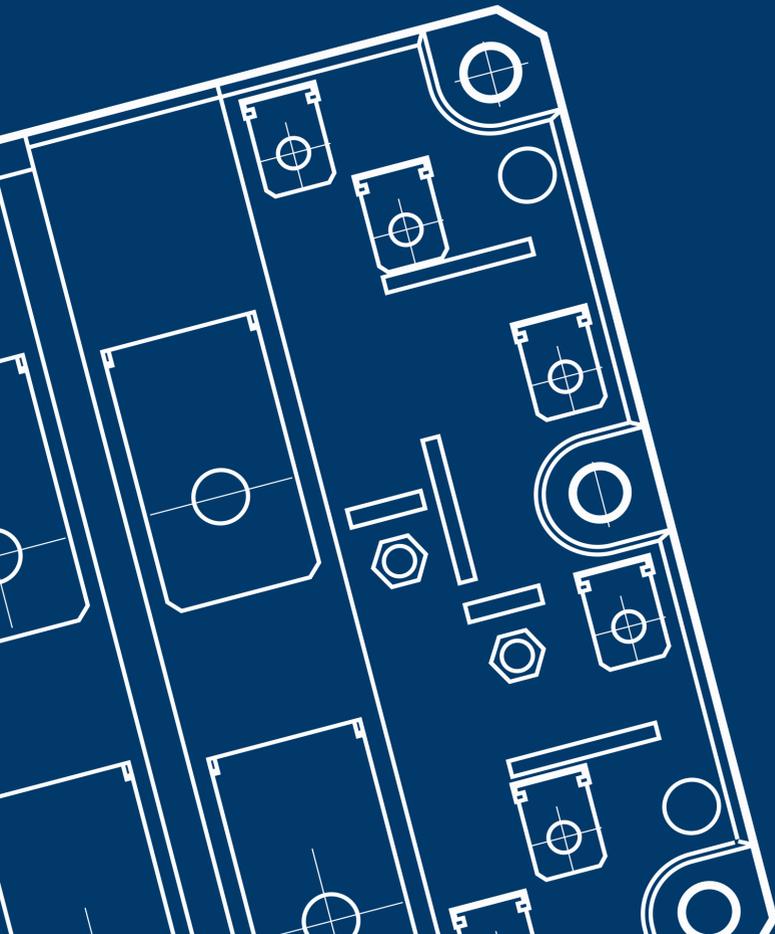




# Online Design Tool User Manual





## Easy selection of the Dynex device most suitable to the application

Our Design Tool contains a topology simulator, that provides an analysis of the behavior of our components in your specific application. All typical power electronic typologies are available with system losses, current ripple, and a maximum thermal resistance as a starting point for your thermal design. The Design Tool offers the comparison of different component configurations in each topology within a few clicks.

**Choose Converter Topology: ?**

2-Level Single Phase

--- AC-Converters ---

2-Level Single Phase

2-Level Three Phase

3-Level Three Phase (T-Type)

3-Level Three Phase (I-Type)

5-Level Three Phase (I-Type)

--- Rectifiers ---

Diode Rectifier, Single Phase

Diode Rectifier, Three Phase

--- DC-Topologies ---

Buck Converter

Boost Converter

**Parameters for System Simulation:**

Grid voltage (V)	Grid current (A)	Grid frequency (Hz)
400.0	52.74	50
DC-Link voltage (V)	Grid inductance (H)	Average ambient temperature (°C)
700.0	0.004	25
Switching frequency (Hz)	Power factor	Average junction temperature (°C)
2000	0.9	100

Third harmonic injection:  Off  Inductive

Reactive power:  Inductive

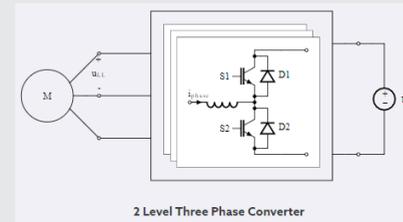
**Overview system losses**

Loss Type	Design A	Design B	Design C
Conduction Losses	~100 W	~100 W	~100 W
Switching Losses	~350 W	~450 W	~350 W
Combined Losses	~450 W	~550 W	~450 W

**Alternating current and grid voltage**

Time (s): 0 to 0.02

Y-axis: Current (A) and Voltage (V)



Our Design Tool is designed to assist you in selecting the right Dynex products, using an integrated interactive datasheet, which allows you to analyse our component's properties and performance at a specific operation point considering current, voltage and junction temperature.

