FAIRCHILD

SEMICONDUCTOR ™

December 2000

$QFET^{TM}$
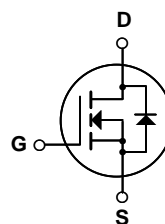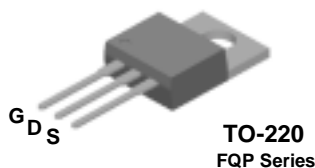
FQP9N08L

80V LOGIC 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 is especially tailored to minimize on-state resistance, provide superior switching performance, and withstand a high energy pulse in the avalanche and commutation modes. These devices are well suited for low voltage applications such as automotive, high efficiency switching for DC/DC converters, and DC motor control.

Features

- 9.3A, 80V, $R_{DS(on)}$ = 0.21Ω @V_{GS} = 10 V
- Low gate charge (typical 4.7 nC)
- Low Crss (typical 16 pF)
- Fast switching
- 100% avalanche tested
- Improved dv/dt capability
- 175°C maximum junction temperature rating
- Low level gate drive requirements allowing direct operation from logic drives

TO-220
FQP Series

Absolute Maximum Ratings T_C = 25°C unless otherwise noted

Symbol	Parameter		FQP9N08L	Units
V_{DSS}	Drain-Source Voltage		80	V
I_D	Drain Current - Continuous (T_C = 25°C)		9.3	A
	- Continuous (T_C = 100°C)		6.57	A
I_{DM}	Drain Current - Pulsed	(Note 1)	37.2	A
V_{GSS}	Gate-Source Voltage		± 20	V
E_{AS}	Single Pulsed Avalanche Energy	(Note 2)	55	mJ
I_{AR}	Avalanche Current	(Note 1)	9.3	A
E_{AR}	Repetitive Avalanche Energy	(Note 1)	4.0	mJ
dv/dt	Peak Diode Recovery dv/dt	(Note 3)	6.5	V/ns
P_D	Power Dissipation (T_C = 25°C)		40	W
	- Derate above 25°C		0.27	W/°C
T_J, T_{STG}	Operating and Storage Temperature Range		-55 to +175	°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	--	3.75	°C/W
$R_{\theta CS}$	Thermal Resistance, Case-to-Sink	0.5	--	°C/W
$R_{\theta JA}$	Thermal Resistance, Junction-to-Ambient	--	62.5	°C/W

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	80	--	--	V
$\Delta BV_{DSS} / \Delta T_J$	Breakdown Voltage Temperature Coefficient	$I_D = 250$ µA, Referenced to 25°C	--	0.08	--	V/°C
I_{DSS}	Zero Gate Voltage Drain Current	$V_{DS} = 80$ V, $V_{GS} = 0$ V	--	--	1	µA
		$V_{DS} = 64$ V, $T_C = 150°C$	--	--	10	µA
I_{GSSF}	Gate-Body Leakage Current, Forward	$V_{GS} = 20$ V, $V_{DS} = 0$ V	--	--	100	nA
I_{GSSR}	Gate-Body Leakage Current, Reverse	$V_{GS} = -20$ V, $V_{DS} = 0$ V	--	--	-100	nA
On Characteristics						
$V_{GS(th)}$	Gate Threshold Voltage	$V_{DS} = V_{GS}$, $I_D = 250$ µA	1.0	--	2.0	V
$R_{DS(on)}$	Static Drain-Source On-Resistance	$V_{GS} = 10$ V, $I_D = 4.65$ A	--	0.15	0.21	Ω
		$V_{GS} = 5$ V, $I_D = 4.65$ A		0.17	0.23	
g_{FS}	Forward Transconductance	$V_{DS} = 25$ V, $I_D = 4.65$ A (Note 4)	--	4.9	--	S
Dynamic Characteristics						
C_{iss}	Input Capacitance	$V_{DS} = 25$ V, $V_{GS} = 0$ V, f = 1.0 MHz	--	215	280	pF
C_{oss}	Output Capacitance		--	70	90	pF
C_{rss}	Reverse Transfer Capacitance		--	16	20	pF
Switching Characteristics						
$t_{d(on)}$	Turn-On Delay Time	$V_{DD} = 40$ V, $I_D = 9.3$ A, $R_G = 25$ Ω	--	6.5	23	ns
t_r	Turn-On Rise Time		--	180	370	ns
$t_{d(off)}$	Turn-Off Delay Time		--	13	35	ns
t_f	Turn-Off Fall Time	(Note 4, 5)	--	30	70	ns
Q_g	Total Gate Charge	$V_{DS} = 64$ V, $I_D = 9.3$ A, $V_{GS} = 5$ V	--	4.7	6.1	nC
Q_{gs}	Gate-Source Charge		--	1.2	--	nC
Q_{gd}	Gate-Drain Charge	(Note 4, 5)	--	2.8	--	nC
Drain-Source Diode Characteristics and Maximum Ratings						
I_S	Maximum Continuous Drain-Source Diode Forward Current		--	--	9.3	A
I_{SM}	Maximum Pulsed Drain-Source Diode Forward Current		--	--	37.2	A
V_{SD}	Drain-Source Diode Forward Voltage	$V_{GS} = 0$ V, $I_S = 9.3$ A	--	--	1.5	V
t_{rr}	Reverse Recovery Time	$V_{GS} = 0$ V, $I_S = 9.3$ A, $dI_F / dt = 100$ A/µs (Note 4)	--	54	--	ns
Q_{rr}	Reverse Recovery Charge		--	80	--	nC

