FAIRCHILD
SEMICONDUCTOR TM

April 1995

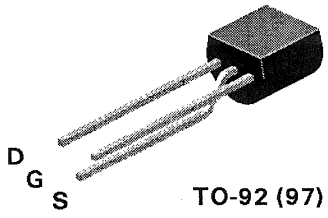
BS170 / MMBF170
N-Channel Enhancement Mode Field Effect Transistor

General Description

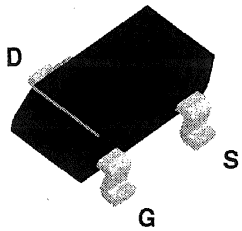
These N-Channel enhancement mode field effect transistors are produced using Fairchild's proprietary, high cell density, DMOS technology. These products have been designed to minimize on-state resistance while provide rugged, reliable, and fast switching performance. They can be used in most applications requiring up to 500mA DC. These products are particularly suited for low voltage, low current applications such as small servo motor control, power MOSFET gate drivers, and other switching applications.

Features

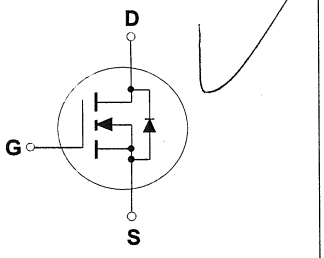
- High density cell design for low $R_{DS(ON)}$.
- Voltage controlled small signal switch.
- Rugged and reliable.
- High saturation current capability.



TO-92 (97)



SOT-23



Absolute Maximum Ratings T_A = 25°C unless otherwise noted

Symbol	Parameter	BS170	MMBF170	Units
V_{DSS}	Drain-Source Voltage	60		V
V_{DGR}	Drain-Gate Voltage ($R_{GS} \leq 1M\Omega$)	60		V
V_{GSS}	Gate-Source Voltage	± 20		V
I_D	Drain Current - Continuous	500	500	mA
	- Pulsed	1200	800	
P_D	Maximum Power Dissipation	830	300	mW
	Derate Above 25°C	6.6	2.4	mW/°C
T_J,T_{STG}	Operating and Storage Temperature Range	-55 to 150		°C
T_L	Maximum Lead Temperature for Soldering Purposes, 1/16" from Case for 10 Seconds	300		°C
THERMAL CHARACTERISTICS				
$R_{\theta JA}$	Thermal Resistacne, Junction-to-Ambient	150	417	°C/W

Electrical Characteristics (T_A = 25°C unless otherwise noted)

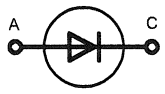
Symbol	Parameter	Conditions	Type	Min	Typ	Max	Units
OFF CHARACTERISTICS							
BV_{DSS}	Drain-Source Breakdown Voltage	V_{GS} = 0 V, I_D = 100 µA	All	60			V
I_{DSS}	Zero Gate Voltage Drain Current	V_{DS} = 25 V, V_{GS} = 0 V	All			0.5	µA
I_{GSSF}	Gate - Body Leakage, Forward	V_{GS} = 15 V, V_{DS} = 0 V	All			10	nA
ON CHARACTERISTICS (Note 1)							
$V_{GS(th)}$	Gate Threshold Voltage	V_{DS} = V_{GS}, I_D = 1 mA	All	0.8	2.1	3	V
$R_{DS(ON)}$	Static Drain-Source On-Resistance	V_{GS} = 10 V, I_D = 200 mA	All		1.2	5	Ω
g_{FS}	Forward Transconductance	V_{DS} = 10 V, I_D = 200 mA	BS170		320		mS
		$V_{DS} \geq 2\ V_{DS(on)}$, I_D = 200 mA	MMBF170		320		
DYNAMIC CHARACTERISTICS							
C_{iss}	Input Capacitance	V_{DS} = 10 V, V_{GS} = 0 V, f = 1.0 MHz	All		24	40	pF
C_{oss}	Output Capacitance		All		17	30	pF
C_{rss}	Reverse Transfer Capacitance		All		7	10	pF
SWITCHING CHARACTERISTICS (Note 1)							
t_{on}	Turn-On Time	V_{DD} = 25 V, I_D = 200 m A, V_{GS} = 10 V, R_{GEN} = 25 Ω	BS170			10	ns
		V_{DD} = 25 V, I_D = 500 mA, V_{GS} = 10 V, R_{GEN} = 50 Ω	MMBF170			10	
t_{off}	Turn-Off Time	V_{DD} = 25 V, I_D = 200 m A, V_{GS} = 10 V, R_{GEN} = 25 Ω	BS170			10	ns
		V_{DD} = 25 V, I_D = 500 mA, V_{GS} = 10 V, R_{GEN} = 50 Ω	MMBF170			10	

Note:
1. Pulse Test: Pulse Width ≤ 300µs, Duty Cycle ≤ 2.0%.

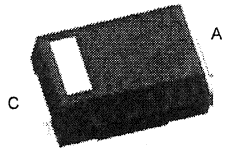
Power Schottky Rectifier

I_{FAV} = 1 A
V_{RRM} = 100 V
V_F = 0.6 V

V_{RSM} V	V_{RRM} V	Type	Marking on product
100	100	DSS 1-100AA	X1KA



SMA (DO-214 AC)



Symbol	Conditions	Maximum Ratings	
I_{FAV}	T_L = 125°C; rectangular, d = 0.5	1	A
I_{FAVM}	rectangular, d = 0.5	2	A
I_{FSM}	T_{VJ} = 45°C; t_p = 10 ms (50 Hz), sine	38	A
E_{AS}	I_{AS} = tbd A; L = 100 µH; T_{VJ} = 25°C; non repetitive	tbd	mJ
I_{AR}	V_A = 1.5 • V_{RRM} typ.; f=10 kHz; repetitive	tbd	A
$(dv/dt)_{cr}$		10000	V/µs
T_{VJ} *		-55...+175	°C
T_{VJM}		175	°C
T_{stg}		-55...+150	°C
Weight	typical	0.1	g
Package unit	tape & reel	7500	pcs