Operating point 1 (OP 1)	Operating point 2 (OP 2)
Junction temperature in °C	Junction temperature in °C
25	125.0
Voltage to be blocked in V	Voltage to be blocked in V
600.0	600.0

The instantaneous and average power losses in each semiconductor component of the circuit are displayed for each topology, selected alongside other outputs shown below.

- Converter output (pulsed and fundamental) & grid voltage
- Alternating current & grid voltage
- Current separated into actual conducting devices
- Conduction losses
- Switching energies

**Step 1:** Choose the Converter Topology

2-Level Single Phase

--- AC-Converters ---

2-Level Single Phase

2-Level Three Phase

3-Level Three Phase (T-Type)

3-Level Three Phase (I-Type)

5-Level Three Phase (I-Type)

--- Rectifiers ---

Diode Rectifier, Single Phase

Diode Rectifier, Three Phase

--- DC-Topologies ---

Buck Converter

Boost Converter

**Step 2:** Choose the AC terminals:

If you intend to simulate a converter, please choose whether the AC terminals are connected to the power grid or a motor.

Choose Converter Topology: ?

2-Level Single Phase

Select load: Motor / Grid ?

Motor

Find Semiconductors

2 Level Single Phase Converter

**Step 3:** After the preconfiguration of the topology and the AC terminals, please confirm the input with “Find Semiconductors”.

Choose Converter Topology: ?

2-Level Single Phase

Select load: Motor / Grid ?

Grid

Find Semiconductors

2 Level Single Phase Converter

**Step 4:** Choose the components dependent on the selected topology from the product table. The simulation shows results for the:

- Switching and conductive losses (table)
- Carrier and reference (graph)
- Converter output and grid voltage (graph)
- Alternating current (graph)
- Current phase 1 (graph)
- Switching and conductive losses in phase 1 (graph)

a) Furthermore, you can view a digital data sheet of a component.

IGBTs ?

DIM400PHM17-A

Search: [ ]

Part Number	VCE (V)	Configuration	IC (A)	st TC (°C)	VCE (SAT) @ Tc=25°C (V)	Total Esw (J)	Rth(j-c) (per switch) (°C/kW)	Baseplate Dims (mm)	Isolation voltage (V)	Technology	Select as Switching Device
DIM400PHM17-A	1700.0	Half Bridge	400.0	75.0	2.7	0.35	36.0	140x73	4000.0	DNPT	○
DIM400DDM17-A	1700.0	Dual	400.0	75.0	2.7	0.35	36.0	140x130	4000.0	DNPT	○
DIM1200FSM17-A	1700.0	Single	1200.0	75.0	2.7	1.0	12.0	140x130	4000.0	DNPT	○
DIM1600FSM17-A	1700.0	Single	1600.0	75.0	2.7	1.25	9.0	140x130	4000.0	DNPT	○

## Step 4b: Digital Datasheet

On this page you can define two operating points at different temperatures and blocking voltages to compare the output characteristics of the device, as well as the switching energies generated.

The marked current in the graphs corresponds to your previously selected operating point.

### Parameters for static Plots:

#### Operating point 1 (OP 1)

Junction temperature in °C ?

25

Voltage to be blocked in V ?

900.0

#### Operating point 2 (OP 2)

Junction temperature in °C ?

