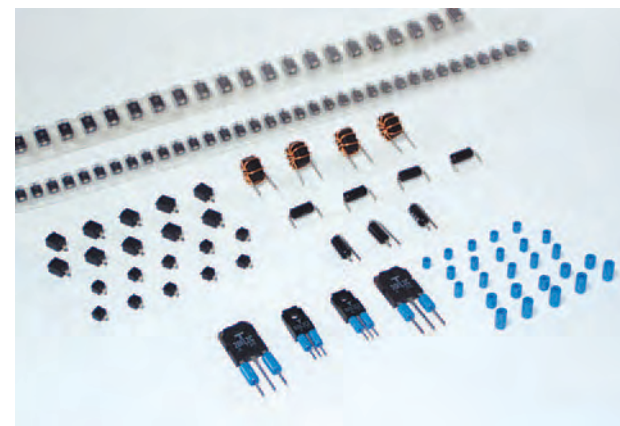
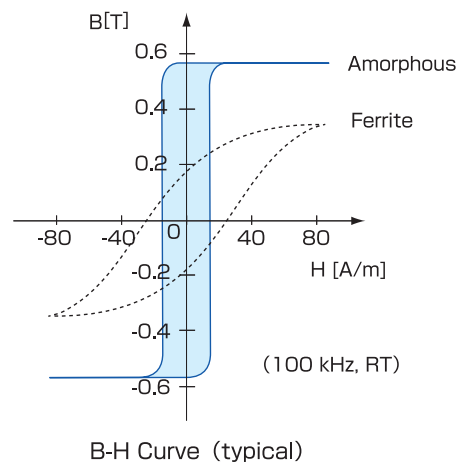
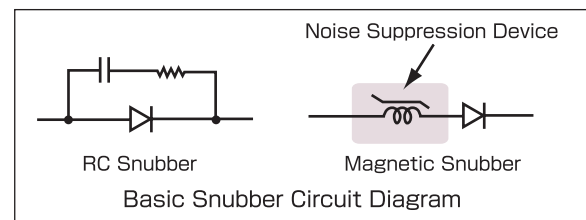


## 2. Noise Suppression Devices

An amorphous noise suppression device is unique and completely different from conventional noise filters. Conventional noise prevention products focus on somehow minimizing the noise after it's been created, by typically trying to absorb the noise, and so their effectiveness in noise reduction is directly influenced by frequency of the circuit. Amorphous noise suppressing devices, on the other hand, focus on the source of the noise and work to prevent or minimize the noise before it has a chance to develop. The source of the electronic circuit noise is the rapid change of current or voltage, and the effectiveness of the amorphous cores in eliminating this noise is independent of frequency.

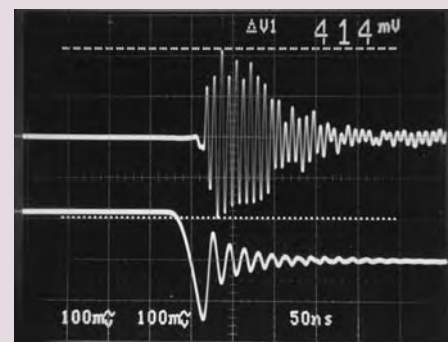
An amorphous noise suppression device is a product that takes full advantage of the unique magnetic characteristics of the cobalt based amorphous alloy. Toshiba Materials offers two noise suppression devices, "AMOBeads®" and "SPIKE KILLERS®". AMOBeads® deliver excellent noise suppression results and are convenient to use by simply being slipped over the leads of the semiconductor device. "AMOBeads®" are also available with a lead thru and in a surface mount configuration. "SPIKE KILLERS®", which are larger in size than "AMOBeads®", most often are wire wound and are effective in eliminating or minimizing higher noise levels.



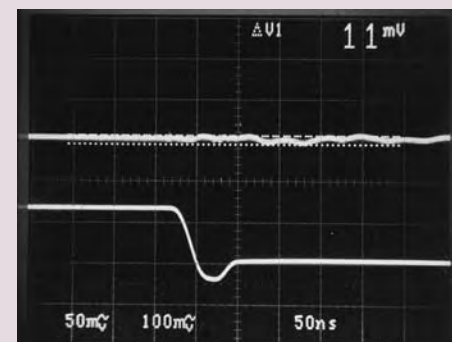
Noise Suppression Devices

### Example for Noise Suppressing Effect (Chopper Converter)

With an excellent saturable characteristic, "AMOBeads®" suppress the reverse recovery current of the diode and decrease the noise that was occurring. When the current for diode reverses and tries to go into the recovery condition, the "AMOBeads®" displays a large inductance and oppose the generation of the recovery current. In this instance, a soft recovery is possible for core material with a smaller coercive force.