Symbol	Conditions	Characteristic Values typ.	max.	
I_R	T_{VJ} = 25°C; V_R = V_{RRM}		0.02	mA
	T_{VJ} = 125°C; V_R = V_{RRM}		1	mA
V_F ①	I_F = 1 A; T_{VJ} = 25°C		0.75	V
	I_F = 2 A; T_{VJ} = 25°C		0.85	V
	I_F = 1 A; T_{VJ} = 125°C		0.60	V
	I_F = 2 A; T_{VJ} = 125°C		0.71	V
R_{thJL}	thermal resistance junction to lead mounted on 1 inch square PCB		30	K/W
R_{thJA}	thermal resistance junction - ambient		70	K/W
C_T	typ. junction capacitance		60	pF

* $\frac{dP_{tot}}{dT_J} < \frac{1}{R_{th(J-A)}}$ thermal runaway condition for a diode on its own heatsink

Pulse test: ① Pulse Width = 400 µs, Duty Cycle < 2.0 %
Data according to IEC 60747 and per diode unless otherwise specified

Features

- International standard package
- Very low V_F
- Extremely low switching losses
- Low I_{RM}
- Epoxy meets UL 94V-0

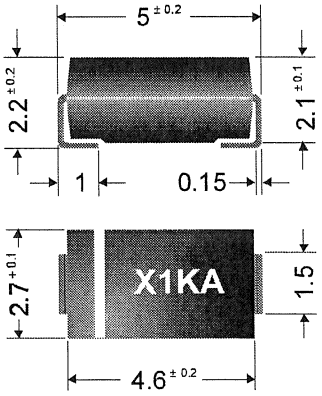
Applications

- Rectifiers in switch mode power supplies (SMPS)
- Free wheeling diode in low voltage converters
- Decoupling diode

Advantages

- High reliability circuit operation
- Low voltage peaks for reduced protection circuits
- Low noise switching
- Low losses

Dimensions in mm



313

Chip Monolithic Ceramic Capacitors

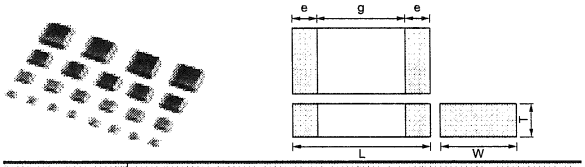
for Smoothing

■ Features

1. Heat generation is low at high frequency because of low dielectric loss.
2. Compared with aluminum electrolytic capacitors, capacitance can be lower to obtain the same smoothing performance.
3. Ceramic capacitor has no polarity and ensures long life time.

■ Applications

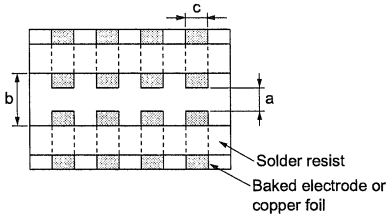
- DC-DC converter
- Noise elimination LCD bias circuit
  (Use for only alumina, paper or glass epoxy board)



Part Number	Dimensions (mm)				
	L	W	T	e min.	g min.
GJ221B	2.0 ±0.1	1.25 ±0.1	1.25 ±0.1	0.2 to 0.7	0.7
GJ231M	3.2 ±0.15	1.6 ±0.15	1.15 ±0.1	0.3 to 0.8	1.5
GJ232N	3.2 ±0.3	2.5 ±0.2	1.35 ±0.15	0.3	1.0
GJ232C			1.6 ±0.15		
GJ232R			1.8 ±0.2		
GJ243R	4.5 ±0.4	3.2 ±0.3	1.8 ±0.2	0.3	2.0
GJ243X			2.2 ±0.3		

Part Number	TC	Rated Voltage (Vdc)	Capacitance (μF)	Length L (mm)	Width W (mm)	Thickness T (mm)
GJ221BF50J106ZD01	Y5V	6.3	10 +80.-20%	2.00	1.25	1.25
GJ231MF50J226ZD01	Y5V	6.3	22 +80.-20%	3.20	1.60	1.15
GJ232CF50J476ZD01	Y5V	6.3	47 +80.-20%	3.20	2.50	1.60
GJ243RF50J107ZD11	Y5V	6.3	100 +80.-20%	4.50	3.20	1.80
GJ232NF51A226ZD01	Y5V	10	22 +80.-20%	3.20	2.50	1.35
GJ243RF51A107ZD11	Y5V	10	100 +80.-20%	4.50	3.20	1.80
GJ232RF51H475ZD01	Y5V	50	4.7 +80.-20%	3.20	2.50	1.80
GJ243XF51H106ZD12	Y5V	50	10 +80.-20%	4.50	3.20	2.20
GJ232RF52A105ZD01	Y5V	100	1 +80.-20%	3.20	2.50	1.8

Specifications and Test Methods

No.	Item	Specification	Test Method
1	Operating Temperature Range	F5 : −30°C to 85°C	
2	Rated Voltage	See the previous pages.	The rated voltage is defined as the maximum voltage which may be applied continuously to the capacitor. When AC voltage is superimposed on DC voltage, V^{P-P} or V^{O-P}, whichever is larger, shall be maintained within the rated voltage range.
3	Appearance	No defects or abnormalities.	Visual inspection.
4	Dimensions	Within the specified dimension.	Using calipers.
5	Dielectric Strength	No defects or abnormalities.	No failure shall be observed when 250% of the rated voltage is applied between the both terminations for 1 to 5 seconds, provided the charge/discharge current is less than 50mA.
6	Insulation Resistance	More than 10,000MΩ or 500Ω · F. (Whichever is smaller)	The insulation resistance shall be measured with a DC voltage not exceeding the rated voltage at normal temperature and humidity and within 2 minutes* of charging. *5minutes for c>47μF.
7	Capacitance	Within the specified tolerance.	The capacitance/D.F. shall be measured at 25°C at the frequency and voltage shown in the table.
8	Dissipation Factor (D.F.)	0.07 max. (50/100V) 0.09 max. (10/16/25V) 0.15 max. (6.3V)	
9	Capacitance Temperature Characteristics	Char. F5 / Temp. Range -30 to +85°C / Reference Temp. 25°C / Cap. Change Rate Within +22 −82%	The capacitance change shall be measured after 5 min. at each specified temperature stage. The ranges of capacitance change compared to 25°C with the temperature ranges shown in the table shall be within the specified ranges.
10	Adhesive Strength of Termination	No removal of the terminations or other defects shall occur.  Fig.1	Solder the capacitor on the testing jig (glass epoxy board) shown in Fig.1 using a eutectic solder. Then apply 5N force in parallel with the test jig for 10±1 sec. The soldering shall be done either with an iron or using the reflow method and shall be conducted with care so that the soldering is uniform and free of defect such as heat shock.
11	Vibration Resistance	Item: Frequency Appearance: No defects or abnormalities. Capacitance Change: Within the specified tolerance. D.F.: 50, 100V: 0.07 max. / 10, 16, 25V: 0.09 max. / 6.3V: 0.15 max. Dielectric Strength: No failure	Solder the capacitor on the testing jig (glass epoxy board) in the same manner and under the same conditions as (10). The capacitor shall be subjected to simple harmonic motion having a total amplitude of 1.5mm, the frequency being varied uniformly between the approximate limits of 10 and 55Hz. The frequency range, from 10 to 55Hz and return to 10Hz, shall be traversed in approximately 1 minute. This motion shall be applied for a period of 2 hours in each 3 mutually perpendicular directions (total of 6 hours).