Notes:
1. Repetitive Rating : Pulse width limited by maximum junction temperature
2. L = 0.87mH, $I_{AS} = 9.3$A, $V_{DD} = 25$V, $R_G = 25$ Ω, Starting $T_J = 25°C$
3. $I_{SD} \leq 9.3$A, di/dt ≤ 300A/µs, $V_{DD} \leq BV_{DSS}$, Starting $T_J = 25°C$
4. Pulse Test : Pulse width ≤ 300µs, Duty cycle $\leq 2\%$
5. Essentially independent of operating temperature
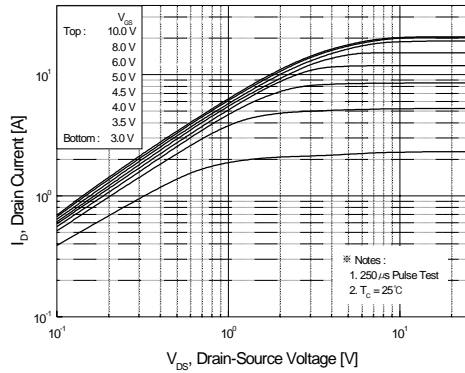
Typical Characteristics

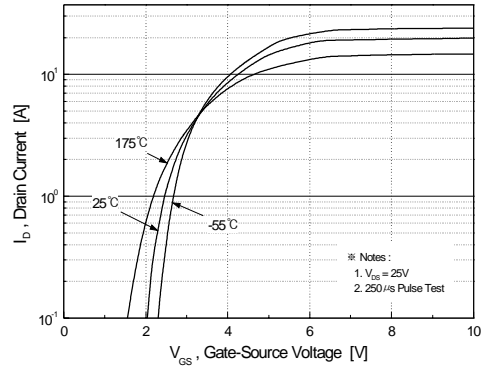**Figure 1. On-Region Characteristics**

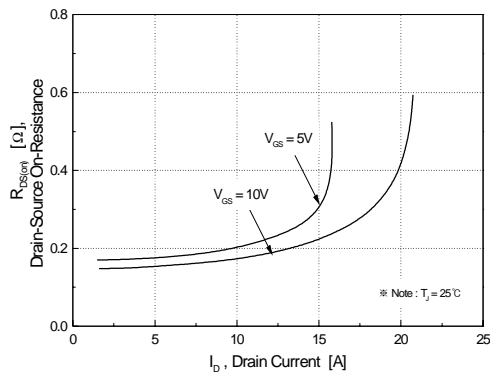**Figure 2. Transfer Characteristics**