Without Countermeasure



With AMOBeads®  
(AB4x2x8W)

## AB/LB/SS Series

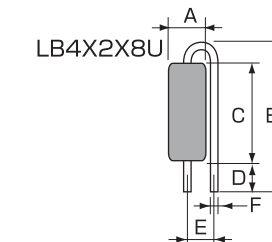
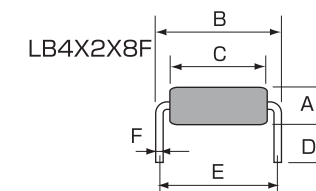
### Standard Specifications

#### AMOBeads®

Type No.	Finished Dimensions [mm]			Core Size [mm]*1			Total Flux*2 $\phi_c [\mu\text{Wb}]$ min	AL value*3 L [ $\mu\text{H}$ ] min	Insulating Cover*7	Packing Unit
	O.D. max	I. D. min	H.T. max	O.D.	I. D.	H.T.				
AB3X2X3W	4.0	1.5	4.5	3.0	2.0	3.0	0.9	3.0	PBT case Blue	2,000 [pcs/box]
AB3X2X4.5W	4.0	1.5	6.0	3.0	2.0	4.5	1.3	5.0		
AB3X2X6W	4.0	1.5	7.5	3.0	2.0	6.0	1.8	7.0		
AB4X2X4.5W	5.0	1.5	6.0	4.0	2.0	4.5	2.7	9.0		
AB4X2X6W	5.0	1.5	7.5	4.0	2.0	6.0	3.6	12.0		
AB4X2X8W	5.0	1.5	9.5	4.0	2.0	8.0	4.8	16.0		

#### AMOBeads® with lead

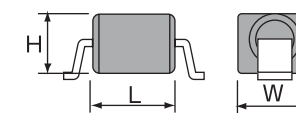
Type No.	Finished Dimensions [mm]						Core Size [mm]*1			I <sub>o</sub> *4 [A]	Total Flux*2 $\phi_c [\mu\text{Wb}]$	AL value*3 L [ $\mu\text{H}$ ]	Insulating Cover*7	Packing Unit
	A	B	C	D	E	F	O.D.	I.D.	H.T.					
LB4X2X8F	6.0max	16.0max	12.0max	4.2±0.5	14.0±1.0	$\phi 1.25 \pm 0.1$	4.0	2.0	8.0	8.0	4.8 min	16.0 min	PBT case Black	1,000 [pcs/box]
LB4X2X8U	6.0max	20.0max	12.0max	4.0±0.5	5.0±1.0	$\phi 1.25 \pm 0.1$								



AMOBeads®

#### SMD Type AMOBeads®

Type No.	Finished Dimensions [mm]			Lead width x thickness	Core Size [mm]*1			I <sub>o</sub> *4 [A]	Total Flux*2 $\phi_c [\mu\text{Wb}]$	AL value*3 L [ $\mu\text{H}$ ]	Insulating Cover*7	Packing Unit [pcs/reel]
	width	length	height		O.D.	I.D.	H.T.					
AB3X2X3SM	5.0±0.3	5.0±0.3	4.0±0.3	(1.8×0.35)	3.0	2.0	3.0	6.0	0.9 min	3.0	LCP case Black	2,000
AB4X2X6SM	6.0±0.3	8.0±0.3	5.0±0.3	(1.8×0.52)	4.0	2.0	6.0	9.0	3.6 min	12.0		1,000



Paper Reel (330φ)

	Recommended Land Pattern (mm)	Taping Spec.(mm)
AB3X2X3SM		
AB4X2X6SM		

#### SPIKE KILLER®

Type No.	Finished Dimensions [mm]*6			Core Size [mm]*1			Effective core cross section Ae [mm <sup>2</sup> ]	Mean Flux*1 Path Length Lm [mm]	Total Flux*5 $\phi_c [\mu\text{Wb}]$ min	Coercive Force*5 Hc [A/m]	Rectangular Ratio*5 Br/Bm [%]	Insulating Cover*7
	O.D.	I.D.	H.T.	O.D.	I.D.	H.T.						
SS10X7X4.5W	11.5	5.8	6.6	10.0	7.0	4.5	5.06	26.7	4.73	22max	90min	PET case Black
SS14X8X4.5W	15.8	6.8	6.6	14.0	8.0	4.5	10.1	34.6	9.46			

- \*1 Reference Value
- \*2 Minimum Guarantee on Measuring Condition : 50kHz, 80A/m (sine wave), R.T.
- \*3 Measuring Condition : 50kHz, 1V, 1 turn, R.T.
- \*4 Typical Value, using a cross section of lead
- \*5 Measuring Condition : 100kHz, 80A/m (sine wave), R.T.
- \*6 Tolerance ±0.2 [mm]
- \*7 UL94V-0 approved material

