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AN6353
Dynex High Power IGBT Optimization Guide
Application Note

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Introduction

Dynex's IGBT offering is optimized for several applications across voltage ratings from 750V-6500V; this application note is to aid in the selection of the appropriate optimized High Power (3300V-6500V) IGBT variant.

Refer to AN5700 for a complete explanation of Dynex's IGBT naming convention.

V_{CE} vs E_{SW}

The V_{CE} / E_{SW} trade-off is determined by the current gain of the bipolar part of an IGBT; high current gain devices will have Low V_{CE} and High E_{SW}; conversely devices with a lower current gain will have High V_{CE} and Low E_{SW}.

Dynex's IGBT offerings will typically feature a low E_{SW}, Low V_{CE} and balanced E_{SW} V_{CE} variants; which are identified with the following suffixes.

Variant	Identifier
Low E_{SW}	DIM…-*F***
Low V_{CE}	DIM…-*L***
Balanced (standard)	DIM…-*S***

Dynex Optimized Variant Identifier
*(E.g. DIM1500ESM33-**TF000**)*

This enables the designer to select optimized chip variants, in which criteria for switching frequency and forward currents can be simultaneously evaluated. Consult with Dynex AN5700 for device naming nomenclature and our Product Guide for our complete IGBT offering. The tradeoff figures on page 3 show how the optimized variants compare to each other regarding V_{CE} and E_{SW}.

Low E_{SW} / F Applications

Generally speaking, Low E_{SW} / F variants; are ideal choices for applications with switching frequencies above 250Hz (6500V/4500V) - 750Hz (3300V). Typically, higher switching applications are DC/DC converters, active front end rectifiers and inverters. While the F variants have significantly higher V_{CE} / Conduction Losses; their lower V_{CE} counterparts will suffer disproportionally higher switching losses at the same forward current and frequency. The Application Example section of this application note details the conduction vs switching losses by chip variant in a generic inverter application.

Low V_{CE} / L Applications

Applications with switching frequencies below 150-200Hz favour Low V_{CE} devices, with elevated switching losses that realize their low on-state losses to their best potential. Transmission/Generation tied MMCs are an ideal application for L variant IGBT modules; a generic MMC simulation is shown in the Application Example in which the benefits of the L variant shown.

S Variant Applications

The S variant will deliver slightly higher V_{CE} and E_{SW}; which can suit ZVS, interrupter/breaker and refurbishment applications.

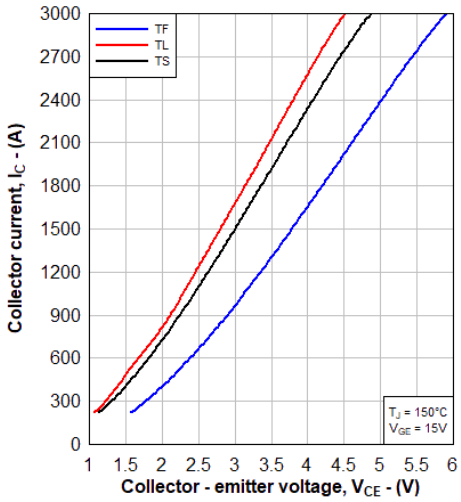
Trade off Comparison

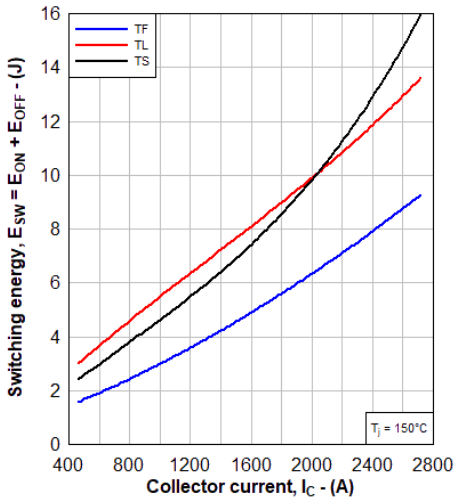
The following figures show the related V_{CE} and E_{SW} obtained from Figures 4 and 5 of the datasheets:

DIM1500ESM33-T(**F/L/S**)000 **3300V d²**
DIM1200ASM45-T(**F/L/S**)000 **4500V d²**
DIM750ASM45-T(**F/L/S**)000 **6500V d²**

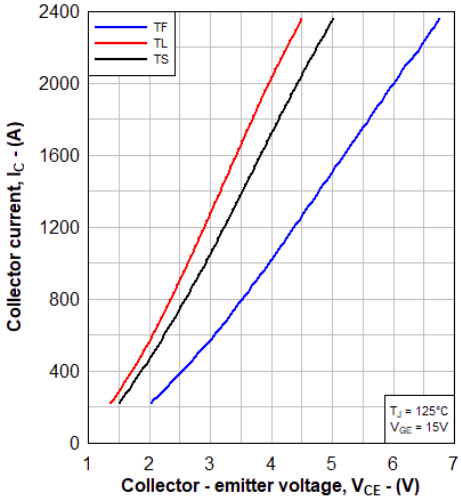
The relationship between the three optimization offerings is shown on the following page.

