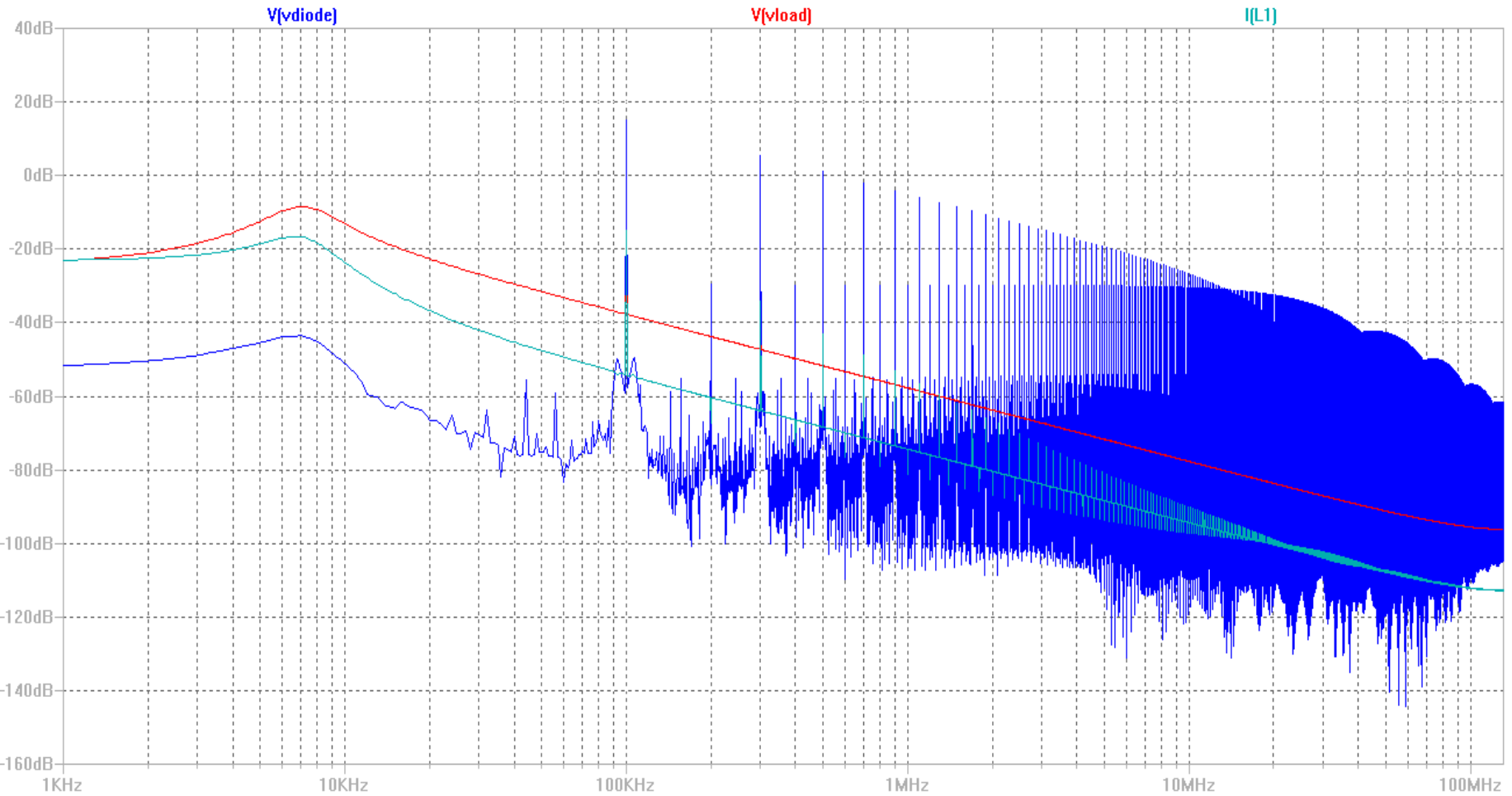


# Steady State response

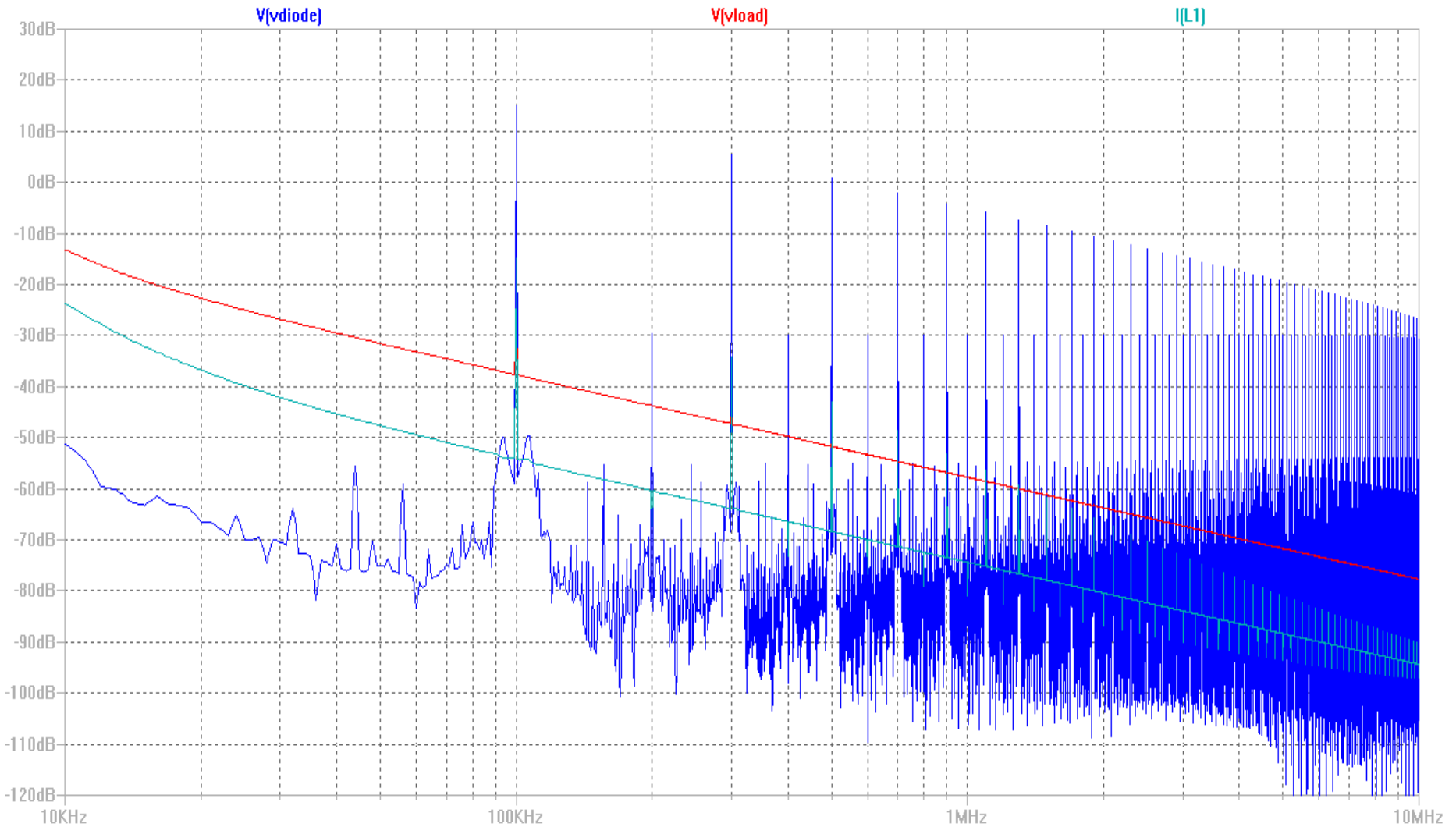


Continuous mode of operation as inductor never goes to zero it always remains charged.

