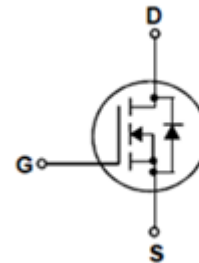
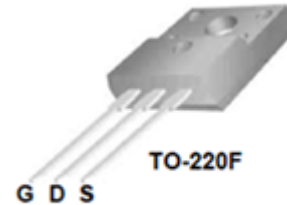


## 500V N-Channel MOSFET

### General Description

This Power MOSFET is produced using advanced 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 switched mode power supplies, active power factor correction based on half bridge topology.



### Features

13A, 500V,  $R_{DS(on)}$  typ. =  $0.42\Omega$  @  $V_{GS} = 10V$

Advanced planar process

Low gate charge minimize switching loss

100% avalanche tested

Improved dv/dt capability

Fast Recovery Body Diode

### Absolute Maximum Ratings $T_c = 25^\circ\text{C}$ unless otherwise noted

Symbol	Parameter	JFFM13N50E	Units
$V_{DSS}$	Drain – Source Voltage	500	V
$I_D$	Drain Current	Continuous ( $T_c = 25^\circ\text{C}$ )	13*
		Continuous ( $T_c = 100^\circ\text{C}$ )	7.5*
$I_{DM}$	Drain Current - Pulsed ( Note 1 )	48	A
$V_{GSS}$	Gate – Source Voltage	$\pm 30$	V
EAS	Single Pulsed Avalanche Energy ( Note 2 )	563	mJ
$I_{AR}$	Avalanche Current ( Note 1 )	13	A
$E_{AR}$	Repetitive Avalanche Energy ( Note 1 )	26	mJ
dv/dt	Peak Diode Recovery dv/dt ( Note 3 )	5.0	V/ns
$P_D$	Power Dissipation ( $T_c = 25^\circ\text{C}$ )	65	W
	-Derate above $25^\circ\text{C}$	0.52	W/ $^\circ\text{C}$
$T_J, T_{STG}$	Operating and Storage Temperature Range	-55 to +150	$^\circ\text{C}$
$T_L$	Maximum lead temperature for soldering purposes 1/8" from case for 5 seconds	300	$^\circ\text{C}$

\*Drain current limited by maximum junction temperature.

## Thermal characteristics

Symbol	Parameter	JFFM13N50E	Units
R <sub>θJC</sub>	Thermal Resistance, Junction-to-Case	1.92	°C/W
R <sub>θJS</sub>	Thermal Resistance, Case-to-Sink Typ.	--	°C/W
R <sub>θJA</sub>	Thermal Resistance, Junction-to-Ambient	62.5	°C/W