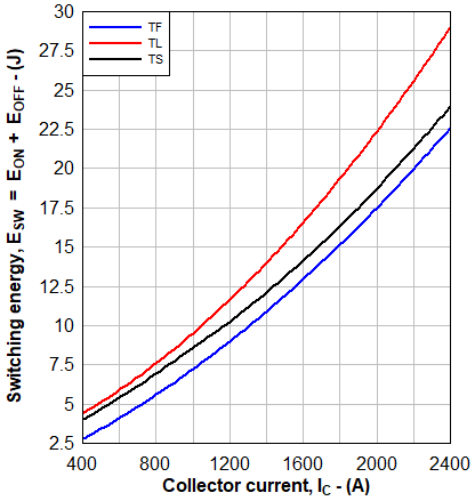
T Series d² 3300V / 1500A Modules



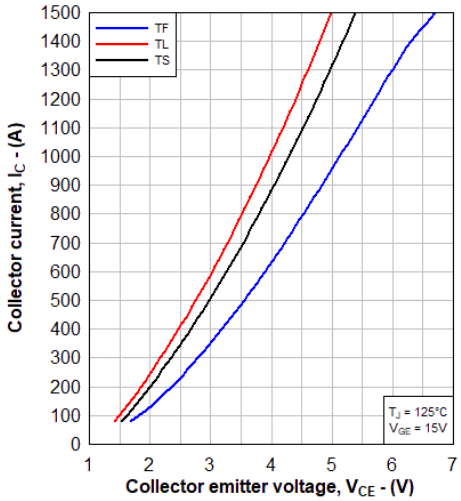


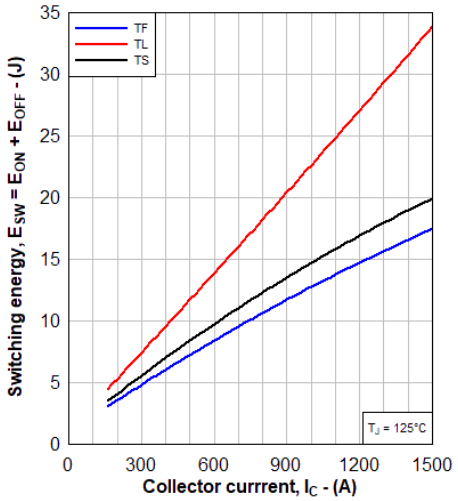
T Series d² 4500V / 1200A Modules





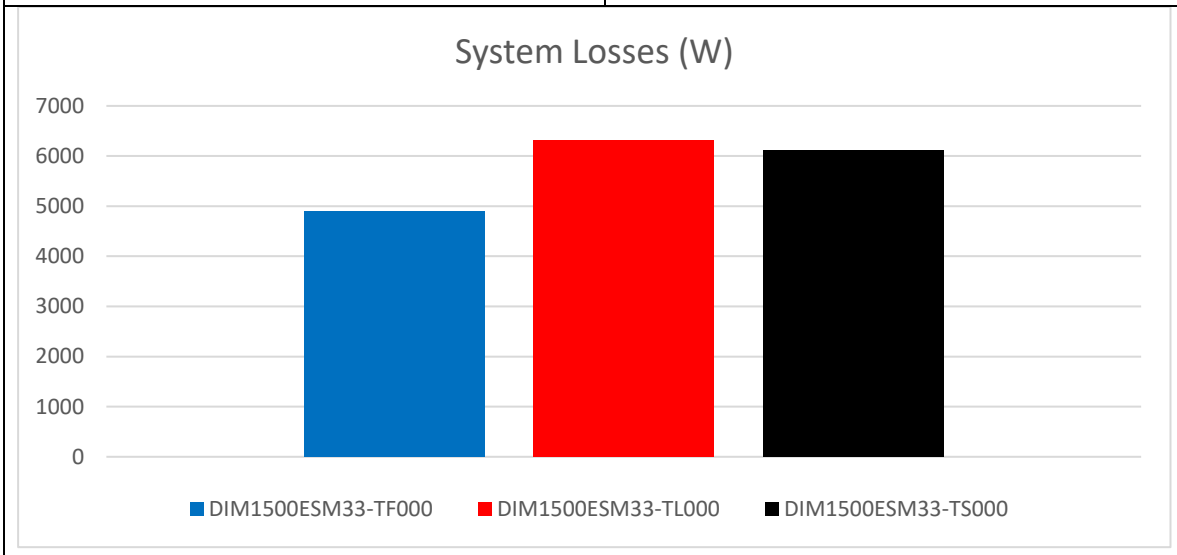
T Series d² 6500V / 750A Modules

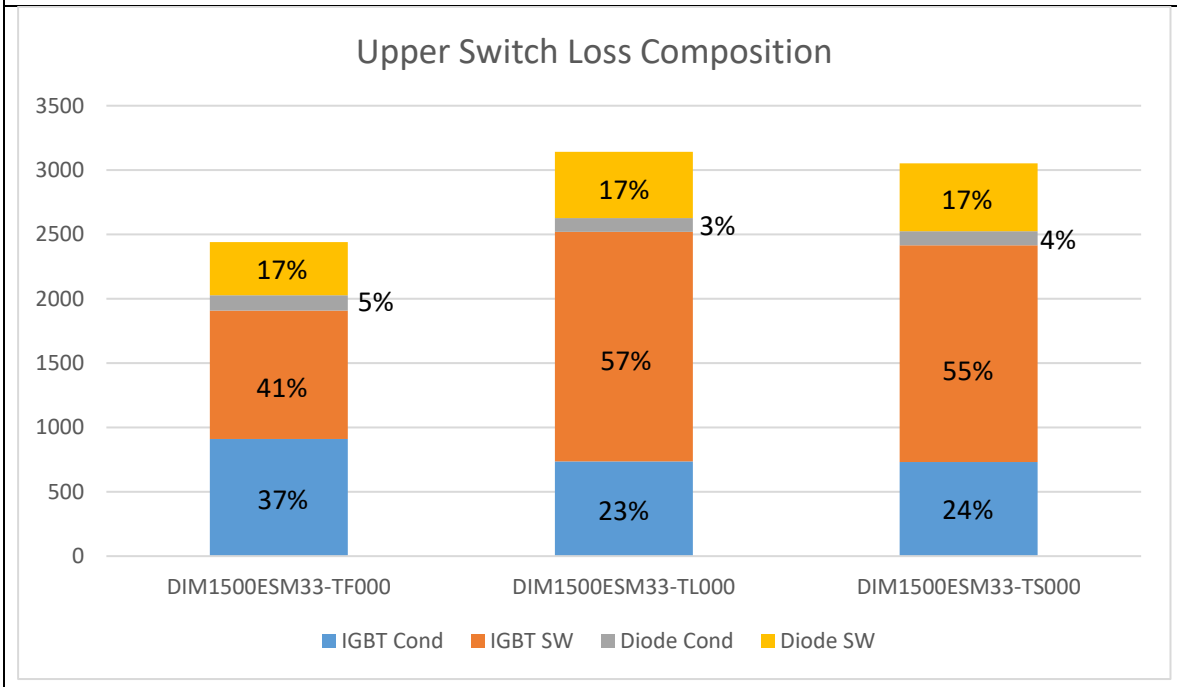




Application Example – 1 Ph Voltage Source Inverter

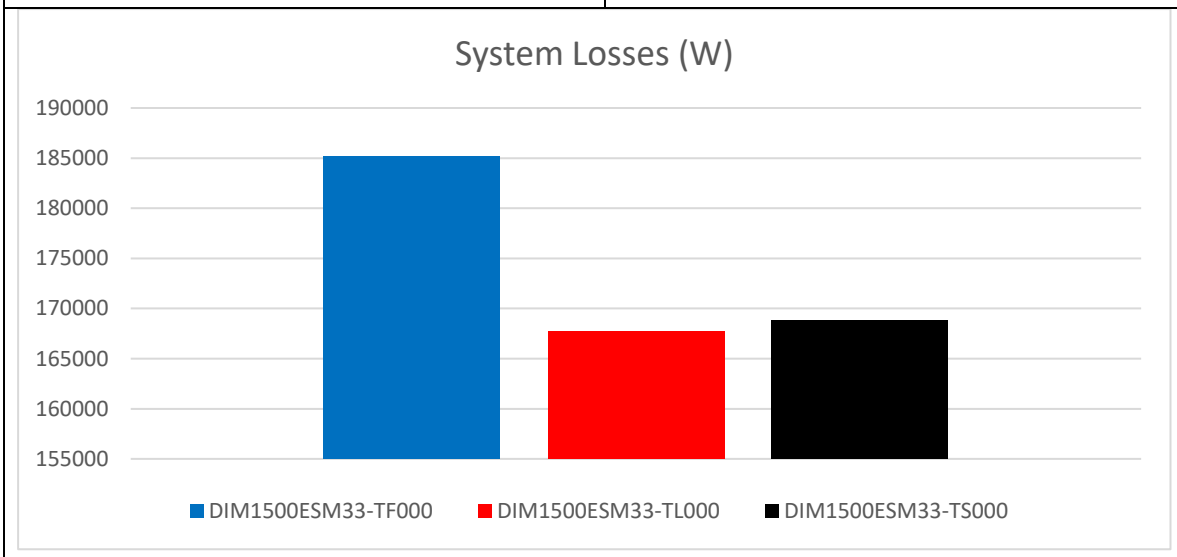
Parameters	Comment:
V = 600 Vrms, 50 hz, 1 ph. P = 0.5 MVA, pf = 0.9 DC Link = 1800V FSW = 1000hz, SPWM, open loop control T_{hs} = 50ºC	The TF's reduction in switching losses is greater than the difference between its elevated conduction losses relative to the TS and TL variants. Lower switching frequencies will reduce the TF's advantage, until there is relative parity among the variants.

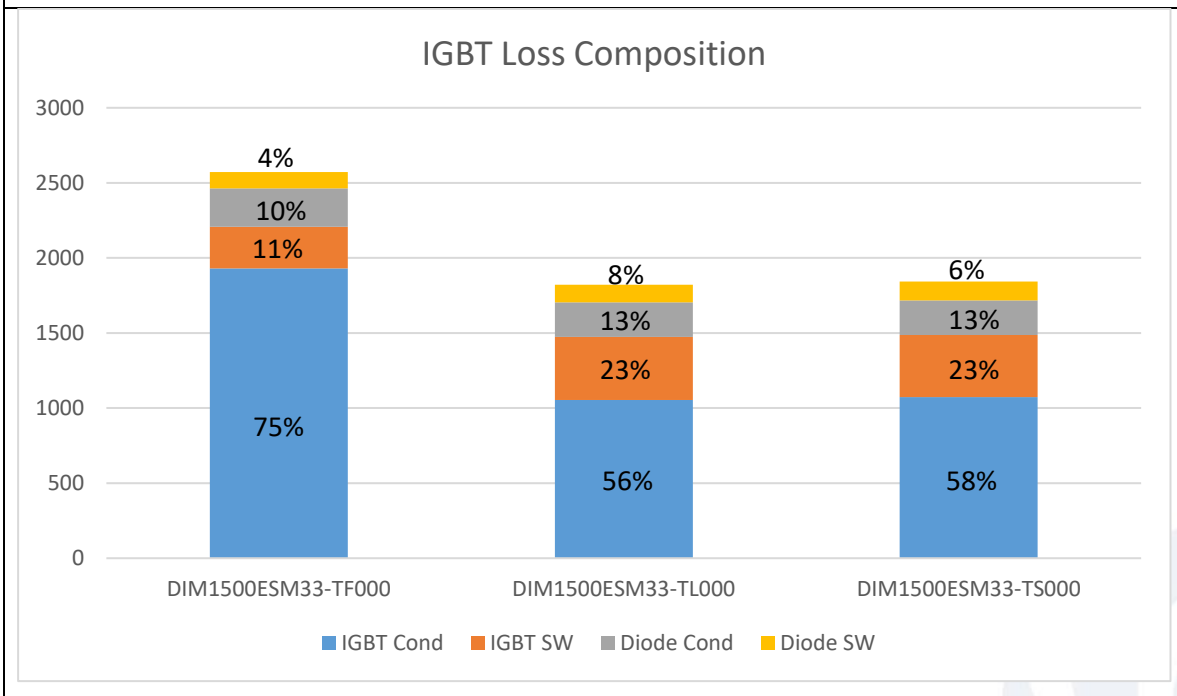




Application Example Modular Multilevel Converter

Parameters	Comment:
V = 13.6 kVrms, 60 hz, 1 ph. P = 1.5 MVA, pf = 0.9 DC Link = 1800V, 1500A pk module current FSW = 150hz, SPWM T_{hs} = 50ºC	The TL's reduced on-state losses is greater than the difference between it's elevated switching relative to the TF variant. The low switching frequency of the MMC enables the TL and TS variants to be the most advantageous selection.





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