Capacitance	Frequency	Voltage
C≦10μF	1±0.1kHz	1±0.2Vrms
C>10μF	120±24Hz	0.5±0.1Vrms

Type	a	b	c
GJ218	1.0	3.0	1.2
GJ221	1.2	4.0	1.65
GJ231	2.2	5.0	2.0
GJ232	2.2	5.0	2.9
GJ243	3.5	7.0	3.7

(in mm)

Continued on the following page.

7

FAIRCHILD SEMICONDUCTOR TM

April 2000

QFET™

FQB4N60 / FQI4N60

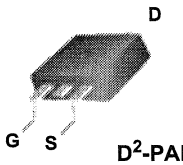
600V N-Channel MOSFET

General Description

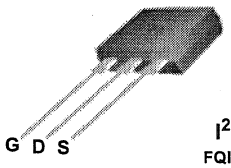
These N-Channel enhancement mode power field effect transistors are produced using Fairchild's proprietary, planar stripe, DMOS technology.
This advanced technology has been especially tailored to minimize on-state resistance, provide superior switching performance, and withstand high energy pulse in the avalanche and commutation mode. These devices are well suited for high efficiency switch mode power supply.

Features

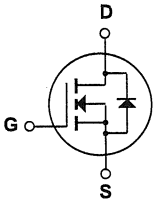
- 4.4A, 600V, $R_{DS(on)}$ = 2.2Ω @V_{GS} = 10 V
- Low gate charge (typical 15 nC)
- Low Crss (typical 8.0 pF)
- Fast switching
- 100% avalanche tested
- Improved dv/dt capability



D^2-PAK
FQB Series



I^2-PAK
FQI Series



Absolute Maximum Ratings T_C = 25°C unless otherwise noted

Symbol	Parameter		FQB4N60 / FQI4N60	Units
V_{DSS}	Drain-Source Voltage		600	V
I_D	Drain Current - Continuous (T_C = 25°C)		4.4	A
	- Continuous (T_C = 100°C)		2.8	A
I_{DM}	Drain Current - Pulsed	(Note 1)	17.6	A
V_{GSS}	Gate-Source Voltage		± 30	V
E_{AS}	Single Pulsed Avalanche Energy	(Note 2)	260	mJ
I_{AR}	Avalanche Current	(Note 1)	4.4	A
E_{AR}	Repetitive Avalanche Energy	(Note 1)	10.6	mJ
dv/dt	Peak Diode Recovery dv/dt	(Note 3)	4.5	V/ns
P_D	Power Dissipation (T_A = 25°C) *		3.13	W
	Power Dissipation (T_C = 25°C)		106	W
	- Derate above 25°C		0.6	W/°C
T_J, T_{STG}	Operating and Storage Temperature Range		-55 to +150	°C
T_L	Maximum lead temperature for soldering purposes, 1/8" from case for 5 seconds		300	°C

Thermal Characteristics

Symbol	Parameter	Typ	Max	Units
$R_{\theta JC}$	Thermal Resistance, Junction-to-Case	--	1.18	°C/W
$R_{\theta JA}$	Thermal Resistance, Junction-to-Ambient *	--	40	°C/W
$R_{\theta JA}$	Thermal Resistance, Junction-to-Ambient	--	62.5	°C/W

* When mounted on the minimum pad size recommended (PCB Mount)

Electrical Characteristics

T_C = 25°C unless otherwise noted

Symbol	Parameter	Test Conditions	Min	Typ	Max	Units
Off Characteristics						
BV_{DSS}	Drain-Source Breakdown Voltage	V_{GS} = 0 V, I_D = 250 µA	600	--	--	V
ΔBV_{DSS} / ΔT_J	Breakdown Voltage Temperature Coefficient	I_D = 250 µA, Referenced to 25°C	--	0.6	--	V/°C
I_{DSS}	Zero Gate Voltage Drain Current	V_{DS} = 600 V, V_{GS} = 0 V	--	--	10	µA
		V_{DS} = 480 V, T_C = 125°C	--	--	100	µA
I_{GSSF}	Gate-Body Leakage Current, Forward	V_{GS} = 30 V, V_{DS} = 0 V	--	--	100	nA
I_{GSSR}	Gate-Body Leakage Current, Reverse	V_{GS} = -30 V, V_{DS} = 0 V	--	--	-100	nA
On Characteristics						
$V_{GS(th)}$	Gate Threshold Voltage	V_{DS} = V_{GS}, I_D = 250 µA	3.0	--	5.0	V
$R_{DS(on)}$	Static Drain-Source On-Resistance	V_{GS} = 10 V, I_D = 2.2 A	--	1.77	2.2	Ω
g_{FS}	Forward Transconductance	V_{DS} = 50 V, I_D = 2.2 A (Note 4)	--	4.0	--	S
Dynamic Characteristics						
C_{iss}	Input Capacitance	V_{DS} = 25 V, V_{GS} = 0 V, f = 1.0 MHz	--	520	670	pF
C_{oss}	Output Capacitance		--	70	90	pF
C_{rss}	Reverse Transfer Capacitance		--	8	11	pF
Switching Characteristics						
$t_{d(on)}$	Turn-On Delay Time	V_{DD} = 300 V, I_D = 4.4 A, R_G = 25 Ω (Note 4, 5)	--	13	35	ns
t_r	Turn-On Rise Time		--	45	100	ns
$t_{d(off)}$	Turn-Off Delay Time		--	25	60	ns
t_f	Turn-Off Fall Time		--	35	80	ns
Q_g	Total Gate Charge	V_{DS} = 480 V, I_D = 4.4 A, V_{GS} = 10 V (Note 4, 5)	--	15	20	nC
Q_{gs}	Gate-Source Charge		--	3.4	--	nC
Q_{gd}	Gate-Drain Charge		--	7.1	--	nC
Drain-Source Diode Characteristics and Maximum Ratings						
I_S	Maximum Continuous Drain-Source Diode Forward Current		--	--	4.4	A
I_{SM}	Maximum Pulsed Drain-Source Diode Forward Current		--	--	17.6	A
V_{SD}	Drain-Source Diode Forward Voltage	V_{GS} = 0 V, I_S = 4.4 A	--	--	1.4	V
t_{rr}	Reverse Recovery Time	V_{GS} = 0 V, I_S = 4.4 A, dI_F / dt = 100 A/µs (Note 4)	--	250	--	ns
Q_{rr}	Reverse Recovery Charge		--	1.5	--	µC