## Electrical Characteristics T<sub>C</sub> = 25 °C unless otherwise noted

Symbol	Parameter	Test Conditions	Min	Typ	Max	Units
<b>Off Characteristics</b>						
BV <sub>DSS</sub>	Drain – Source Breakdown Voltage	V <sub>GS</sub> = 0 V, I <sub>D</sub> = 250 uA	500	--	--	V
ΔBV <sub>DSS</sub> /ΔT <sub>J</sub>	Breakdown Voltage Temperature Coefficient	I <sub>D</sub> = 250 uA, Referenced to 25 °C	--	0.6	--	V/°C
I <sub>DSS</sub>	Zero Gate Voltage Drain Current	V <sub>DS</sub> = 500 V, V <sub>GS</sub> = 0 V	--	--	1	uA
		V <sub>DS</sub> = 400 V, T <sub>C</sub> = 125 °C	--	--	10	uA
I <sub>GSSF</sub>	Gate-Body Leakage Current, Forward	V <sub>GS</sub> = 30 V, V <sub>DS</sub> = 0 V	--	--	100	nA
I <sub>GSSR</sub>	Gate-Body Leakage Current, Reverse	V <sub>GS</sub> = -30 V, V <sub>DS</sub> = 0 V	--	--	-100	nA
<b>On Characteristics</b>						
V <sub>GS(th)</sub>	Gate Threshold Voltage	V <sub>DS</sub> = V <sub>GS</sub> , I <sub>D</sub> = 250 uA	2.0	--	4.0	V
R <sub>DS(on)</sub>	Static Drain-Source on-Resistance	V <sub>GS</sub> = 10 V, I <sub>D</sub> = 6.5A	--	0.42	0.55	Ω
g <sub>FS</sub>	Forward Transconductance	V <sub>DS</sub> = 20 V, I <sub>D</sub> = 13A ( Note 4 )	--	20	--	S
<b>Dynamic Characteristics</b>						
C <sub>iss</sub>	Input Capacitance	V <sub>DS</sub> = 25 V, V <sub>GS</sub> = 0 V, f = 1.0 MHz	--	1180	--	pF
C <sub>oss</sub>	Output Capacitance		--	120	--	pF
C <sub>rss</sub>	Reverse Transfer Capacitance		--	13	--	pF
<b>Switching Characteristics</b>						
t <sub>d(on)</sub>	Turn-On Delay Time	V <sub>DS</sub> = 250 V, I <sub>D</sub> = 13.0 A, R <sub>G</sub> = 25Ω, V <sub>GS</sub> = 10 V ( Note 4,5 )	--	22	--	ns
t <sub>r</sub>	Turn-On Rise Time		--	13	--	ns
t <sub>d(off)</sub>	Turn-Off Delay Time		--	90	--	ns
t <sub>f</sub>	Turn-Off Fall Time		--	30	--	ns
Q <sub>g</sub>	Total Gate Charge		V <sub>DS</sub> = 400 V, I <sub>D</sub> = 13.0 A V <sub>GS</sub> = 10 V ( Note 4,5 )	--	32	--
Q <sub>gs</sub>	Gate-Source Charge	--		7	--	nC
Q <sub>gd</sub>	Gate-Drain Charge	--		16	--	nC
<b>Drain – Source Diode Characteristics and Maximum Ratings</b>						
I <sub>S</sub>	Maximum Continuous Drain-Source Diode Forward Current		--	--	13	A
I <sub>SM</sub>	Maximum Pulsed Drain-Source Diode Forward Current		--	--	48	A
V <sub>SD</sub>	Drain-Source Diode Forward Voltage	V <sub>GS</sub> = 0 V, I <sub>S</sub> = 13.0 A	--	--	1.4	V
t <sub>rr</sub>	Reverse Recovery Time	V <sub>GS</sub> = 0 V, I <sub>S</sub> = 13.0 A	--	305	--	ns
Q <sub>rr</sub>	Reverse Recovery Charge	di <sub>F</sub> /dt = 100 A/us ( Note 4 )	--	4.0	--	uC

### Notes:

1. Repetitive Rating : Pulsed width limited by maximum junction temperature
2. L = 6.0mH, I<sub>AS</sub> = 13A, V<sub>DD</sub> = 50V, R<sub>G</sub> = 25Ω, Starting T<sub>J</sub> = 25 °C
3. I<sub>SD</sub> ≤ 13.0A, di/dt ≤ 200A/us, V<sub>DD</sub> ≤ BV<sub>DSS</sub>, Starting T<sub>J</sub> = 25 °C
4. Pulsed Test : Pulsed width ≤ 300us, Duty cycle ≤ 2%
5. Essentially independent of operating temperature

## Typical Characteristics

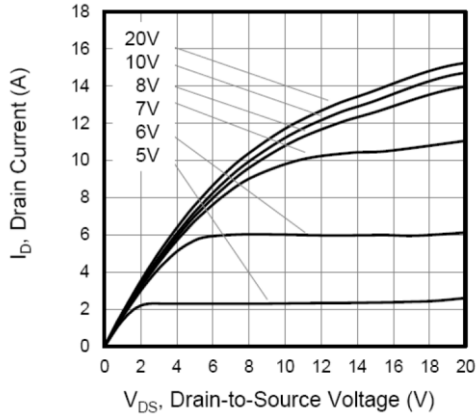


Figure 1. On-Region Characteristics

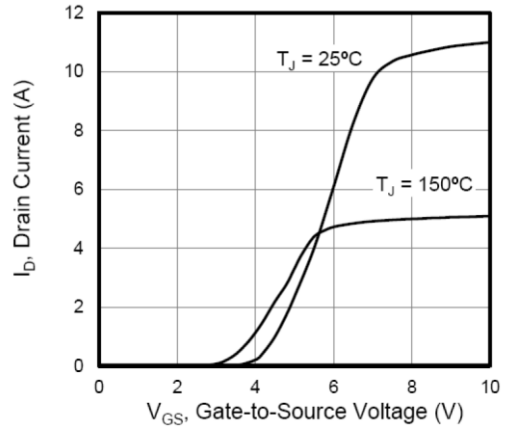


Figure 2. Transfer Characteristics

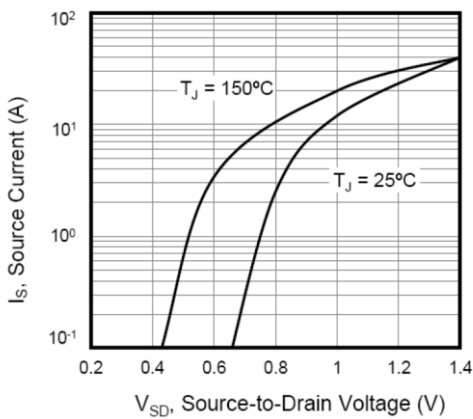


Figure 3. Body Diode Forward Voltage Variation with Source Current and Temperature