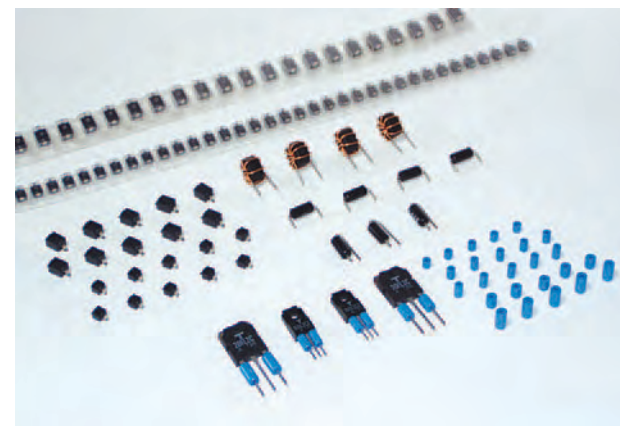
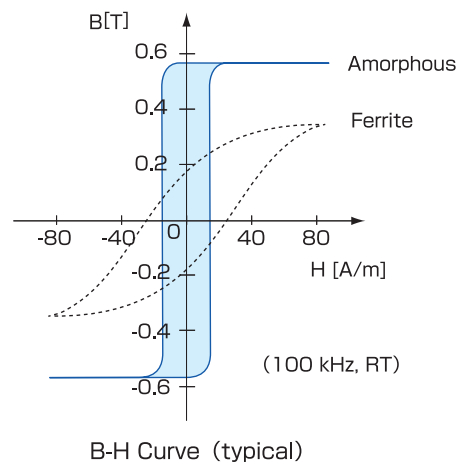
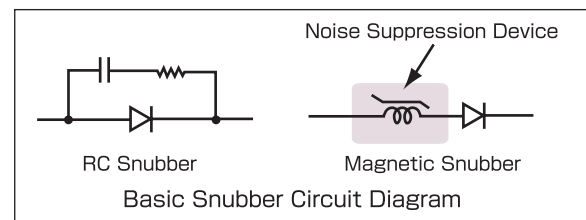
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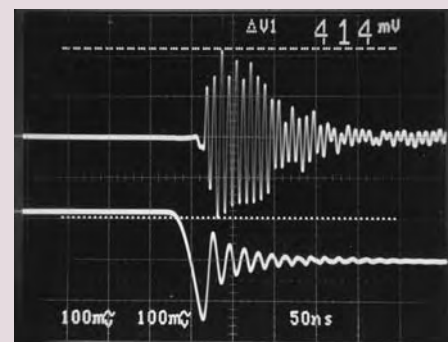
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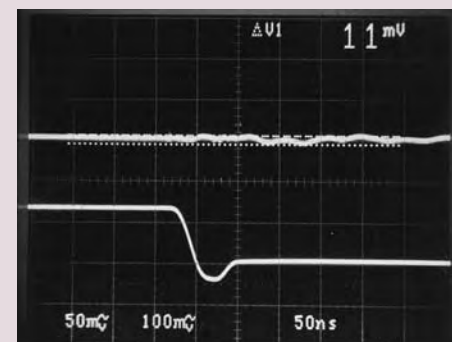
Noise Suppression Devices

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Without Countermeasure



With AMOBeads®  
(AB4x2x8W)

## AB/LB/SS Series

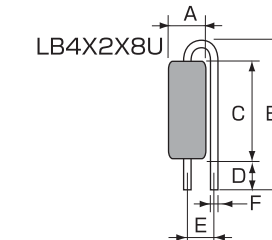
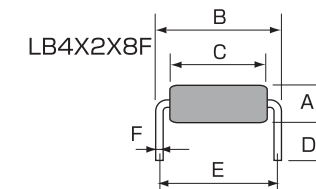
### Standard Specifications

#### AMOBeads®

Type No.	Finished Dimensions [mm]			Core Size [mm]*1			Total Flux*2 $\phi_c [\mu\text{Wb}]$ min	AL value*3 $L [\mu\text{H}]$ min	Insulating Cover*7	Packing Unit
	O.D. max	I. D. min	H.T. max	O.D.	I. D.	H.T.				
AB3X2X3W	4.0	1.5	4.5	3.0	2.0	3.0	0.9	3.0	PBT case Blue	2,000 [pcs/box]
AB3X2X4.5W	4.0	1.5	6.0	3.0	2.0	4.5	1.3	5.0		
AB3X2X6W	4.0	1.5	7.5	3.0	2.0	6.0	1.8	7.0		
AB4X2X4.5W	5.0	1.5	6.0	4.0	2.0	4.5	2.7	9.0		
AB4X2X6W	5.0	1.5	7.5	4.0	2.0	6.0	3.6	12.0		
AB4X2X8W	5.0	1.5	9.5	4.0	2.0	8.0	4.8	16.0		