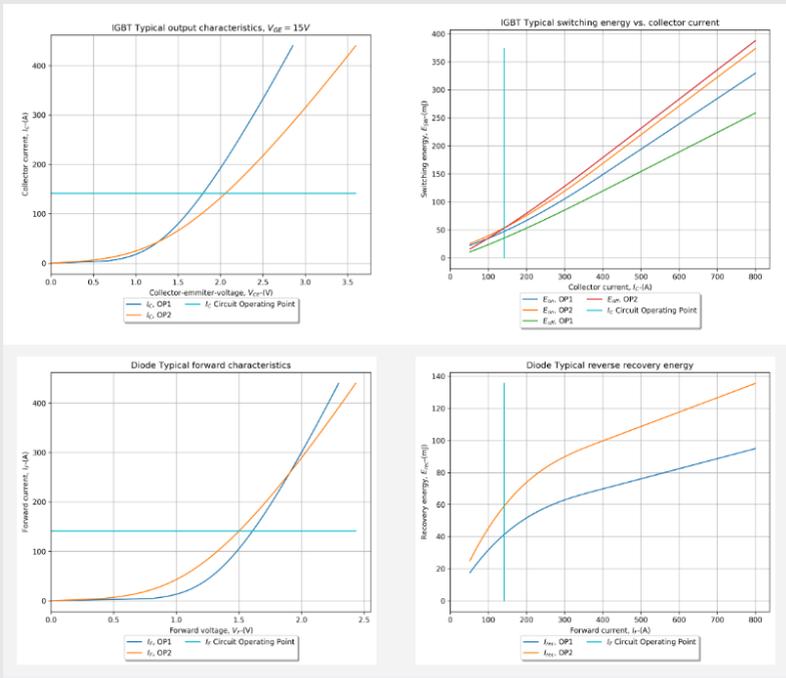
125.0

Voltage to be blocked in V ?

900.0

Device was measured for  $T_J = 25.0\text{ °C}$  and  $T_J = 125.0\text{ °C}$ ; you can chose operating temperatures in between.

Compare Operating Points



In addition, you can view the original digital Dynex datasheet for this component.

## Data sheet of DIM400PHM17-A

On this page you can define two operating points at different temperatures and blocking voltages to compare the output characteristics of the device, as well as the switching energies generated.

The marked current in the graphs corresponds to your previously selected operating point.

Open PDF Datasheet

Step 5: If all components, which are necessary for the selected topology, are chosen, the System Simulation can be started by “Show System Simulation”.

Nominal voltage-(V) ? 400      Apparent power-(VA) ? 40000      Nominal current-(A) ? 100

Update List ?

Show System Simulation ?

IGBTs ?

Search: \_\_\_\_\_

Part Number	VCES (V)	Configur- ation	IC (A)	at TC (°C)	VCE (SAT) @ Tc=25°C (V)	Total Esw @ Tc=125°C (J)	Rth(j-c) (per switch) (°C/kW)	Baseplate Dims (mm)	Isolation voltage (V)	Technology	Select as Switching Device
DIM1400PHM17-A	1700.0	Half Bridge	400.0	75.0	2.7	0.35	36.0	140x73	4000.0	DNPT	<input type="radio"/>
DIM1400DDM17-A	1700.0	Dual	400.0	75.0	2.7	0.35	36.0	140x130	4000.0	DNPT	<input type="radio"/>
DIM11200FSH17-A	1700.0	Single	1200.0	75.0	2.7	1.0	12.0	140x130	4000.0	DNPT	<input type="radio"/>

**Step 6:** Choose the parameters for System Simulation and start the simulation with “Update System Simulation”.

**Parameters for System Simulation:**

Nominal voltage-(V)	Nominal current-(A)	Nominal electrical frequency-(Hz)
400.0	100.0	50
DC-Link voltage-(V)	Motor phase inductance-(H)	Average ambient temperature-(°C)
1400.0	0.001528	25
Switching frequency-(Hz)	Power factor	Average junction temperature-(°C)
2000	0.9	100

Reactive power

Inductive

**Update System Simulation**

Superimposing a 3rd harmonic on the generated voltage produces higher voltage amplitudes, without entering the non-linear over modulation range. In three phase systems this voltage is a zero sequence component and therefore generates no current, provided the DC-Link and AC starpoint are isolated.

This parameter sets the type (inductive or capacitive) of reactive power generated, depending on the power factor chosen.

### DC-link voltage:

Enter the DC-Link voltage used in your system.

**Hint:** Typical values are larger than the AC voltage amplitude to avoid undesired diode rectification, which will cause flawed results. In three phase systems the line to line voltage has to exceed the DC-Link voltage.

### Average Ambient Temperature:

This is the temperature the cooling system uses for heat dissipation. This value is used to determine the maximum allowed thermal resistance of the heatsinks used. The Ambient temperature is assumed to remain constant for all calculations.

### Nominal Electrical Frequency:

Enter the electrical frequency of the motor the circuit shall be connected to. Typical values are 50 Hz and 60 Hz and can be found on the machine label.

### Motor Phase Inductance:

**Hint:** Typical values realise a voltage drop between 2% and 12% of the grid voltage if nominal current is produced. Enter the inductance of the motor.

**Hint:** You can find this value in the motor datasheet or by contacting your supplier.

### Power Factor:

Enter the desired power factor on the AC-side.

**Hint:** Value must be between -1 and 1 where 1 results in an inverter with pure active power, -1 in a rectifier with pure active power and 0 in pure reactive power. The type of reactive power can be chosen in the field “Inductive vs. Capacitive”.