# Freq. response

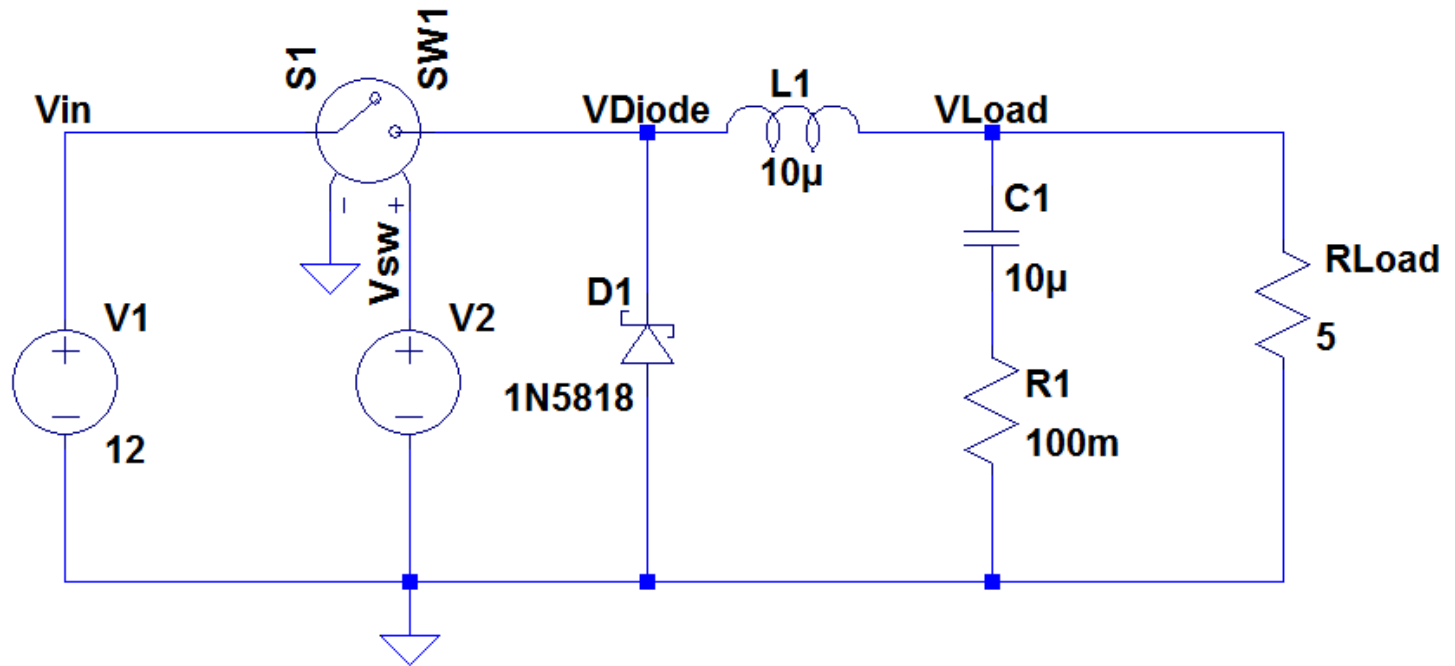


# Freq. response Zoomed





# Buck Converter-2

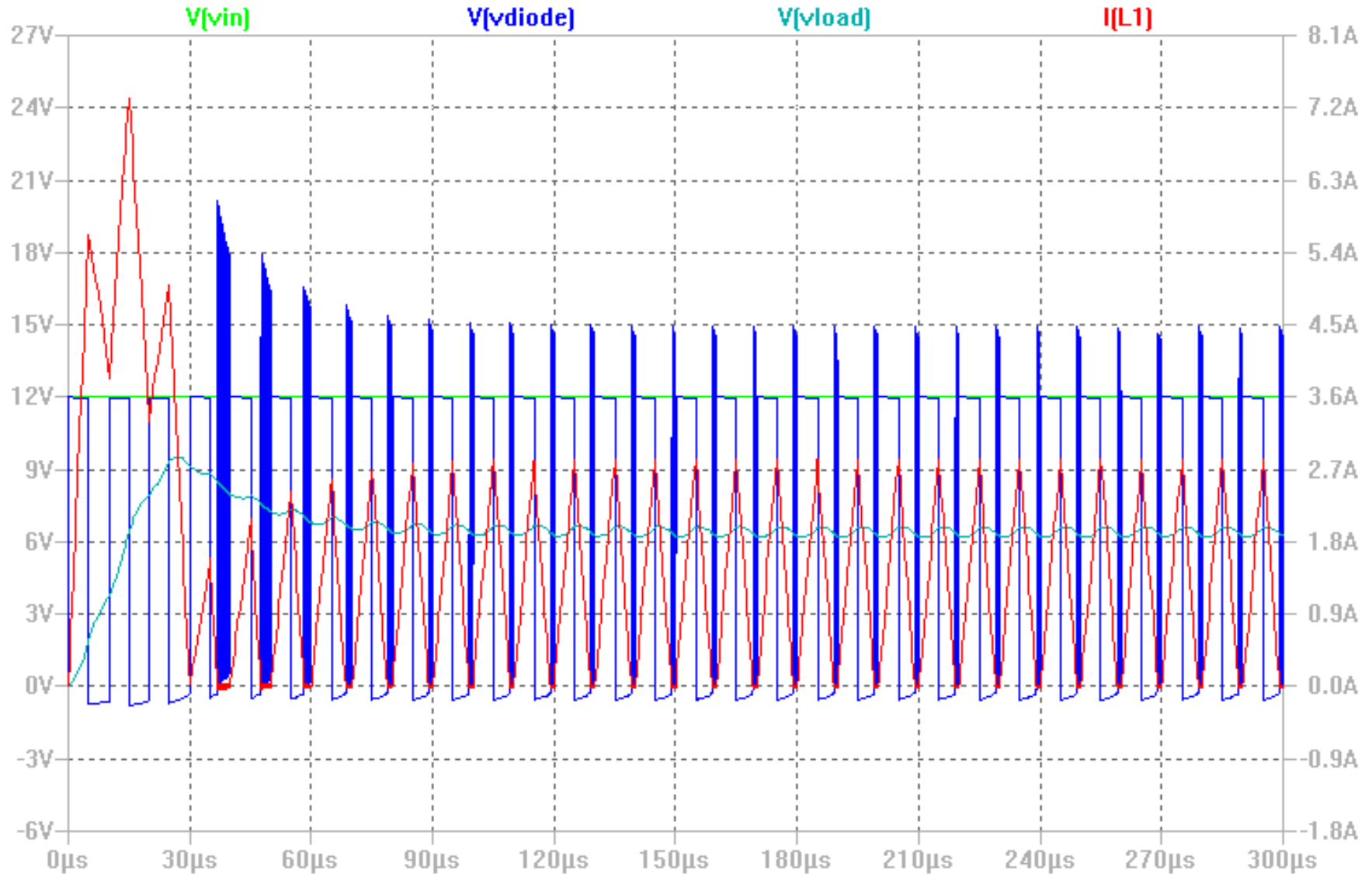


```
.model SW1 SW(Ron=0.01 Roff=1Meg Vt=1.1 Vh=-0.1)
PULSE(0 12 0 0.00000001 0.00000001 0.000005 0.00001 100000)
.tran 0 1msec 0 0.1ms
```