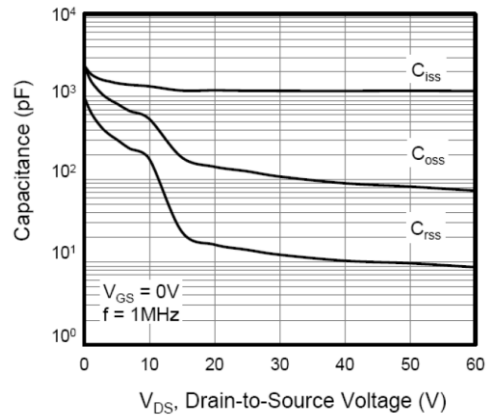


Figure 4. Capacitance Characteristics

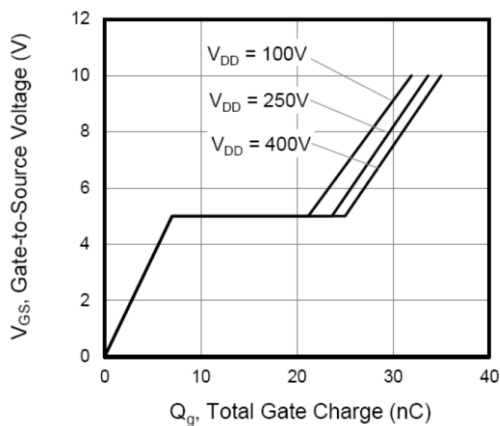


Figure 5. Gate Charge Characteristics

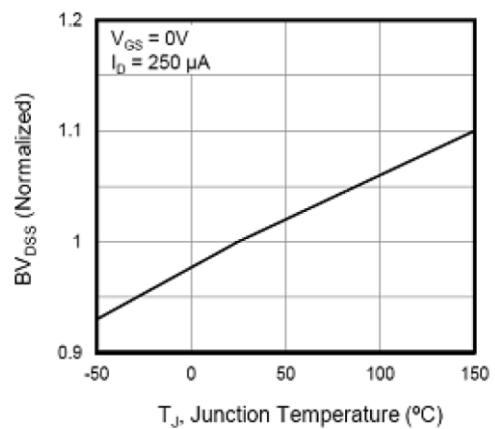


Figure 6. Breakdown Voltage Variation vs Temperature

## Typical Characteristics

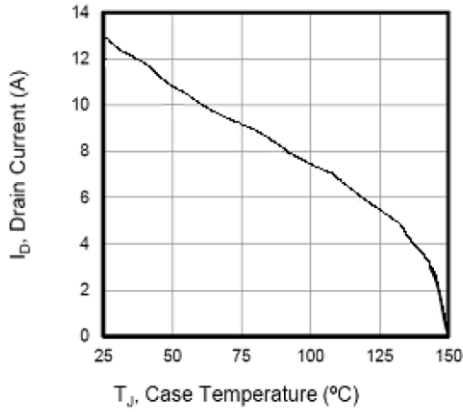


Figure 7. Maximum Drain Current vs Case Temperature