### Switching Frequency:

The switching frequency should be significantly larger than the desired output frequency, within the limits of the component used.

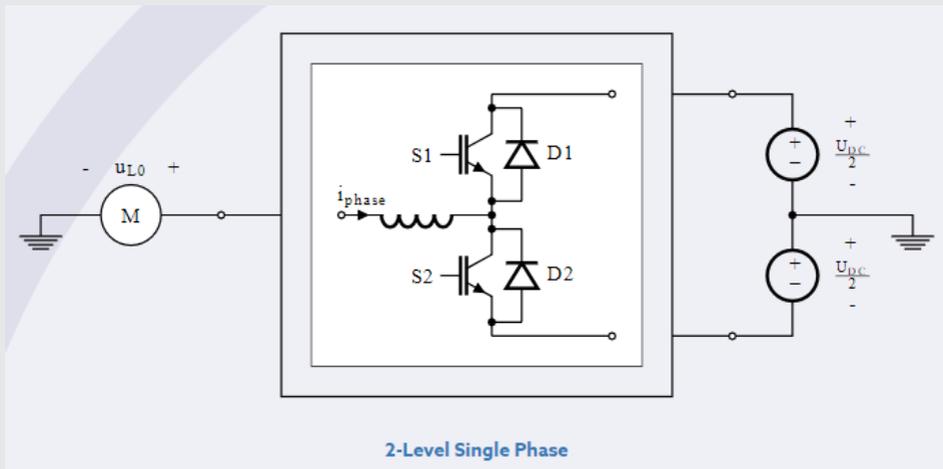
**Hint:** A typical maximum allowed switching frequency for IGBTs is 20 kHz.

### Average Junction Temperature:

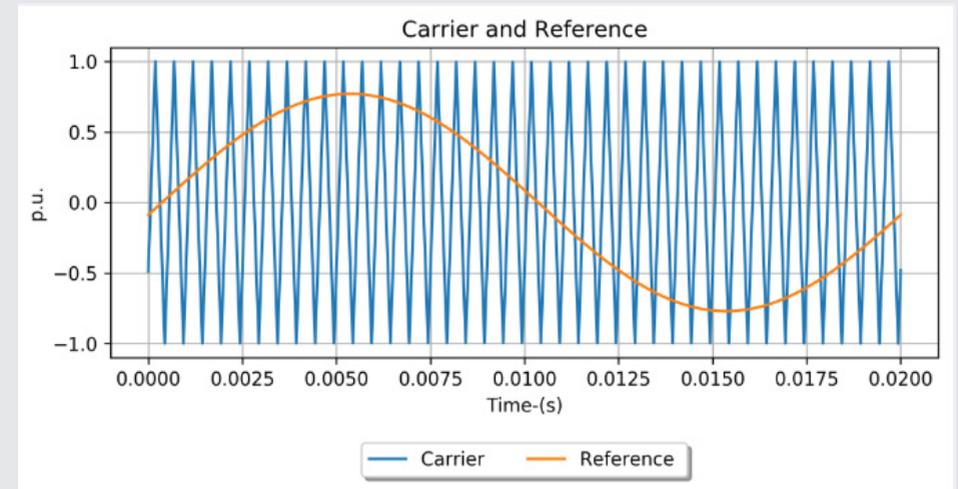
Set the average junction temperature you would like to achieve. The simulation will limit the temperature to the range given in the component datasheet. Make sure your application stays below the limit of the components, also considering the temperature swing of the components.