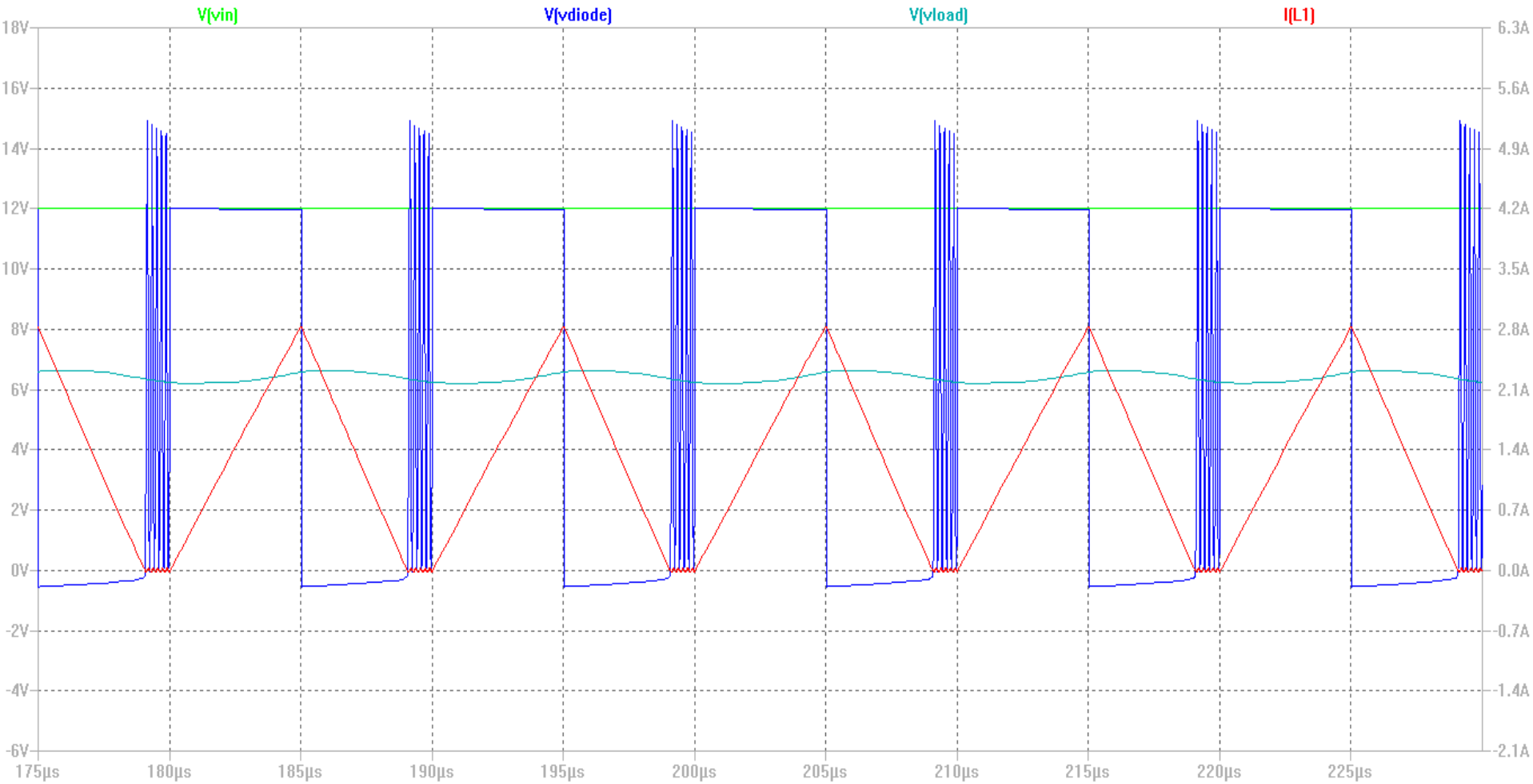
# Design parameters

- $V_{in} = 12V$
- $V_{sw} = 12V$  ( $R_{on}=0.01$   $R_{off}=1Meg$   $V_t=1.1$   $V_h=-0.1$ )
- $L = 10\mu H$
- $C = 10\mu F$  ESR = 100mohm
- Diode = 1N5818
- $R_{load} = 5\ \Omega$