#### AMOBeads® with lead

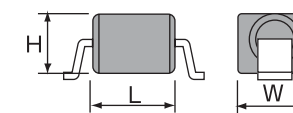
Type No.	Finished Dimensions [mm]						Core Size [mm]*1			I <sub>o</sub> *4 [A]	Total Flux*2 $\phi_c [\mu\text{Wb}]$	AL value*3 $L [\mu\text{H}]$	Insulating Cover*7	Packing Unit
	A	B	C	D	E	F	O.D.	I.D.	H.T.					
LB4X2X8F	6.0max	16.0max	12.0max	4.2±0.5	14.0±1.0	$\phi 1.25 \pm 0.1$	4.0	2.0	8.0	8.0	4.8 min	16.0 min	PBT case Black	1,000 [pcs/box]
LB4X2X8U	6.0max	20.0max	12.0max	4.0±0.5	5.0±1.0	$\phi 1.25 \pm 0.1$								



AMOBeads®

#### SMD Type AMOBeads®

Type No.	Finished Dimensions [mm]			Lead width x thickness	Core Size [mm]*1			I <sub>o</sub> *4 [A]	Total Flux*2 $\phi_c [\mu\text{Wb}]$	AL value*3 $L [\mu\text{H}]$	Insulating Cover*7	Packing Unit [pcs/reel]
	width	length	height		O.D.	I.D.	H.T.					
AB3X2X3SM	5.0±0.3	5.0±0.3	4.0±0.3	(1.8×0.35)	3.0	2.0	3.0	6.0	0.9 min	3.0	LCP case Black	2,000
AB4X2X6SM	6.0±0.3	8.0±0.3	5.0±0.3	(1.8×0.52)	4.0	2.0	6.0	9.0	3.6 min	12.0		1,000



Paper Reel (330φ)

	Recommended Land Pattern (mm)	Taping Spec.(mm)
AB3X2X3SM		
AB4X2X6SM		

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Type No.	Finished Dimensions [mm]*6			Core Size [mm]*1			Effective core cross section Ae[mm <sup>2</sup> ]	Mean Flux*1 Path Length Lm [mm]	Total Flux*5 $\phi_c [\mu\text{Wb}]$ min	Coercive Force*5 Hc[A/m]	Rectangular Ratio*5 Br/Bm[%]	Insulating Cover*7
	O.D.	I.D.	H.T.	O.D.	I.D.	H.T.						
SS10X7X4.5W	11.5	5.8	6.6	10.0	7.0	4.5	5.06	26.7	4.73	22max	90min	PET case Black
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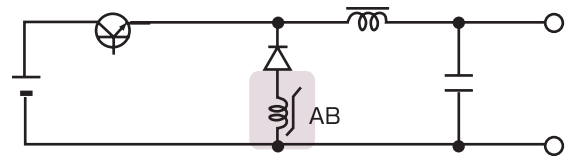
- \*1 Reference Value \*2 Minimum Guarantee on Measuring Condition : 50kHz, 80A/m(sine wave), R.T.
- \*3 Measuring Condition : 50kHz, 1V, 1 turn, R.T.
- \*4 Typical Value, using a cross section of lead
- \*5 Measuring Condition : 100kHz, 80A/m (sine wave), R.T. \*6 Tolerance ±0.2 [mm]
- \*7 UL94V-0 approved material

☆"AMOBeads®" sample kits are prepared. Please ask to sales department.  
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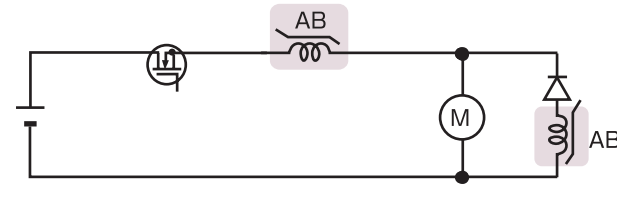


# Examples of Applied Circuits and their Characteristics

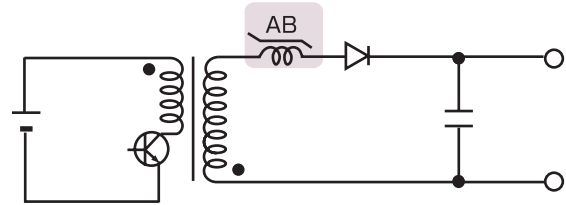
## Application of Amorphous Noise Suppression Devices