**Hint:** Typical temperature limits are 125°C or 150°C.

**Step 7:** This page shows a table with the calculated conduction and switching losses.



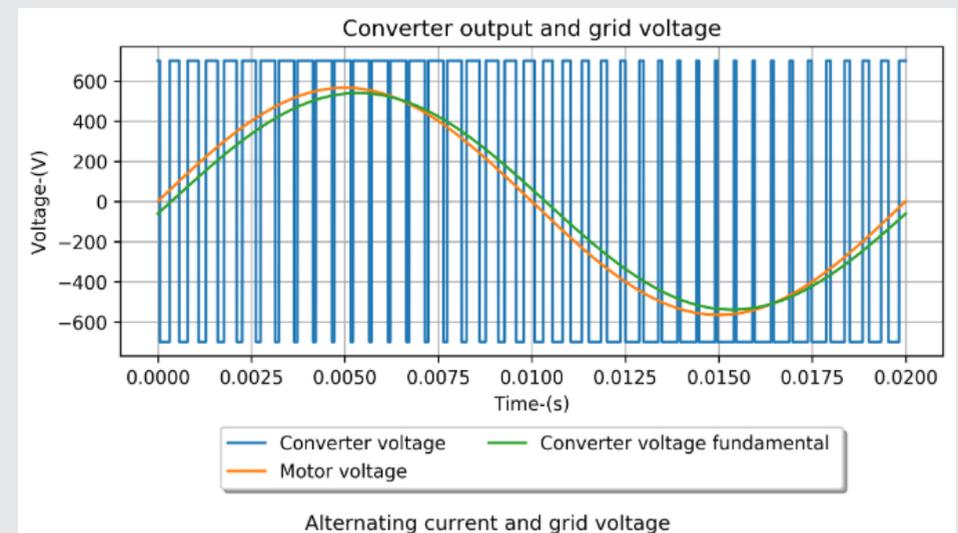
The values for carrier, reference, converter and grid voltage are displayed graphically.



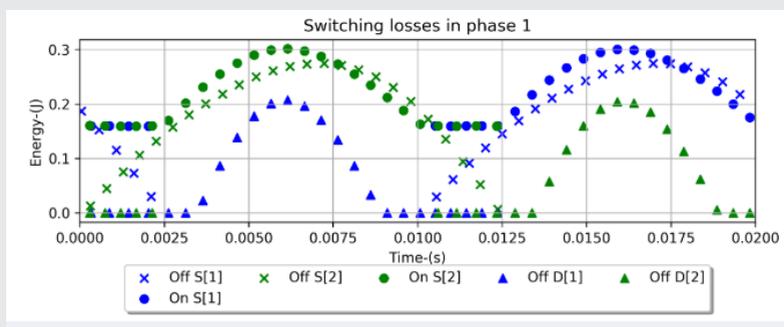
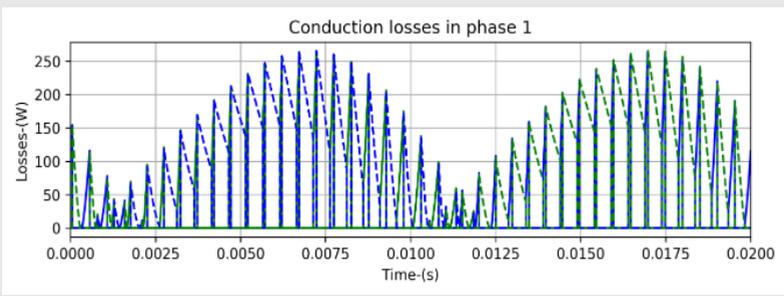
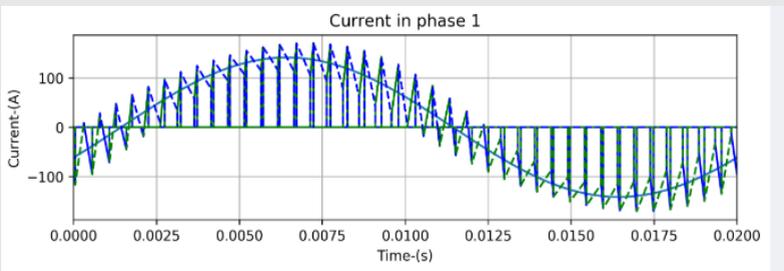
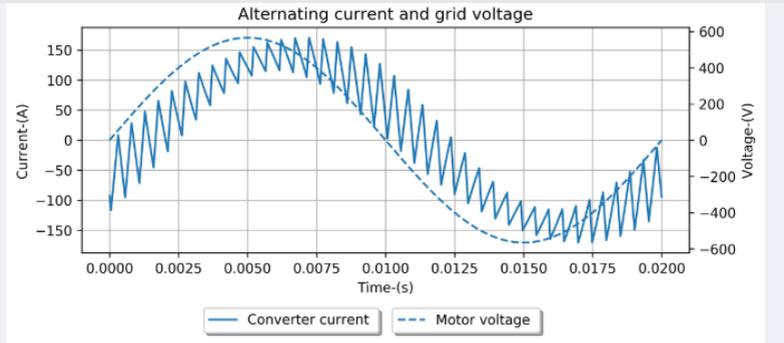
Search:

Calculated System Losses <span style="font-size: small;">?</span>			
	Conduction Losses-(W)	Switching Losses-(W)	Combined Losses-(W)
Efficiency 97.64 %			
System	119.04	1111.1	1230.14
Switch S1	12.66	478.99	491.66
Diode D1	46.84	72.65	119.48
Switch S2	12.68	487.02	499.7
Diode D2	46.86	72.44	119.29

Showing 1 to 6 of 6 entries



The values for alternating current, grid voltage and current in phase 1 are displayed graphically.