# Transient response

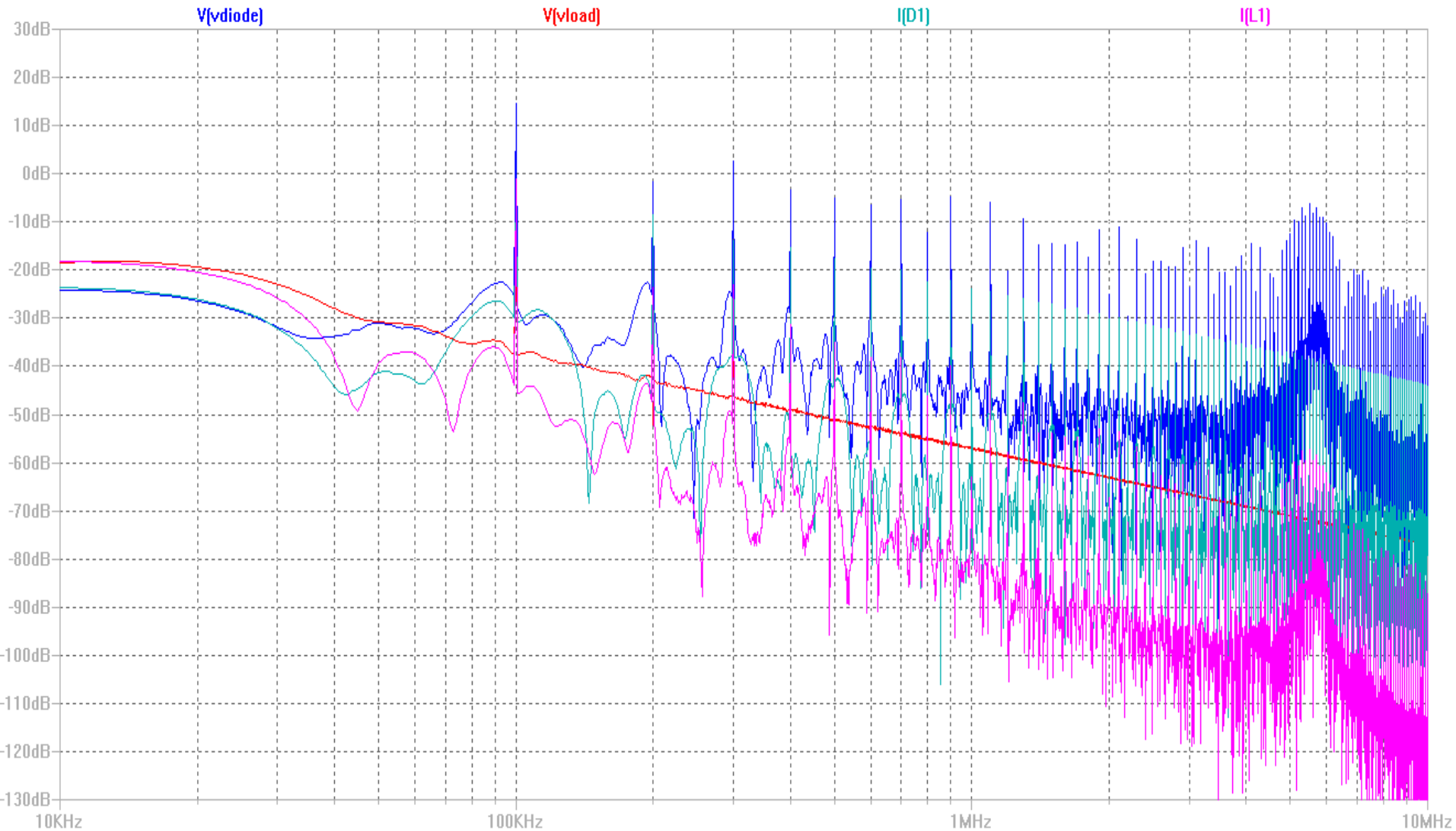


# Steady State response

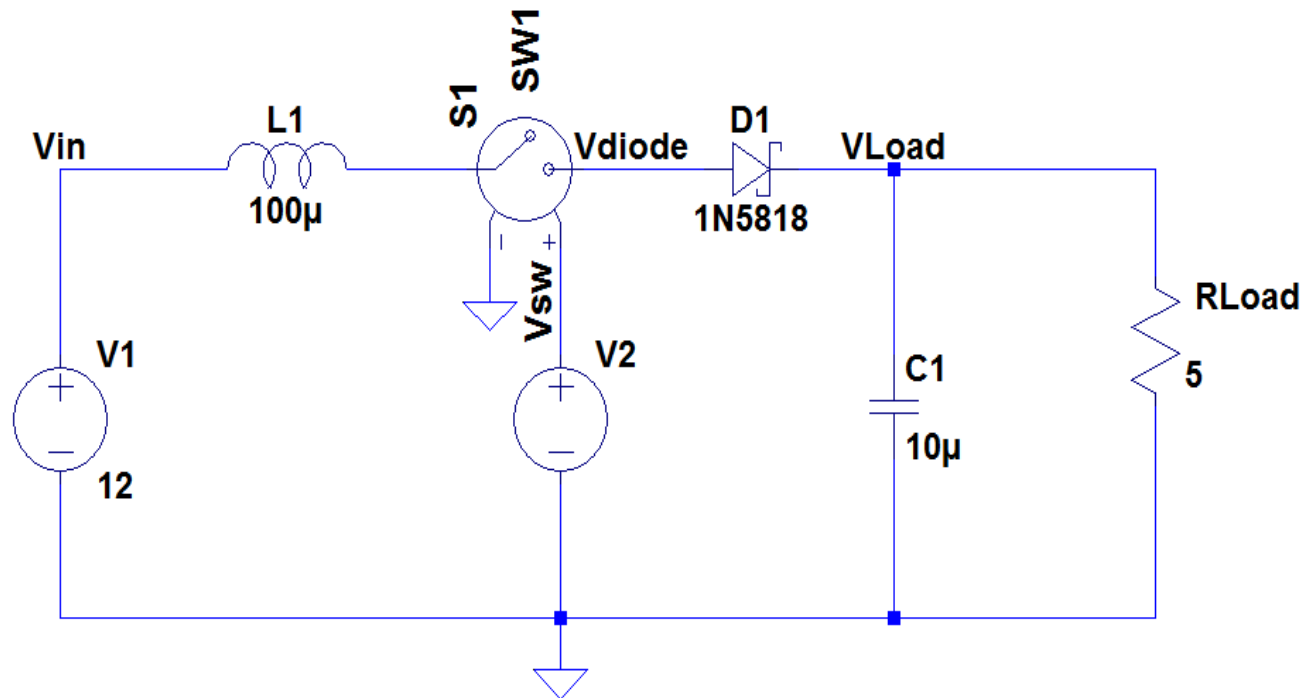


Discontinuous mode of operation as inductor goes to zero. Also Vdiode shoots suddenly.