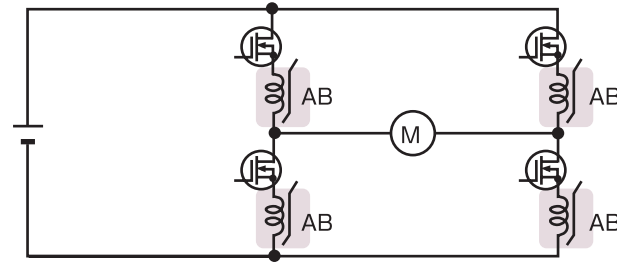
Chopper Converter



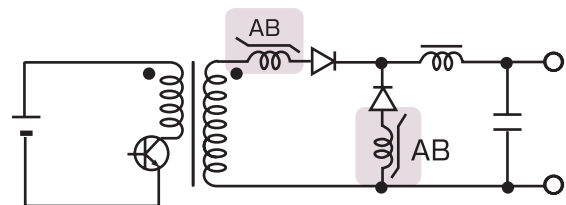
Control Circuit for Motor



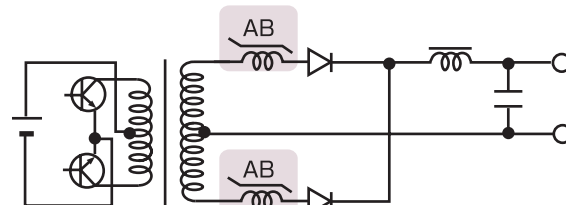
Flyback Converter



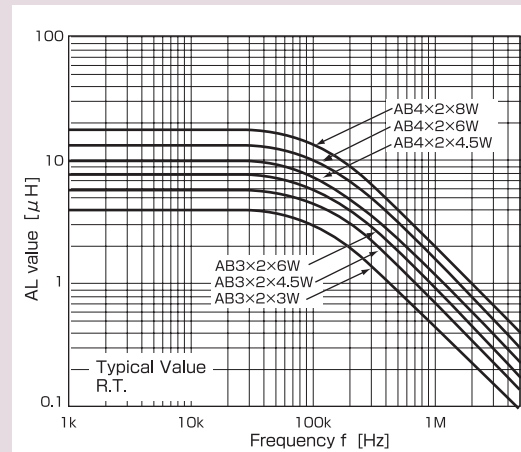
Motor Driving Circuit



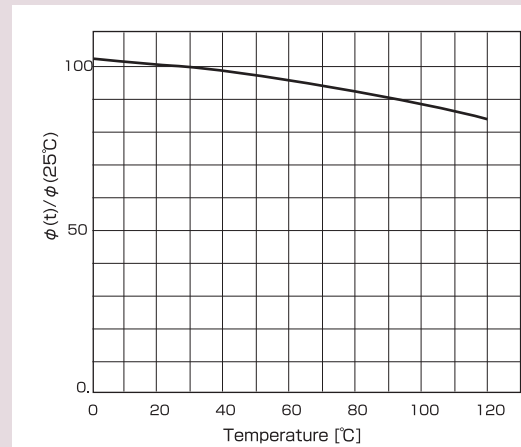
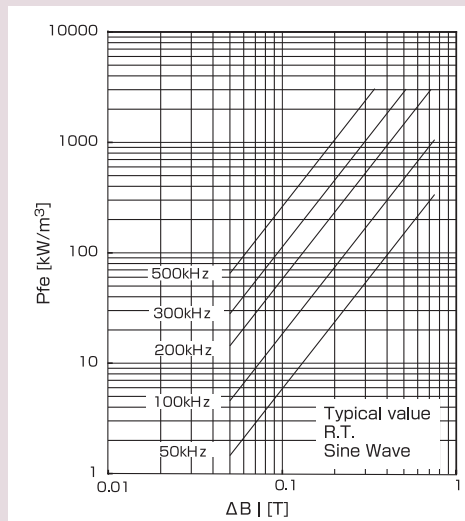
Forward Converter



Push-pull Converter



## Characteristics (Typical value)



Coreloss Characteristic [AMOBeads®]

Flux (φ) Decline Ratio vs. Temperature

# Effects of Noise Suppression by AMOBeads®

## Spike Voltage Suppression

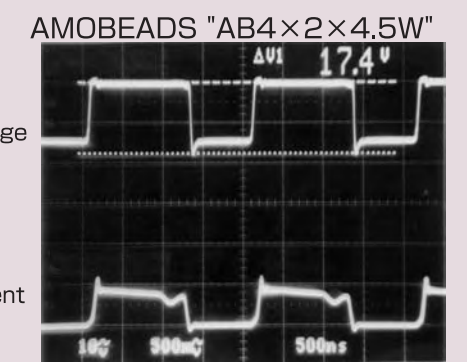
Spike voltage can be reduced and ringing phenomena can also be prevented by AMOBeads, and also Schottky barrier diode (SBD) can be protected from over withstand voltage.

Frequency : 500kHz  
Output Voltage - Current : 5V-20A



Diode Voltage Vd  
10V/div

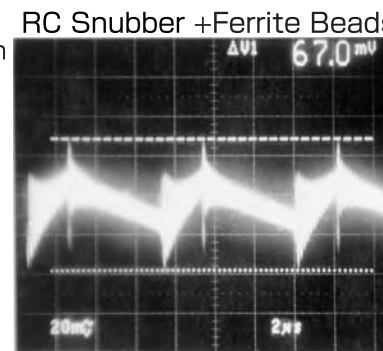
Diode Current Id  
5A/div



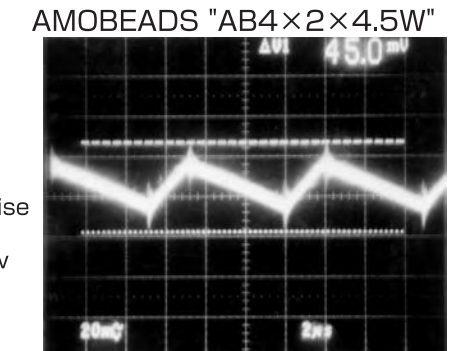
## Output Noise Reduction

When the ferrite replaced to AMOBeads at the secondary output diode (FRD) of the forward converter circuit, the output noise can be tremendously reduced, not only noise peak level but also amplitude range.

