How to Select the Proper Size "AMOBEADS®"

Reference

The proper size "AMOBEADS" core is selected by calculating the necessary voltage times the time in seconds (=flux). From its operating theory, there is a need to increase the voltage used in the calculation by that which develops during the reverse recovery period of diode. The multiple of the voltage and time (voltage times second) is equal to the operating flux. Therefore, the magnetization $\Delta\phi$ns necessary to suppress the noise is calculated by the voltage Ec[V] and time for reverse recovery of diode, that is added to "AMOBEADS"

$$\Delta\phi_{ns}\ [Wb] = E_c \times t_{rr}\ [V \times Sec]$$

A good result is achieved when the voltage Ec added to "AMOBEADS" is close to voltage added to diode. Please select the "AMOBEADS" that have a larger core magnetization ϕc than the voltage times seconds that was calculated here. However, the actual noise suppression result for "AMOBEADS" on real circuit may differ from the calculated value due to the peculiar recovery characteristics of the diode used or the circuit structure. So please confirm the effect by performing examination. "AMOBEADS" can be also affected by things like a CR snubber, so please perform evaluation under condition without any effect of a snubber.

Since "AMOBEADS" have high circuit voltage, sometimes an insufficient result is obtained when the reverse recovery time is long and has minimal magnetization. Under this condition, please consider a wire wound type "SPLIKE KILLER"

Example of "AMOBEADS" Selection

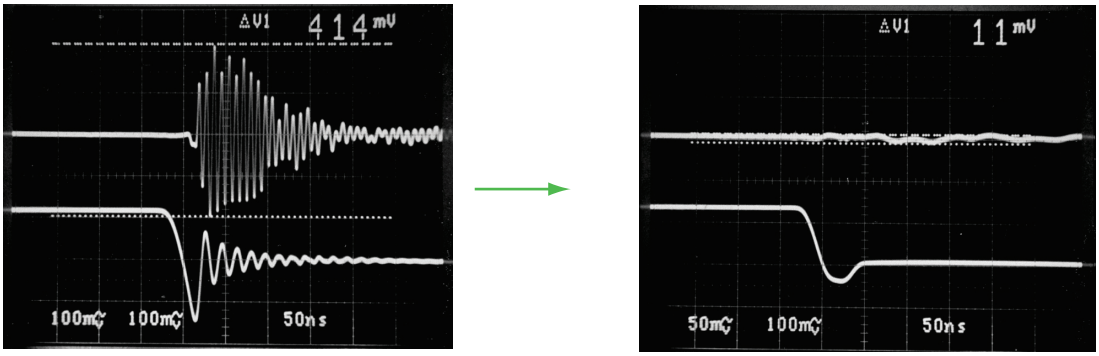
Forward Converter

	Output Voltage				
trr	3.3V	5V	12V	15V	24V
35nsec	AB3×2×3W	AB3×2×4.5W	AB3×2×6W	AB4×2×4.5W	AB4×2×6W
60nsec	AB3×2×4.5W	AB3×2×6W	AB4×2×4.5W	AB4×2×6W	SPIKE KILLER

Flyback Converter

	Output Voltage				
trr	3.3V	5V	12V	15V	24V
35nsec	AB3×2×3W	AB3×2×3W	AB3×2×4.5W	AB3×2×6W	AB4×2×4.5W
60nsec	AB3×2×3W	AB3×2×4.5W	AB3×2×6W	AB4×2×4.5W	AB4×2×6W

Example of Noise Reduction



Without Countermeasure

With AMOBEADS
(AB4×2×8W)

Principle of the Noise Suppressing Device

Reference

We will explain the behavior of "AMOBEADS" when slipped over the lead of a switching power supply output diode.

Period I (When Diode is On)

During period I, which is when the diode is in the "ON" condition and the forward current is running, the "AMOBEADS" are in the saturated magnetic condition "I". There will be almost no inductance under this condition. (Inductance is proportional to the slope of the B-H curve.)

Period Ⅱ (When Diode is Turn Off)

During period Ⅱ, which is when the diode current starts to turn off and the current decreases heading towards zero, the "AMOBEADS" magnetization curve will change like "Ⅱ" in a condition of almost no inductance until the current crosses zero. Since there is no inductance during this period Ⅱ, the angle or slope of the diode current during turn off is constant, a unique characteristic of the "AMOBEADS". If materials such as ferrite is used, inductance will occur during this period Ⅱ and the angle or slope of current during the turn off period will change and this will lead to increased of diode loss.

Period Ⅲ (Reverse Recovery Period)

During period Ⅲ, a reverse recovery current tries to flow in a direction opposite to the normal direction of current flow of the diode and as a result, the magnetization curve of the "AMOBEADS" change like "Ⅲ" and the inductance increases rapidly. At this time, the large inductance of the "AMOBEADS" intercepts and opposes the recovery current and converts the current into a soft recovery condition. Thus by converting the sharp reverse recovery to a soft recovery condition by decreasing the rate of the current change (di/dt), the "AMOBEADS" minimize the rapid change of current (High di/dt) and suppress the noise in the circuit.

Period Ⅳ (After Reverse Recovery Ends)

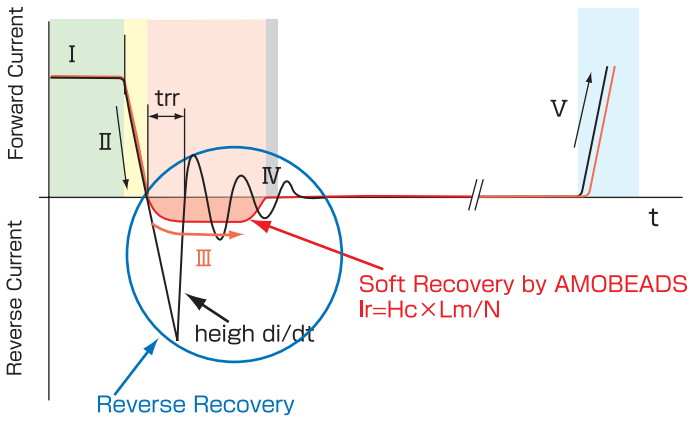
During period Ⅳ, when the reverse recovery of the diode ends, the magnetization of the "AMOBEAD" will move parallel to the vertical axis of the magnetization curve as shown in period "Ⅳ".

Period Ⅴ (When Diode is Turn On)

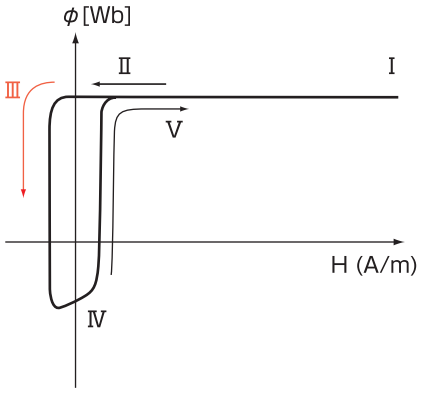
The "AMOBEADS" magnetization will change as shown in "Ⅴ" of the magnetization curve and go back to a saturation condition. At this point, the diode will turn on and after a slight delay of the start up of current, the next current pulse will develop and the cycle described above from Period I thru Ⅴ will repeat itself.

As the complete cycle repeats itself at the circuit operating frequency, the "AMOBEADS" repeatedly suppress circuit noise during period Ⅲ of the cycle by eliminating the rapid change in the reverse recovery current of the diode, which is the cause of noise.

"AMOBEADS" use a cobalt based amorphous alloy with a small coercive force under frequency and this results in excellent noise suppression.



Current Waveform of Diode



Actual BH Curve