**Figure 3. On-Resistance Variation vs.
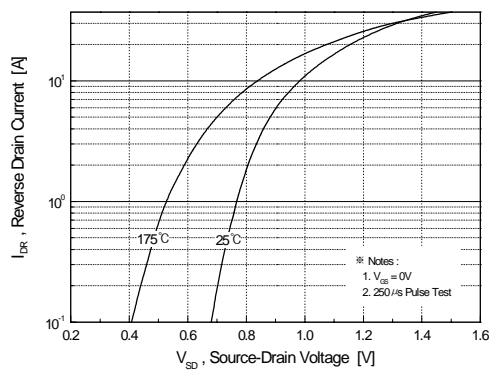Drain Current and Gate Voltage**

**Figure 4. Body Diode Forward Voltage
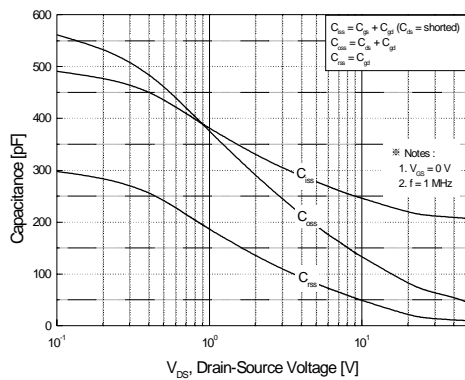Variation vs. Source Current
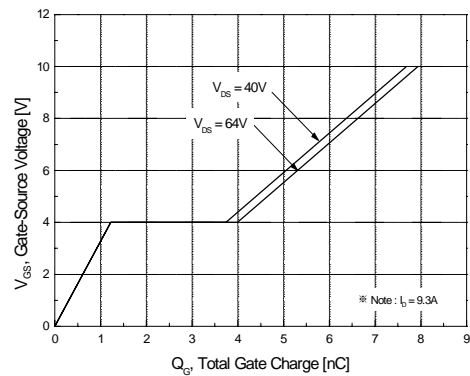and Temperature**

Figure 5. Capacitance Characteristics

Figure 6. Gate Charge Characteristics
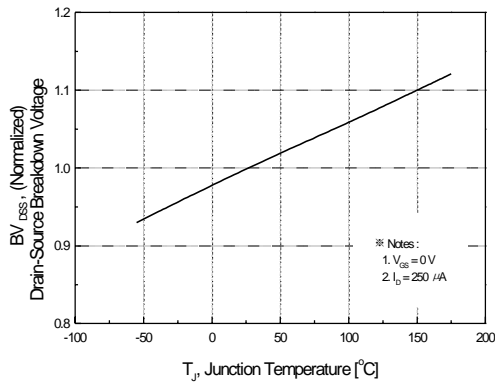
Typical Characteristics (Continued)

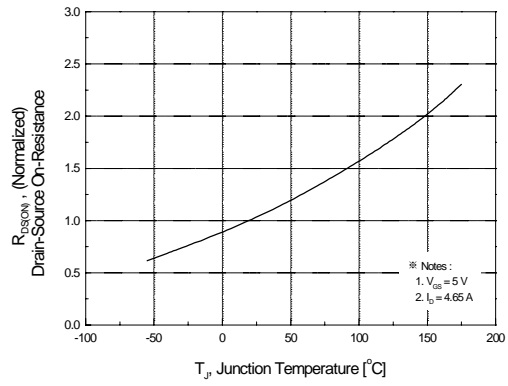**Figure 7. Breakdown Voltage Variation vs. Temperature**