Frequency : 150kHz  
Output Voltage - Current : 15V-10A



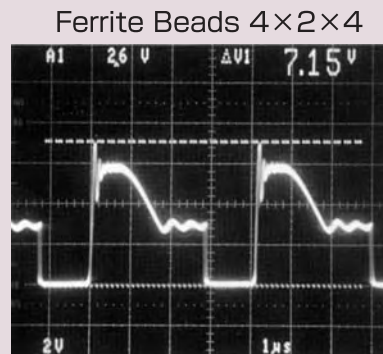
Output Noise Vn  
20mV/div



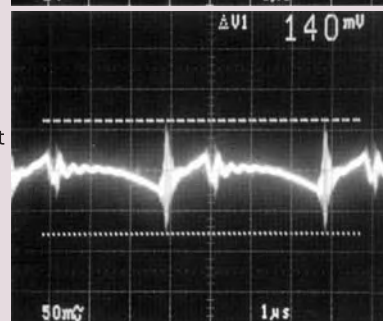
## Primary Surge Voltage

When the ferrite replaced to AMOBeads at the secondary output diode (SBD) of the forward converter circuit, the output noise and harmful influence to the primary stage can be reduced. These effects are based on the inclination of the actual BH curves between amorphous and ferrite materials.

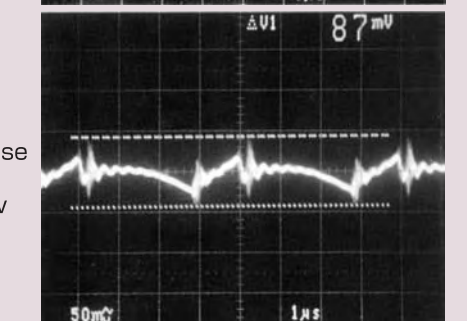
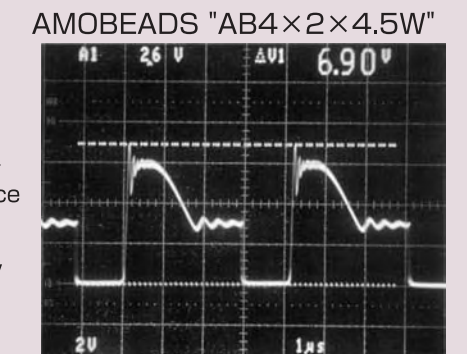
Frequency : 250kHz  
Output Voltage - Current : 5V-15A



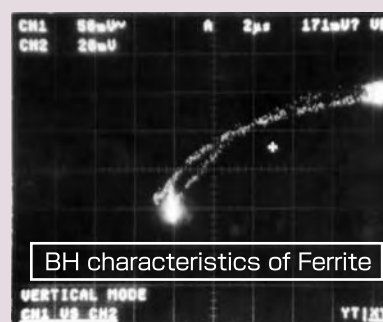
MOS-FET Drain-Source Voltage Vds  
200V/div