Notes:
1. Repetitive Rating : Pulse width limited by maximum junction temperature
2. L = 25mH, I_{AS} = 4.4A, V_{DD} = 50V, R_G = 25 Ω, Starting T_J = 25°C
3. I_{SD} ≤ 4.4A, di/dt ≤ 200A/µs, V_{DD} ≤ BV_{DSS}, Starting T_J = 25°C
4. Pulse Test : Pulse width ≤ 300µs, Duty cycle ≤ 2%
5. Essentially independent of operating temperature

FAIRCHILD
SEMICONDUCTOR®

1N5400 - 1N5408

Features

- 3.0 ampere operation at T_A = 75°C with no thermal runaway.
- High current capability.
- Low leakage.

DO-201AD
COLOR BAND DENOTES CATHODE

General Purpose Rectifiers

Absolute Maximum Ratings*

T_A = 25°C unless otherwise noted

Symbol	Parameter	Value									Units
		5400	5401	5402	5403	5404	5405	5406	5407	5408	
V_{RRM}	Maximum Repetitive Reverse Voltage	50	100	200	300	400	500	600	800	1000	V
$I_{F(AV)}$	Average Rectified Forward Current, .375 " lead length @ T_A = 75°C	3.0									A
I_{FSM}	Non-repetitive Peak Forward Surge Current 8.3 ms Single Half-Sine-Wave	200									A
T_{stg}	Storage Temperature Range	-55 to +150									°C
T_J	Operating Junction Temperature	-55 to +150									°C

*These ratings are limiting values above which the serviceability of any semiconductor device may be impaired.

Thermal Characteristics

Symbol	Parameter	Value	Units
P_D	Power Dissipation	6.25	W
$R_{\theta JA}$	Thermal Resistance, Junction to Ambient	20	°C/W

Electrical Characteristics

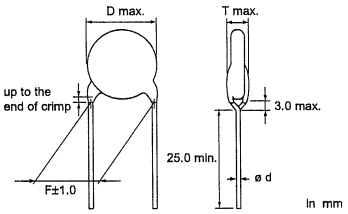
T_A = 25°C unless otherwise noted

Symbol	Parameter	Device									Units
		5400	5401	5402	5403	5404	5405	5406	5407	5408	
V_F	Forward Voltage @ 3.0 A	1.2									V
I_{rr}	Maximum Full Load Reverse Current, Full Cycle T_A = 105°C	0.5									mA
I_R	Reverse Current @ rated V_R T_A = 25°C T_A = 100°C	5.0 500									µA µA
C_T	Toatal Capacitance V_R = 4.0 V, f = 1.0 MHz	30									pF

High-voltage Ceramic Capacitors (250V-6.3kV)

DES Series

Vertical Crimp Long type
(Lead Code: A∗)



Operating Temp. Range -25 to +125°C

●Part number configuration (Please see page 23 for details)

(Ex.) DE ❶ | S ❷ | D3 ❸ | 3A ❹ | 102 ❺ | K ❻ | N2 ❼ | A ❽

Part Number	DC Rated Volt. (V)	❼Lead Code and ❽Packaging Code		Cap. (pF)	Cap. Tol. (%)	Dimensions (mm)			
		Bulk	Taping			D	F	T	ød
DESD32H101K□□□	500	A2B	N2A	100	±10	6	5	4	0.6±0.05
DESD32H151K□□□				150					
DESD32H221K□□□				220					
DESD32H331K□□□				330					
DESD32H471K□□□				470					
DESD32H681K□□□				680					
DESD32H102K□□□				1000		8			
DESD32H152K□□□				1500		9			
DESD32H222K□□□				2200		10			
DESD32H332K□□□		A3B	N3A	3300		12	7.5		
DESD32H472K□□□			N7A	4700		14			
DESD33A101K□□□	1k	A2B	N2A	100		6	5	4.5	
DESD33A151K□□□				150					
DESD33A221K□□□				220					
DESD33A331K□□□				330					
DESD33A471K□□□				470		7			
DESD33A681K□□□				680		8			
DESD33A102K□□□				1000		9			
DESD33A152K□□□				1500		10			
DESD33A222K□□□		A3B	N3A	2200		12	7.5		
DESD33A332K□□□			N7A	3300		14			
DESD33A472K□□□				4700		17			

Three blank columns are filled with Lead Code and Packaging Code.

HTZ150C Series

$I_{F(AV)}$ = 3.0 A

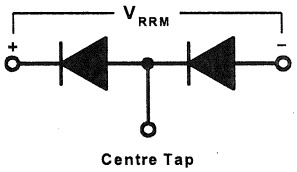
V_{RRM} = 9600 V

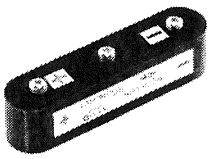
High Voltage Diode Rectifier Module

LARONTROL
Electronic Devices

Type Number	Repetitive Peak	Minimum Avalanche Voltage $V_{(BR)R}$
HTZ150C9K	9600	10200
HTZ150C8K	8400	9000
HTZ150C7K	7200	7800
HTZ150C6K	6000	6600

CIRCUIT DIAGRAM





CURRENT RATINGS - AIR COOLED

$I_{F(AV)}$	Mean forward current	Half wave resistive load T_{amb} = 35°C	3.0	A
I_F	Continuous (direct) forward current	T_{amb} = 35°C	3.6	A
$R_{th(j-a)}$	Thermal resistance junction to ambient		6.5	°C/W