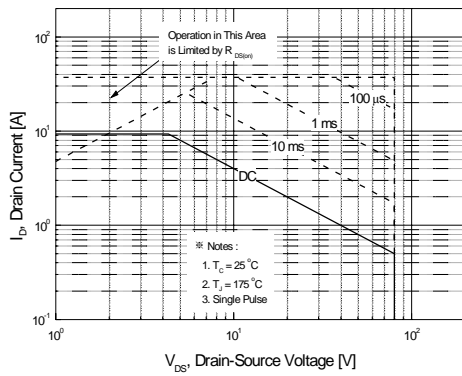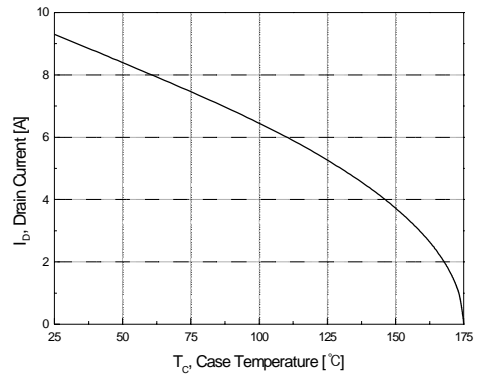**Figure 8. On-Resistance Variation vs. Temperature**

Figure 9. Maximum Safe Operating Area
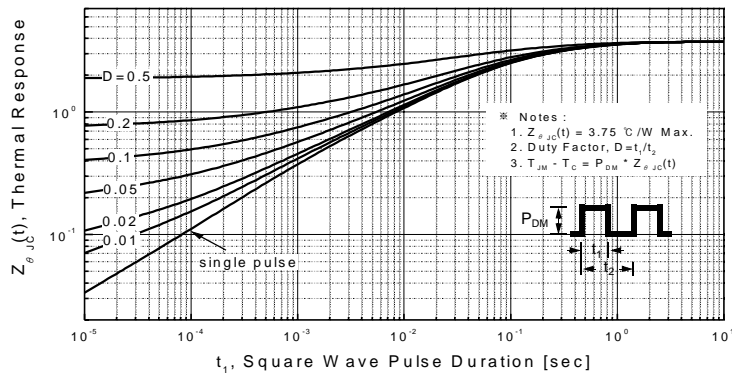

Figure 10. Maximum Drain Current vs. Case Temperature

Figure 11. Transient Thermal Response Curve

Gate Charge Test Circuit & Waveform

V_{GS}

5V

Q_g

Q_{gs} Q_{gd}

Charge

12V   200nF   50KΩ   300nF

V_{GS}

3mA

Same Type
as DUT

DUT

V_{DS}

Resistive Switching Test Circuit & Waveforms

V_{DS} R_L

V_{GS} V_{DD}

R_G

5V   DUT

V_{DS} 90%

V_{GS} 10%

$t_{d(on)}$ t_r $t_{d(off)}$ t_f

t_{on} t_{off}
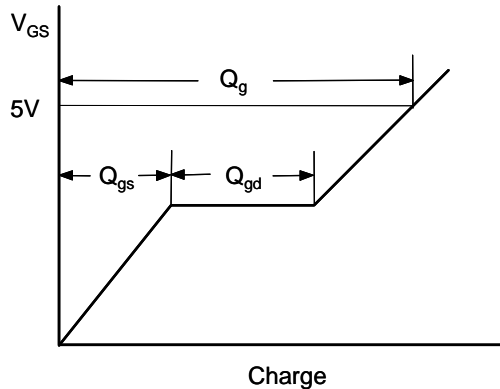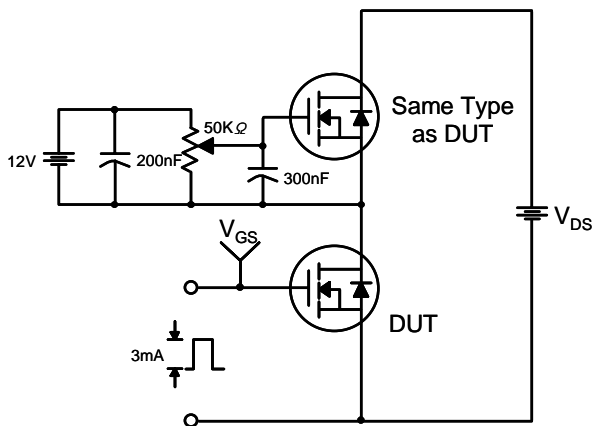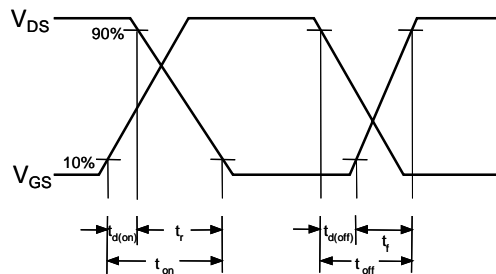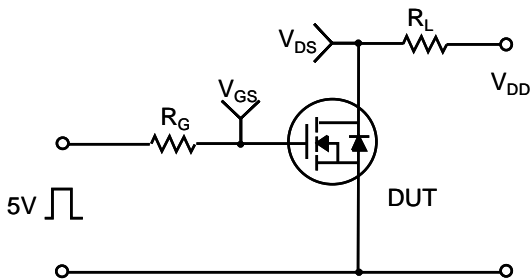
Unclamped Inductive Switching Test Circuit & Waveforms