# Freq. response Zoomed



# Boost Converter-1

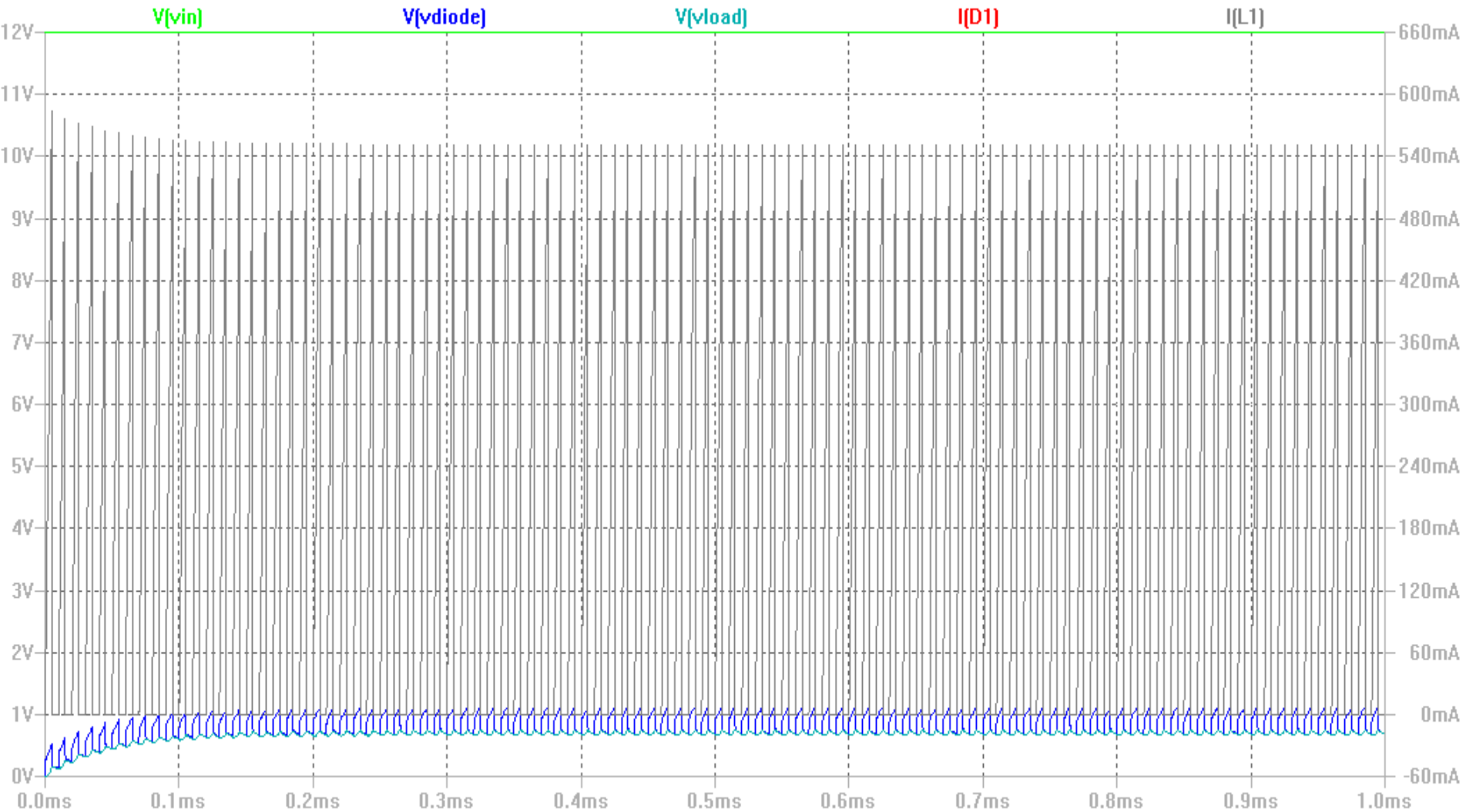


```
.model SW1 SW(Ron=0.01 Roff=1Meg Vt=1.1 Vh=-0.1)
PULSE(0 12 0 0.00000001 0.00000001 0.000005 0.00001 100000)
.tran 0 1msec 0 0.1ms
```