CURRENT RATINGS - OIL COOLED

$I_{F(AV)}$	Mean forward current	Half wave resistive load T_{oil} = 60°C	6.5	A
I_T	Continuous (direct) forward current	T_{oil} = 60°C	7.0	A
$R_{th(j-o)}$	Thermal resistance junction to oil		2.0	°C/W

SURGE RATINGS

I^2t	I^2t for fusing	10 ms half sine T_{vj} = 150°C	50	A^2sec
I_{FSM}	Surge (non-repetitive) forward current	T_{vj} = 150°C	100	A

TEMPERATURE AND FREQUENCY RATINGS

T_{vj}	Virtual junction temperature	Forward (conducting)	180	°C
		Reverse (blocking)	180	°C
T_{stg}	Storage temperature range		-40 to 100	°C
f	Frequency range		20 to 400	Hz

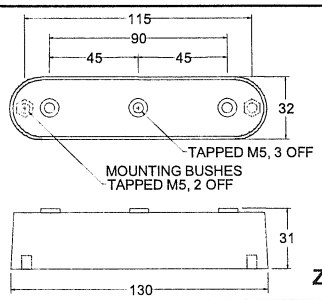
CHARACTERISTICS T_{case} = 25°C unless otherwise stated

V_{FM}	Forward voltage	At 2 Amps peak	max 6.0	V
I_{RM}	Peak reverse current	At V_{RRM}; T_{case} = 150°C	max 0.5	mA

Dimensioned Outlines

Dimensions shown are maximum in mm

Weight typ.: 0,24 Kg



ZC

Issue 1 June 1998

Distributed by
USA
3540 Bassett Street
Santa Clara, CA 95054
Phone: (408) 982-0700
FAX: (408) 496-0670

EUROPE
IXYS Semiconductor GmbH
Lampertheim Germany
Phone: +49.6206.503.0
Fax: +49.6206.503.627

IXYS
www.IXYS.net

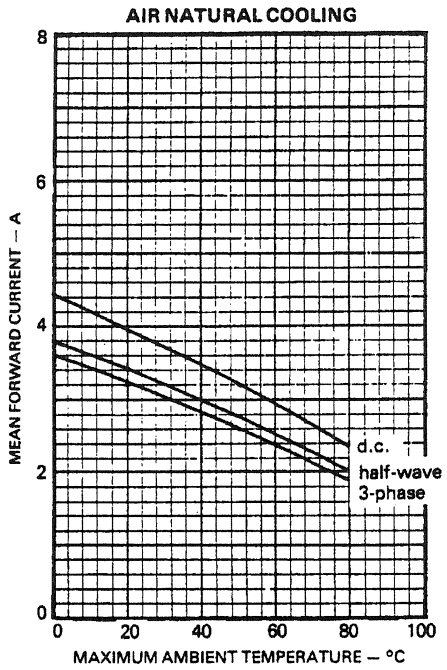
HTZ150C Series

$I_{F(AV)}$ = 3.0 A

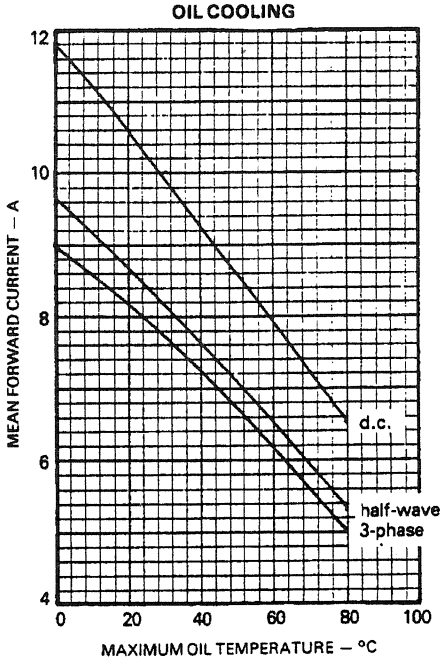
V_{RRM} = 9600 V

High Voltage Diode Rectifier Module

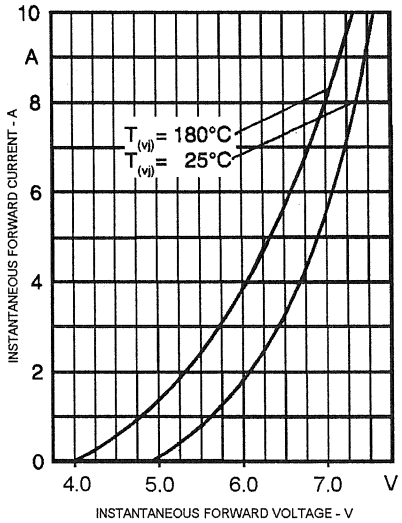
LARONTROL
Electronic Devices



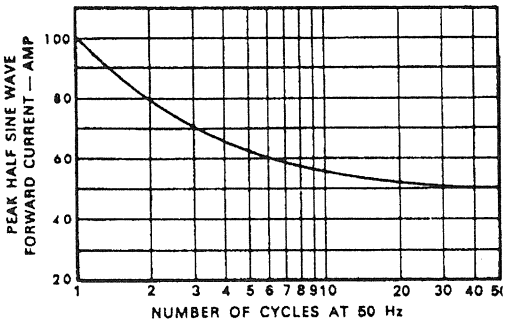
DERATING CURVES



DERATING CURVES



MAXIMUM (LIMIT) FORWARD CHARACTERISTICS

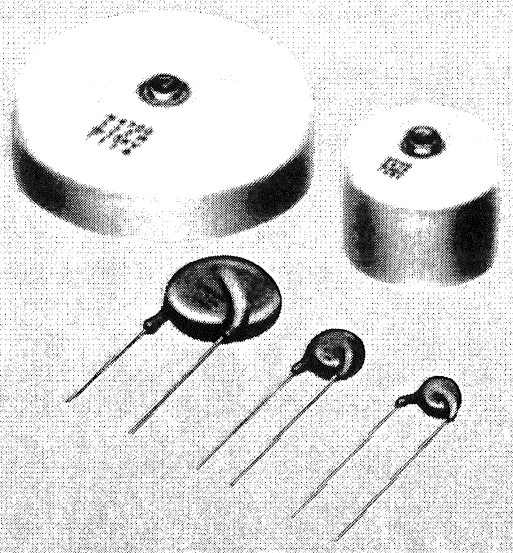


SURGE (NON_REPETITIVE) FORWARD CURRENT VERSUS TIME with reverse voltage. T_j = 150°C

Distributed by: IXYS Corporation • 3540 Bassett Street • Santa Clara, CA 95054 • Phone: 408-982-0700 • Fax: 408-496-0670
IXYS Semiconductor GmbH • Edisonstraße 15 • D-68623 Lampertheim • Phone: +49-6206-503-249 • Fax: +49-6206-503627

High-voltage Ceramic Capacitors DC10-40kV

HIGH-VOLTAGE CERAMIC CAPACITORS



GLOBAL PART NUMBERS
JUNE 2001

muRata Innovator in Electronics

Murata
Manufacturing Co., Ltd.