V_{DS} L

I_D

R_G V_{DD}

10V   DUT

t_p

$$E_{AS} = \frac{1}{2} L I_{AS}^2 \frac{BV_{DSS}}{BV_{DSS} - V_{DD}}$$

BV_{DSS}
I_{AS}

$I_D(t)$

V_{DD} $V_{DS}(t)$

t_p Time
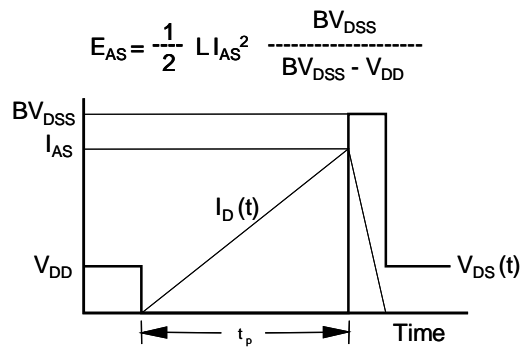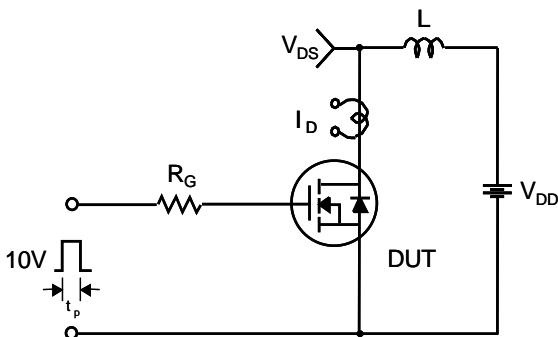
Peak Diode Recovery dv/dt Test Circuit & Waveforms

DUT

V_{DS}

+

−

I_{SD}

L

Driver

R_G

V_{GS}

Same Type
as DUT

V_{DD}

• dv/dt controlled by R_G
• I_{SD} controlled by pulse period

V_{GS}
(Driver)

$$D = \frac{\text{Gate Pulse Width}}{\text{Gate Pulse Period}}$$

10V

I_{SD}
(DUT)

I_{FM} , Body Diode Forward Current

di/dt

I_{RM}

Body Diode Reverse Current

V_{DS}
(DUT)

Body Diode Recovery dv/dt

V_{SD}

V_{DD}

Body Diode
Forward Voltage Drop

Package Dimensions

TO-220

9.90 ±0.20

(8.70)

(1.70)

1.30 ±0.10

ø3.60 ±0.10

2.80 ±0.10

9.20 ±0.20

(1.46)

(3.70)

15.90 ±0.20

18.95MAX.