# Design parameters

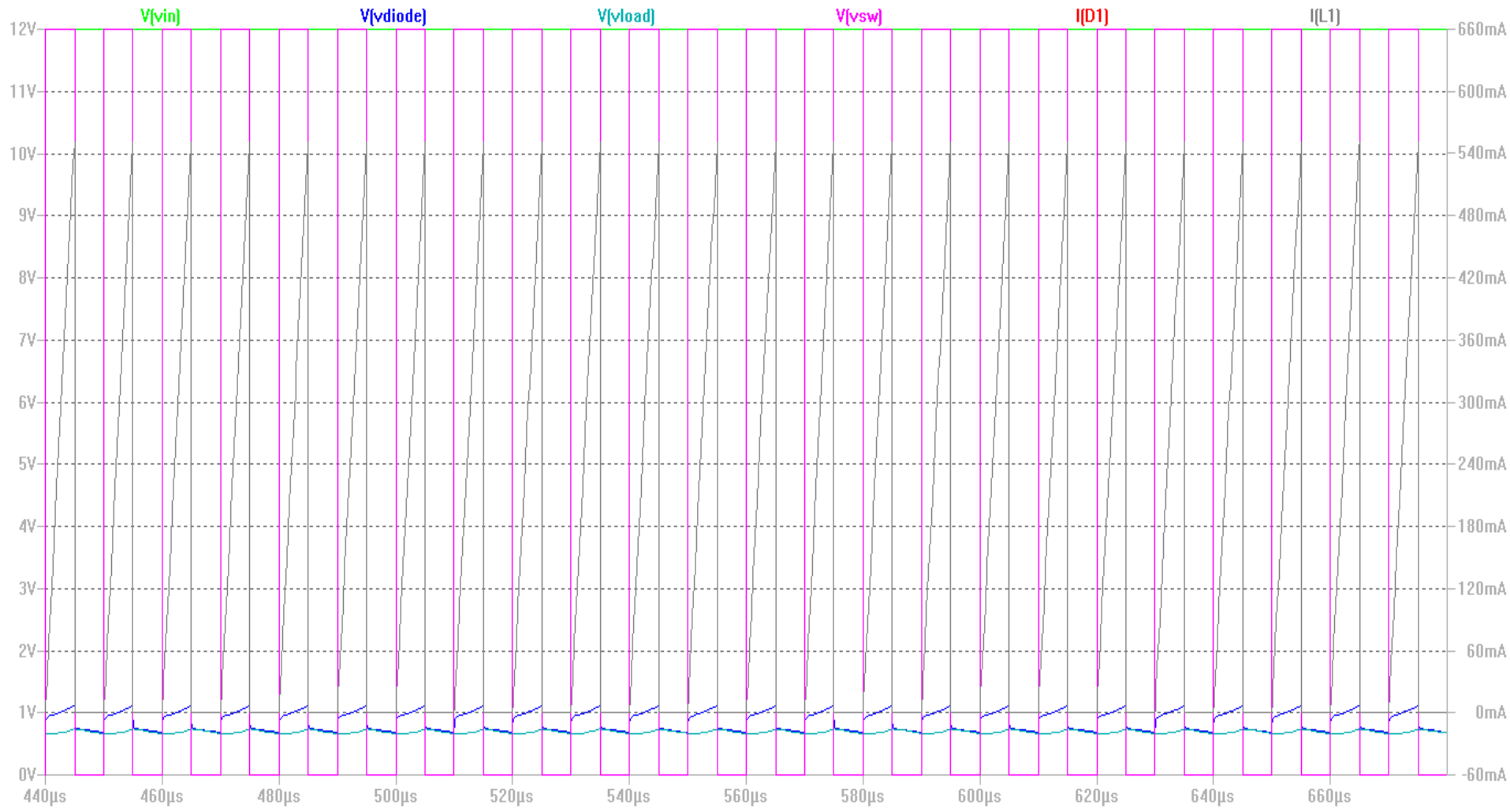
- $V_{in} = 12V$
- $V_{sw} = 12V$  ( $R_{on}=0.01$   $R_{off}=1Meg$   $V_t=1.1$   $V_h=-0.1$ )
- $L = 100\mu H$
- $C = 10\mu F$  ESR = 0 mohm
- Diode = 1N5818
- $R_{load} = 5\ \Omega$