Cat.No.C41E-1

CONTENTS

● Part Numbering (The structure of the "Global Part Numbers" that have been adopted since June 2001 and the meaning of each code are described herein. If you have any questions about details, inquire at your usual Murata sales office or distributor.)

High-voltage Ceramic Capacitors (over 10kV)

(Global Part Number)

DH	R	B3	4A	101	M	2B	B
❶	❷	❸	❹	❺	❻	❼	❽

❶Product ID

Product ID	
DH	High-voltage Ceramic Capacitors (over 10kV)

❷Series Category

Code	Contents
R	Radial Type
S	Mold Type

First three digit of part number (❶Product ID and ❷Series Category) express "Series Name".

❸Temperature Characteristics

Code	Temp. Char.	Cap. Change or Temp. Coeff.	Temp. Range
B3	B	±10%	−25 to +85℃
F4	Z5V	+22%, −82%	+10 to +85℃
4E	ZM	−4700±1000ppm/℃	+20 to +85℃
	N4700		

❹Rated Voltage

Code	Rated Voltage
4A	DC10kV
4B	DC12kV
4C	DC15kV
4D	DC20kV
4F	DC30kV
4G	DC40kV

❺Capacitance

Expressed by three figures. The unit is pico-farad(pF). The first and second figures are significant digits, and the third figure expresses the number of zeros which follow the two numbers. If there is a decimal point, it is expressed by the capital letter "**R**". In this case, all figures are significant digits.

❻Capacitance Tolerance

Code	Capacitance Tolerance
K	±10%
M	±20%
Z	+80%, −20%

❼Lead Type (**DHR** Series)

Code	Lead Type	Lead Spacing	Lead Diameter
2B	Straight Long	9.5mm	ø0.65mm
2F		12.7mm	ø0.8mm

❼Body Diameter and Terminal Type (**DHS** Series)

Code	Body Diameter	Terminal Type
CX	20mm	No.8-32 Tapped Holes
DX	24mm	
HX	30mm	
LX	38mm	
NX	43mm	
RX	52mm	
TX	60mm	

❽Packaging

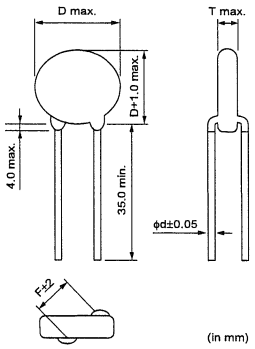
Code	Packaging
B	Bulk

High-voltage Ceramic Capacitors DC10-40kV

Radial Lead Type DHR Series

■ Features

1. Small size.
2. Excellent heat-proof, humidity-proof and high-dielectric strength voltage.
3. Coated with flame-retardant epoxy resin (equivalent to UL94V-0 standards).



■ Applications

1. Color TV doublers and triplers
2. High-voltage DC power supplies (PPCs, X-ray apparatus, air cleaner, lasers, etc.)
3. Tuning capacitor in focus circuit for display

■ Marking

Temp. Char. / Nominal body dia.		ZM	B
ø8mm		101 10K	101 10K
ø9mm and 10mm		221K 10K•	221M 10K
ø11mm to 14mm		ZM 471K 10K	B 471M 10K
ø15mm to 18mm		102KZ Ⓜ 10K 0050	102MB Ⓜ 10K 0050
Temperature Characteristics	Nominal body dia. ø8mm	Omitted	Omitted
	Nominal body dia. ø9 and 10mm	Marked with • (dot)	
	Nominal body dia. ø11 to 14mm	Marked with code.	Marked with code.
	Nominal body dia. ø15mm min.	Marked with Z.	
Nominal Capacitance		Under 100pF : Actual value, 100pF and over : Marked with 3 figures.	
Capacitance Tolerance		Marked with code, Omitted for nominal body diameter ø8mm and under.	
Rated Voltage		Marked with code.	
Manufacturer's Identification		Marked with Ⓜ, Omitted for nominal body diameter ø14mm and under.	
Manufactured Date		Abbreviation. Omitted for nominal body diameter ø14mm and under. (Ex.) 0 0 5 0 ① : Last numeral in year ③ : Fix No. ① ② ③ ② : Number in the month	

1

ZM Characteristics

Part Number	Rated Voltage (kV)	Capacitance (pF)	Body Dia. D (mm)	Lead Spacing F (mm)	Body Thickness T (mm)	Lead Dia. Ød (mm)
DHR4E4A101K2BB	DC10	100 +10, -10%	8.0	9.5	7.3	0.65
DHR4E4A151K2BB	DC10	150 +10, -10%	8.0	9.5	7.0	0.65
DHR4E4A221K2BB	DC10	220 +10, -10%	9.0	9.5	7.0	0.65
DHR4E4A331K2BB	DC10	330 +10,-10%	10.0	9.5	7.0	0.65
DHR4E4A471K2BB	DC10	470 +10, -10%	12.0	9.5	7.0	0.65
DHR4E4A681K2BB	DC10	680 +10, -10%	13.0	9.5	7.0	0.65
DHR4E4A102K2BB	DC10	1000 +10, -10%	15.0	9.5	7.0	0.65
DHR4E4B101K2BB	DC12	100 +10, -10%	8.0	9.5	7.3	0.65
DHR4E4B151K2BB	DC12	150 +10, -10%	9.0	9.5	7.3	0.65
DHR4E4B221K2BB	DC12	220 +10, -10%	9.0	9.5	7.3	0.65
DHR4E4B331K2BB	DC12	330 +10, -10%	11.0	9.5	7.3	0.65
DHR4E4B471K2BB	DC12	470 +10, -10%	12.0	9.5	7.3	0.65
DHR4E4B681K2BB	DC12	680 +10, -10%	14.0	9.5	7.3	0.65
DHR4E4B102K2BB	DC12	1000 +10, -10%	16.0	9.5	7.3	0.65
DHR4E4C101K2BB	DC15	100 +10, -10%	8.0	9.5	8.2	0.65
DHR4E4C151K2BB	DC15	150 +10, -10%	9.0	9.5	8.2	0.65
DHR4E4C221K2BB	DC15	220 +10, -10%	10.0	9.5	8.2	0.65
DHR4E4C331K2BB	DC15	330 +10, -10%	12.0	9.5	8.2	0.65
DHR4E4C471K2BB	DC15	470 +10, -10%	13.0	9.5	8.2	0.65
DHR4E4C681K2BB	DC15	680 +10, -10%	15.0	9.5	8.2	0.65
DHR4E4C102K2FB	DC15	1000 +10, -10%	18.0	12.7	8.2	0.8