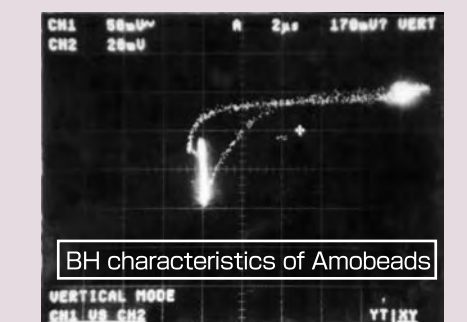
Output Noise Vn  
50mV/div



## Actual BH Curve

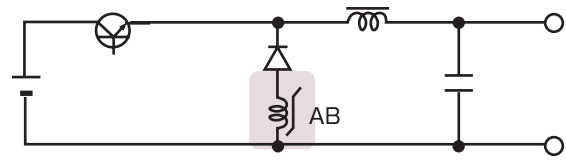


B  
↑  
H  
→

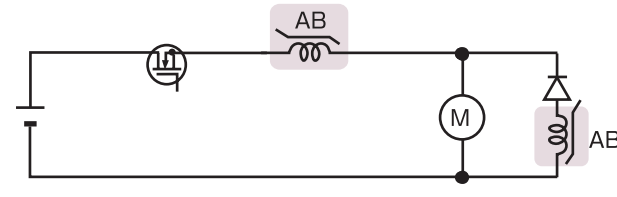


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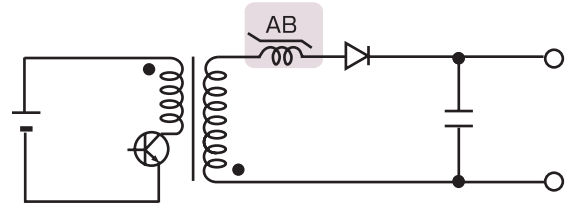
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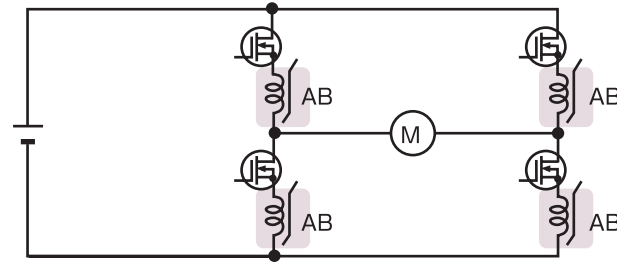
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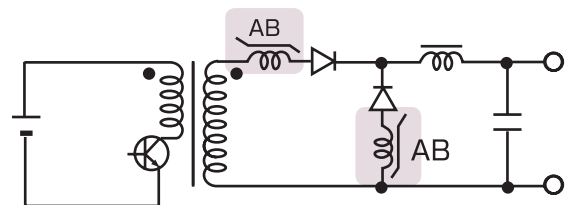
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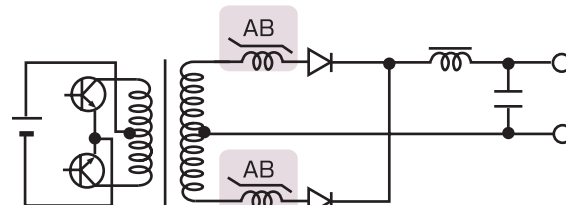
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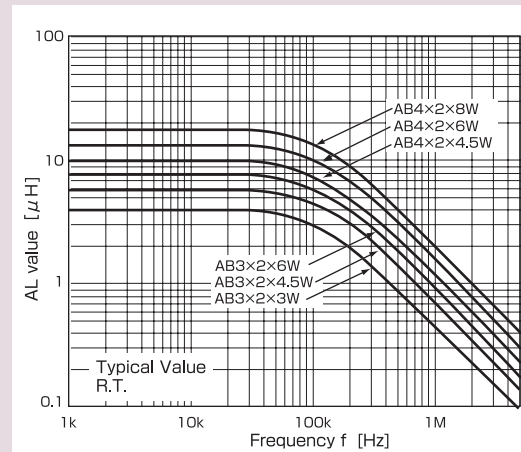
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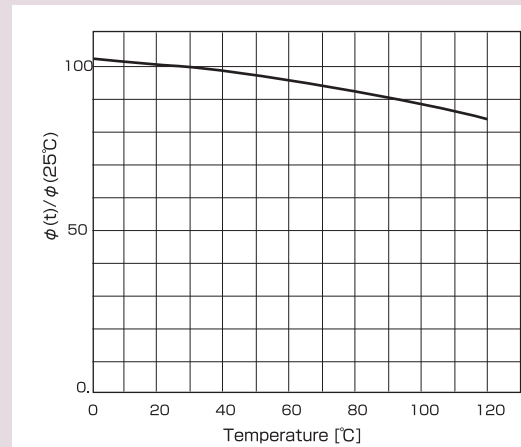
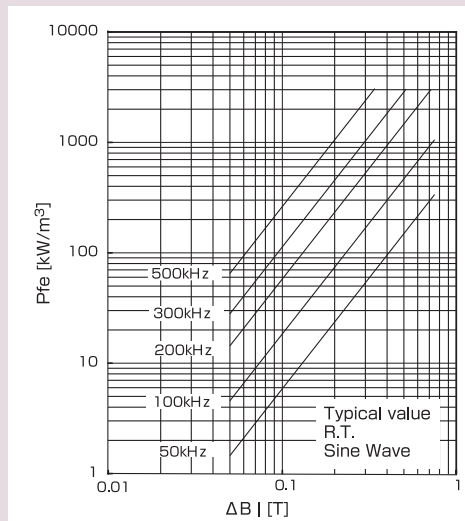
Forward Converter



Push-pull Converter



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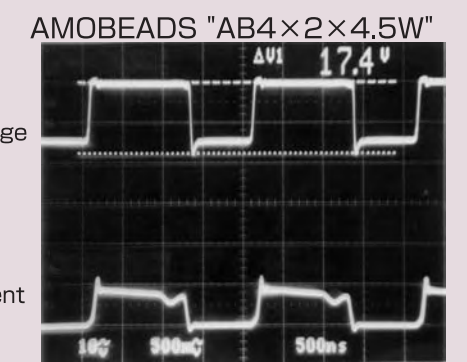
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Output Voltage - Current : 5V-20A