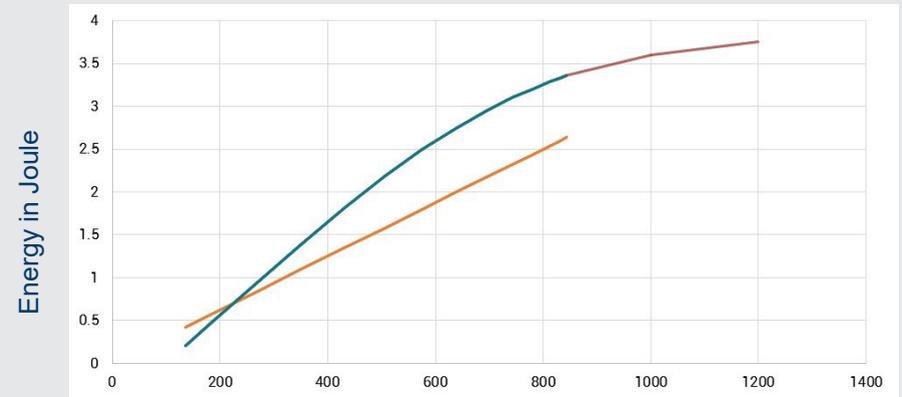
## Further Explanations

### Diode characteristic curve

Mathematical approach for the diode characteristic correspond to a linear interpolation.

A linear interpolation of the diode characteristic results in a curve which is deviated from the actual diode characteristics.

The design tool addresses this deviation. The diode characteristic curve of the PE-Finder corresponds exactly to the characteristic curve of the data sheet. The shape of the curve is reproduced step by step. This results in improved accuracy of the calculation.



— Calculated Energy PE Finder — Calculated Energy Dynex — Datasheet

Current	Mathematical Approach	Time
844.3852839	2.63870401	3.363889957
843.2262359	2.63508199	3.361113926
832.4506949	2.60140842	3.334412339
812.3727394	2.53866481	3.284396931
783.058718	2.44705849	3.211373922
743.3235553	2.32288611	3.105553256
694.8518477	2.17141202	2.949665813
638.5596565	1.99549893	2.745698874
575.1686306	1.79740197	2.492561774
505.7467925	1.58045873	2.189699127
430.9485298	1.34671416	1.817836958
351.4029741	1.09813429	1.38662243
268.3017818	0.83844307	0.933082073
182.2948713	0.56967147	0.463683214
135.5169467	0.42349046	0.208383909

Some of the equations used for loss calculations by the Design Tool.

IGBT and Diode losses (calculated by the Design Tool)

### Buck Converter:

$$\Delta I = \frac{V_{dc}}{Lf} (1 - p) p$$

$$P_{sw} = f. (E_{on}(I_{on}, V_{dc}, T_j) + E_{off}(I_{on}, V_{dc}, T_j))$$

$$P_{cond} (IGBT) = \frac{T_{sim}}{T_0} \sum_{k=1}^{T_0/T_{sim}} i_{c,k} \cdot V_{ce,k}$$

$$P_{cond} (Diode) = \frac{T_{sim}}{T_0} \sum_{k=1}^{T_0/T_{sim}} i_{f,k} \cdot V_{f,k}$$

### Boost Converter:

$$\Delta I = \frac{V_{dc}}{Lf} (1 - p) p \quad \frac{V_{out}}{V_{DC}} = \frac{1}{1 - p}$$

$$P_{sw} = f. (E_{on}(I_{on}, V_{dc}, T_j) + E_{off}(I_{on}, V_{dc}, T_j))$$

$$P_{cond} (IGBT) = \frac{T_{sim}}{T_0} \sum_{k=1}^{T_0/T_{sim}} i_{c,k} \cdot V_{ce,k}$$

$$P_{cond} (Diode) = \frac{T_{sim}}{T_0} \sum_{k=1}^{T_0/T_{sim}} i_{f,k} \cdot V_{f,k}$$



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