B Characteristics

Part Number	Rated Voltage (kV)	Capacitance (pF)	Body Dia. D (mm)	Lead Spacing F (mm)	Body Thickness T (mm)	Lead Dia. Ød (mm)
DHRB34A101M2BB	DC10	100 +20, -20%	8.0	9.5	7.0	0.65
DHRB34A151M2BB	DC10	150 +20, -20%	8.0	9.5	7.0	0.65
DHRB34A221M2BB	DC10	220 +20, -20%	9.0	9.5	7.0	0.65
DHRB34A331M2BB	DC10	330 +20, -20%	10.0	9.5	7.0	0.65
DHRB34A471M2BB	DC10	470 +20, -20%	12.0	9.5	7.0	0.65
DHRB34A681M2BB	DC10	680 +20, -20%	13.0	9.5	7.0	0.65
DHRB34A102M2BB	DC10	1000 +20, -20%	15.0	9.5	7.0	0.65
DHRB34B101M2BB	DC12	100 +20, -20%	8.0	9.5	7.7	0.65
DHRB34B151M2BB	DC12	150 +20, -20%	9.0	9.5	7.5	0.65
DHRB34B221M2BB	DC12	220 +20, -20%	9.0	9.5	7.5	0.65
DHRB34B331M2BB	DC12	330 +20, -20%	11.0	9.5	7.5	0.65
DHRB34B471M2BB	DC12	470 +20, -20%	12.0	9.5	7.5	0.65
DHRB34B681M2BB	DC12	680 +20, -20%	14.0	9.5	7.5	0.65
DHRB34B102M2BB	DC12	1000 +20, -20%	16.0	9.5	7.5	0.65
DHRB34C101M2BB	DC15	100 +20, -20%	8.0	9.5	8.5	0.65
DHRB34C151M2BB	DC15	150 +20, -20%	9.0	9.5	8.2	0.65
DHRB34C221M2BB	DC15	220 +20, -20%	10.0	9.5	8.2	0.65
DHRB34C331M2BB	DC15	330 +20, -20%	12.0	9.5	8.2	0.65
DHRB34C471M2BB	DC15	470 +20, -20%	13.0	9.5	8.2	0.65
DHRB34C681M2BB	DC15	680 +20, -20%	15.0	9.5	8.2	0.65
DHRB34C102M2FB	DC15	1000 +20, -20%	18.0	12.7	8.2	0.8

Technische Information / Technical Information

IGBT-Module
IGBT-Modules

FZ 200 R 65 KF1

eupec

Höchstzulässige Werte / Maximum rated values

Elektrische Eigenschaften / Electrical properties

Kollektor-Emitter-Sperrspannung collector-emitter voltage	T_{vj}=125°C T_{vj}=25°C T_{vj}=-40°C	V_{CES}	6500 6300 5800	V
Kollektor-Dauergleichstrom DC-collector current	T_C = 80 °C T_C = 25 °C	$I_{C,nom.}$ I_C	200 400	A A
Periodischer Kollektor Spitzenstrom repetitive peak collector current	t_P = 1 ms, T_C = 80°C	I_{CRM}	400	A
Gesamt-Verlustleistung total power dissipation	T_C=25°C, Transistor	P_{tot}	3,8	kW
Gate-Emitter-Spitzenspannung gate-emitter peak voltage		V_{GES}	+/- 20V	V
Dauergleichstrom DC forward current		I_F	200	A
Periodischer Spitzenstrom repetitive peak forw. current	t_P = 1 ms	I_{FRM}	400	A
Grenzlastintegral der Diode I^2t - value, Diode	V_R = 0V, t_p = 10ms, T_{vj} = 125°C	I^2t	26	k A^2s
Isolations-Prüfspannung insulation test voltage	RMS, f = 50 Hz, t = 1 min.	V_{ISOL}	10,2	kV
Teilentladungs Aussetzspannung partial discharge extinction voltage	RMS, f = 50 Hz, Q_{PD} typ. 10pC (acc. To IEC 1287)	V_{ISOL}	5,1	kV

Charakteristische Werte / Characteristic values

Transistor / Transistor

			min.	typ.	max.	
Kollektor-Emitter Sättigungsspannung collector-emitter saturation voltage	I_C = 200A, V_{GE} = 15V, T_{vj} = 25°C I_C = 200A, V_{GE} = 15V, T_{vj} = 125°C	$V_{CE\,sat}$	- -	4,3 5,3	4,9 5,9	V V
Gate-Schwellenspannung gate threshold voltage	I_C = 35mA, V_{CE} = V_{GE}, T_{vj} = 25°C	$V_{GE(th)}$	6,4	7,0	8,1	V
Gateladung gate charge	V_{GE} = -15V ... +15V	Q_G	-	2,8	-	µC
Eingangskapazität input capacitance	f = 1MHz,T_{vj} = 25°C,V_{CE} = 25V, V_{GE} = 0V	C_{ies}	-	28	-	nF
Kollektor-Emitter Reststrom collector-emitter cut-off current	V_{CE} = 6300V, V_{GE} = 0V, T_{vj} = 25°C V_{CE} = 6500V, V_{GE} = 0V, T_{vj} = 125°C	I_{CES}	-	0,2 20	-	mA mA
Gate-Emitter Reststrom gate-emitter leakage current	V_{CE} = 0V, V_{GE} = 20V, T_{vj} = 25°C	I_{GES}	-	-	400	nA

prepared by: Dr. Oliver Schilling	date of publication: 2002-07-05
approved by: Dr. Schütze 2002-07-05	revision/Status: Series 1