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10V/div

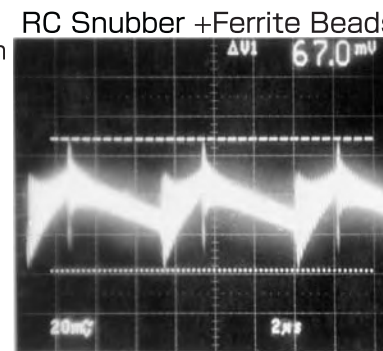
Diode Current Id  
5A/div



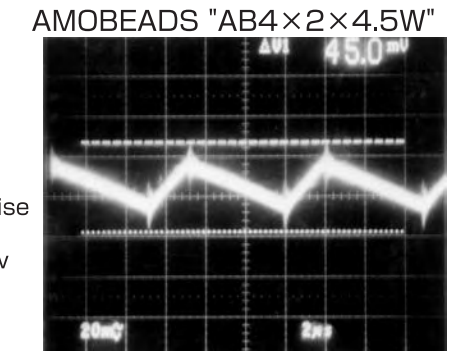
## Output Noise Reduction

When the ferrite replaced to AMOBeads at the secondary output diode (FRD) of the forward converter circuit, the output noise can be tremendously reduced, not only noise peak level but also amplitude range.

Frequency : 150kHz  
Output Voltage - Current : 15V-10A



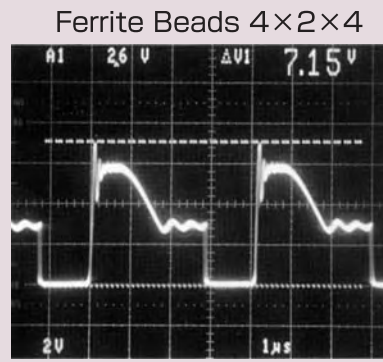
Output Noise Vn  
20mV/div



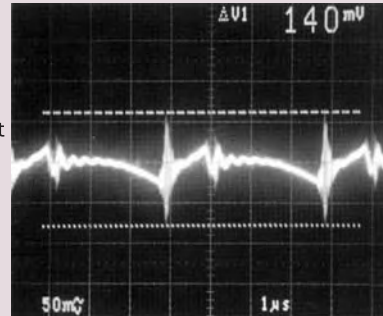
## Primary Surge Voltage

When the ferrite replaced to AMOBeads at the secondary output diode (SBD) of the forward converter circuit, the output noise and harmful influence to the primary stage can be reduced. These effects are based on the inclination of the actual BH curves between amorphous and ferrite materials.

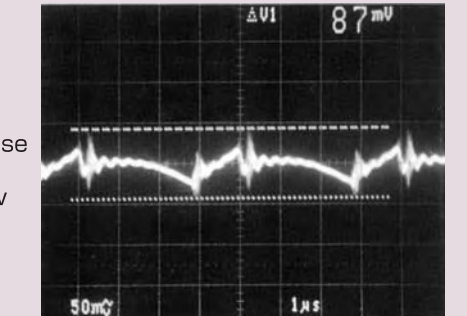
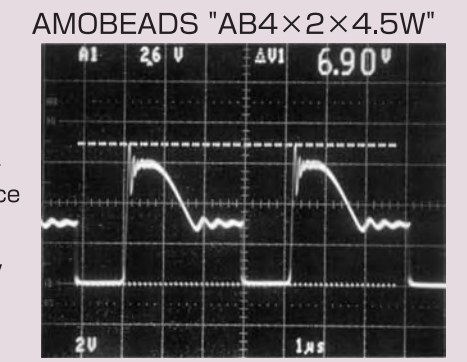
Frequency : 250kHz  
Output Voltage - Current : 5V-15A



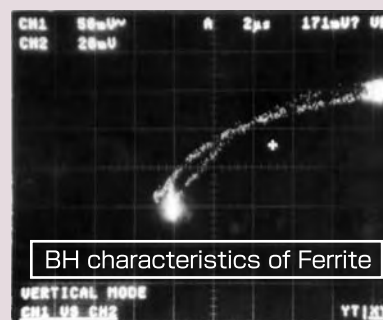
MOS-FET Drain-Source Voltage Vds  
200V/div



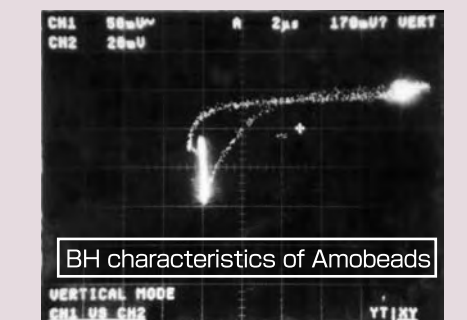
Output Noise Vn  
50mV/div



## Actual BH Curve



B  
↑  
H  
→



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