# Transient response



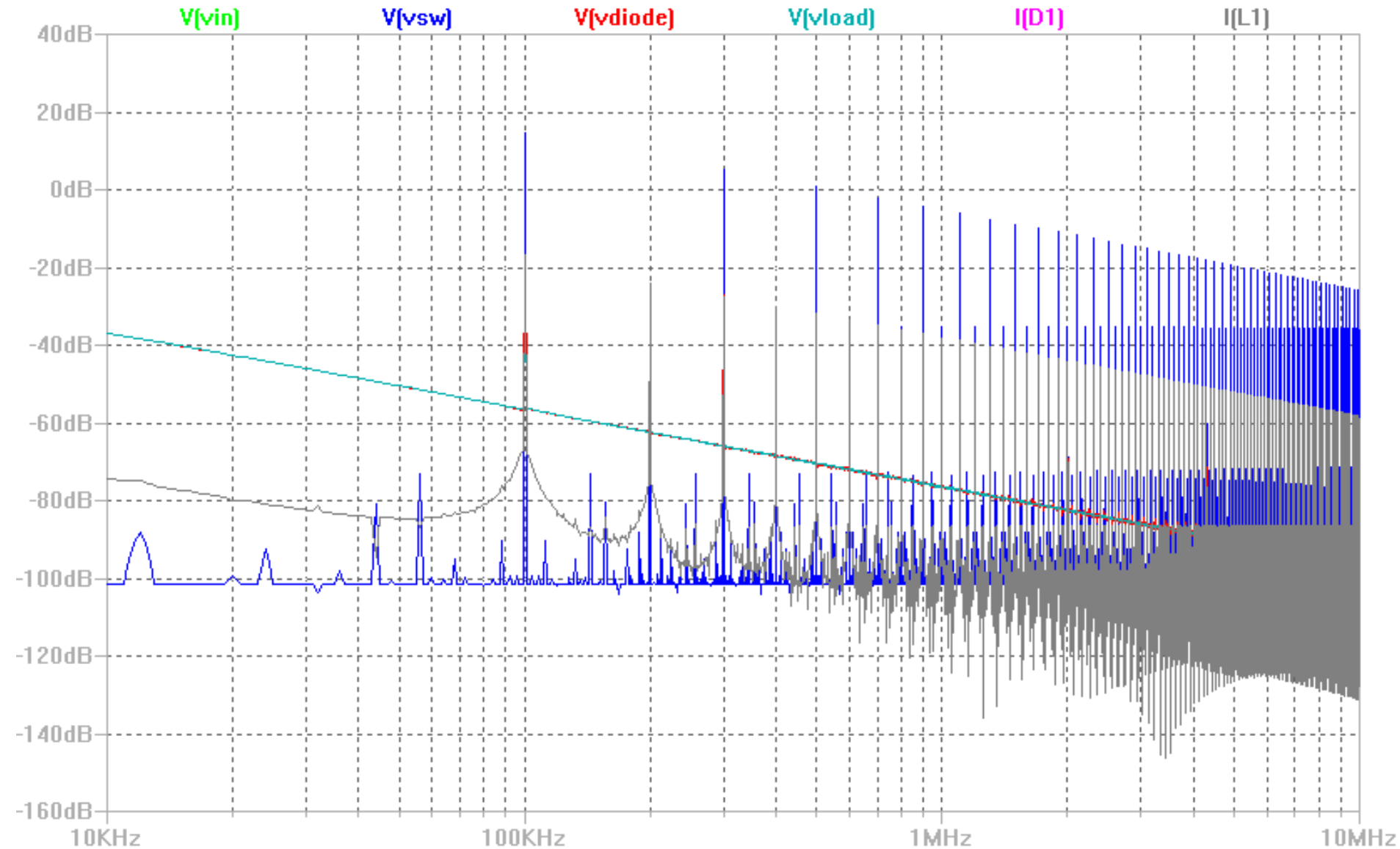


# Steady State response



Discontinuous mode of operation as inductor goes to zero. Also Vdiode shoots suddenly.

# Freq. response Zoomed



# Updates: HPF Circuit

- Bought EPCOS 0.1 $\mu$ F polypropylene film capacitors with  $V_{rms}$  rating 305V.
- Testing a simple HPF circuit with approx values of R on AC voltage and it worked well.

Observations: These capacitors could survive High AC voltages.

- Next step is to get some more resistors (33ohm and 750hm) from LPR and check output voltage of this circuit on 230Vrms.
- Collect some real world data on spectrum analyzer.