Charakteristische Werte / Characteristic values

Transistor / Transistor			min.	typ.	max.	
Einschaltverzögerungszeit (ind. Last) turn on delay time (inductive load)	I_C = 200A, V_{CE} = 3600V					
	V_{GE} = ±15V, R_{Gon} = 13Ω, C_{GE}=22nF, T_{vj} = 25°C,	$t_{d,on}$	-	0,75	-	µs
	V_{GE} = ±15V, R_{Gon} = 13Ω, C_{GE}=22nF, T_{vj} = 125°C,		-	0,72	-	µs
Anstiegszeit (induktive Last) rise time (inductive load)	I_C = 200A, V_{CE} = 3600V					
	V_{GE} = ±15V, R_{Gon} = 13Ω, C_{GE}=22nF, T_{vj} = 25°C,	t_r	-	0,37	-	µs
	V_{GE} = ±15V, R_{Gon} = 13Ω, C_{GE}=22nF, T_{vj} = 125°C,		-	0,40	-	µs
Abschaltverzögerungszeit (ind. Last) turn off delay time (inductive load)	I_C = 200A, V_{CE} = 3600V					
	V_{GE} = ±15V, R_{Goff} = 75Ω, C_{GE}=22nF, T_{vj} = 25°C,	$t_{d,off}$	-	5,50	-	µs
	V_{GE} = ±15V, R_{Goff} = 75Ω, C_{GE}=22nF, T_{vj} = 125°C,		-	6,00	-	µs
Fallzeit (induktive Last) fall time (inductive load)	I_C = 200A, V_{CE} = 3600V					
	V_{GE} = ±15V, R_{Goff} = 75Ω, C_{GE}=22nF, T_{vj} = 25°C,	t_f	-	0,40	-	µs
	V_{GE} = ±15V, R_{Goff} = 75Ω, C_{GE}=22nF, T_{vj} = 125°C,		-	0,50	-	µs
Einschaltverlustenergie pro Puls turn-on energy loss per pulse	I_C = 200A, V_{CE} = 3600V, V_{GE} = ±15V					
	R_{Gon} = 13Ω, C_{GE}=22nF, T_{vj} = 125°C , L_σ = 280nH	E_{on}	-	1900	-	mJ
Abschaltverlustenergie pro Puls turn-off energy loss per pulse	I_C = 200A, V_{CE} = 3600V, V_{GE} = ±15V					
	R_{Goff} = 75Ω, C_{GE}=22nF, T_{vj} = 125°C , L_σ = 280nH	E_{off}	-	1200	-	mJ
Kurzschlußverhalten SC Data	$t_P \leq$ 10µsec, $V_{GE} \leq$ 15V, acc to appl.note 2002/05					
	$T_{vj} \leq$125°C, V_{CC}=4400V, $V_{CEmax}=V_{CES}-L_{\sigma CE}\cdot di/dt$	I_{SC}	-	1000	-	A
Modulinduktivität stray inductance module		L_{sCE}	-	25	-	nH
Modulleitungswiderstand, Anschlüsse - Chip module lead resistance, terminals - chip		$R_{CC'+EE'}$	-	0,37	-	mΩ

Diode / Diode			min.	typ.	max.	
Durchlaßspannung forward voltage	I_F = 200A, V_{GE} = 0V, T_{vj} = 25°C	V_F	3,0	3,8	4,6	V
	I_F = 200A, V_{GE} = 0V, T_{vj} = 125°C			3,9	4,7	V
Rückstromspitze peak reverse recovery current	I_F = 200A, - di_F/dt = 700A/µs					
	V_R = 3600V, V_{GE} = -10V, T_{vj} = 25°C	I_{RM}	-	270	-	A
	V_R = 3600V, V_{GE} = -10V, T_{vj} = 125°C		-	330	-	A
Sperrverzögerungsladung recovered charge	I_F = 200A, - di_F/dt = 700A/µs					
	V_R = 3600V, V_{GE} = -10V, T_{vj} = 25°C	Q_r	-	180	-	µC
	V_R = 3600V, V_{GE} = -10V, T_{vj} = 125°C		-	350	-	µC
Abschaltenergie pro Puls reverse recovery energy	I_F = 200A, - di_F/dt = 700A/µs					
	V_R = 3600V, V_{GE} = -10V, T_{vj} = 25°C	E_{rec}	-	220	-	mJ
	V_R = 3600V, V_{GE} = -10V, T_{vj} = 125°C		-	550	-	mJ

Thermische Eigenschaften / Thermal properties

			min.	typ.	max.	
Innerer Wärmewiderstand thermal resistance, junction to case	Transistor / transistor, DC	R_{thJC}	-	-	0,033	K/W
	Diode/Diode, DC		-	-	0,063	K/W
Übergangs-Wärmewiderstand thermal resistance, case to heatsink	pro Modul / per Module $\lambda_{Paste} \leq 1$ W/m*K / $\lambda_{grease} \leq 1$ W/m*K	R_{thCK}	-	0,016	-	K/W
Höchstzulässige Sperrschichttemperatur maximum junction temperature		$T_{vj,\,max}$	-	-	150	°C
Betriebstemperatur Sperrschicht junction operation temperature	Schaltvorgänge IGBT(RBSOA);Diode(SOA) switching operation IGBT(RBSOA);Diode(SOA)	$T_{vj,op}$	-40	-	125	°C
Lagertemperatur storage temperature		T_{stg}	-40	-	125	°C

Mechanische Eigenschaften / Mechanical properties

Gehäuse, siehe Anlage case, see appendix				
Innere Isolation internal insulation			AlN	
Kriechstrecke creepage distance			56	mm
Luftstrecke clearance			26	mm
CTI comperative tracking index			>600	
Anzugsdrehmoment f. mech. Befestigung mounting torque	Schraube /screw M6	M	5	Nm
Anzugsdrehmoment f. elektr. Anschlüsse terminal connection torque	Anschlüsse / terminals M8	M	8 - 10	Nm
Gewicht weight		G	500	g

Mit dieser technischen Information werden Halbleiterbauelemente spezifiziert, jedoch keine Eigenschaften zugesichert. Sie gilt in Verbindung mit den zugehörigen Technischen Erläuterungen.

This technical information specifies semiconductor devices but promises no characteristics. It is valid in combination with the belonging technical notes.