(3.00)

13.08 ±0.20

(1.00)

(45°)

1.27 ±0.10

1.52 ±0.10

10.08 ±0.30

0.80 ±0.10

2.54TYP
[2.54 ±0.20]

2.54TYP
[2.54 ±0.20]

10.00 ±0.20

4.50 ±0.20

1.30 $^{+0.10}_{-0.05}$

0.50 $^{+0.10}_{-0.05}$

2.40 ±0.20
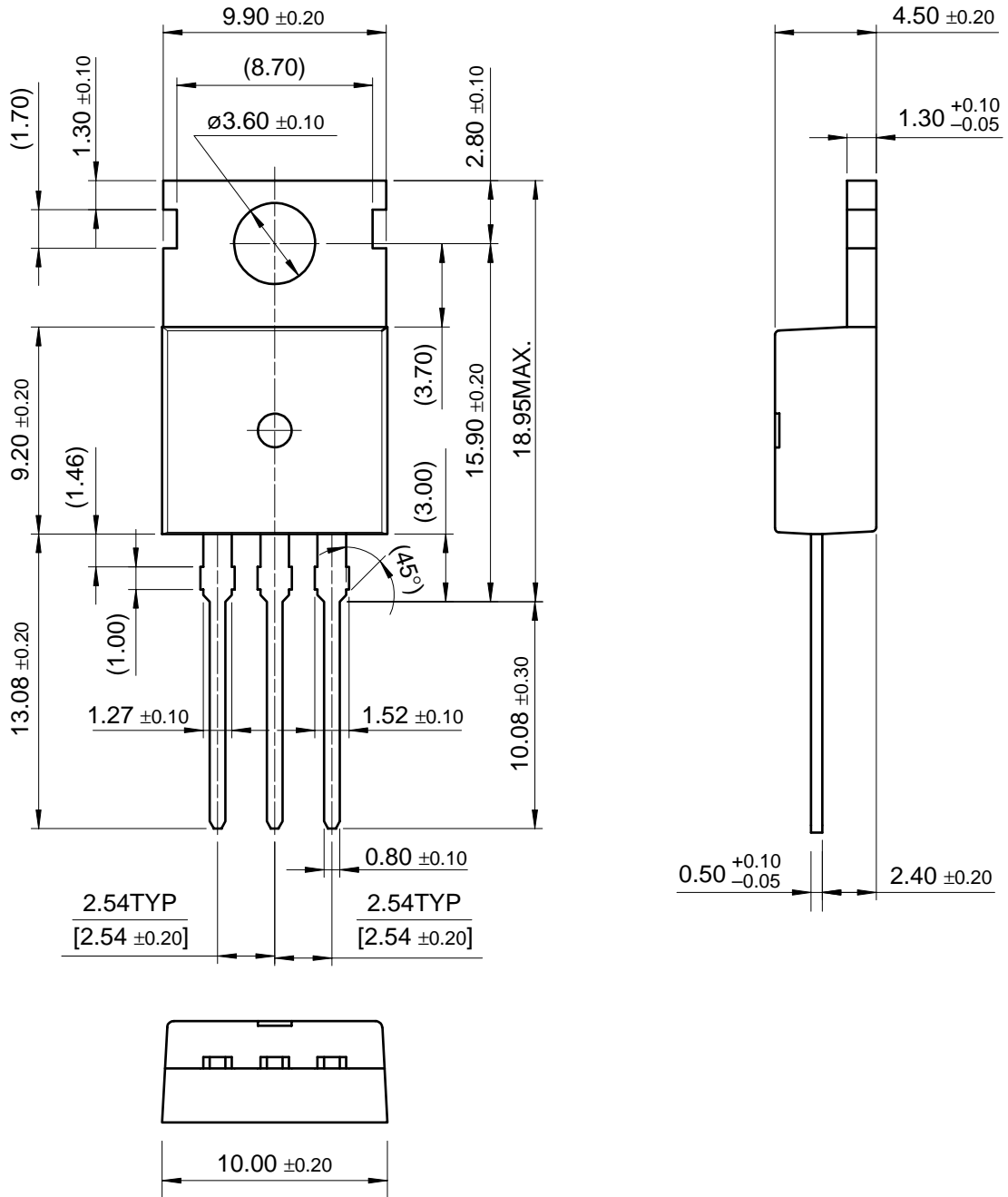
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FAST$^®$	Quiet Series™	
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GTO™	SuperSOT™-6	

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