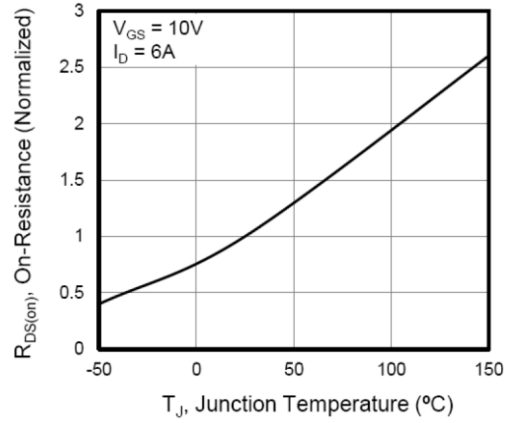


Figure 8. On-Resistance Variation vs Temperature

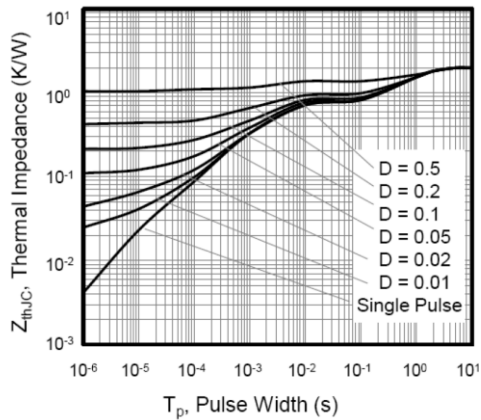
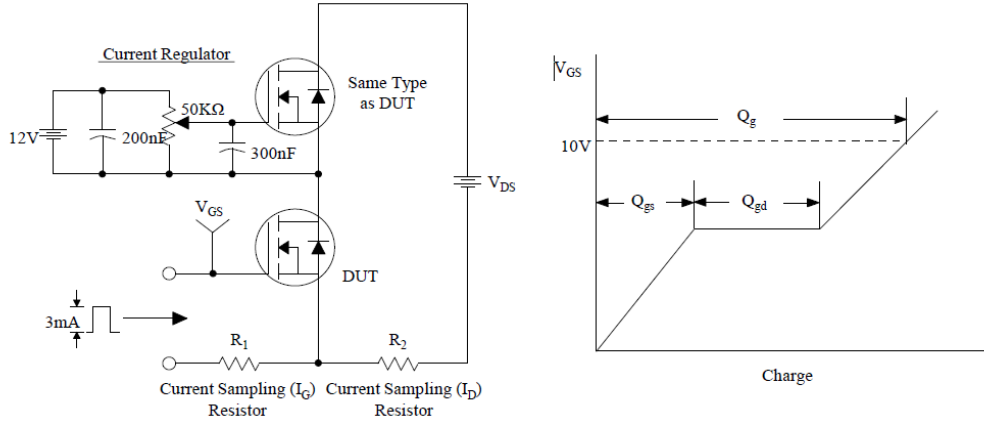
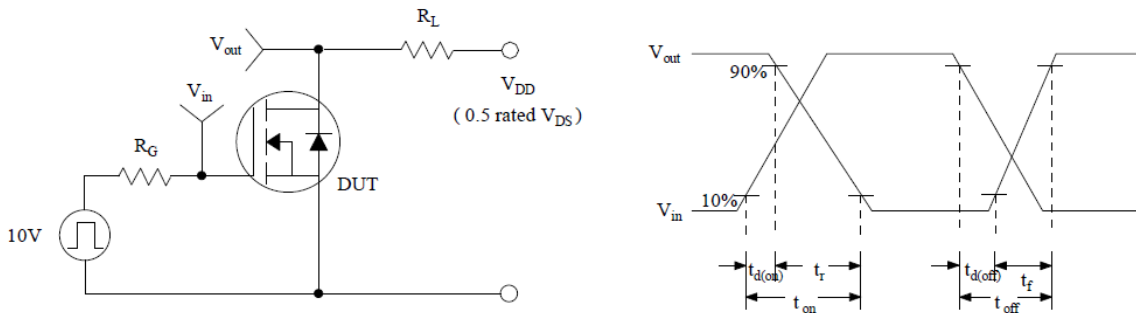


Figure 9. Transient Thermal Response Curve For JFFM13N50E

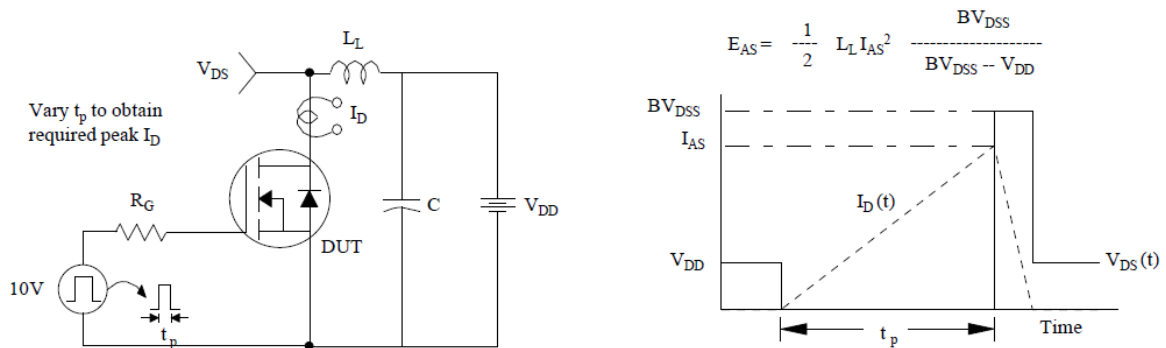
### Test Circuit & Waveform



Gate Charge Test Circuit & Waveform

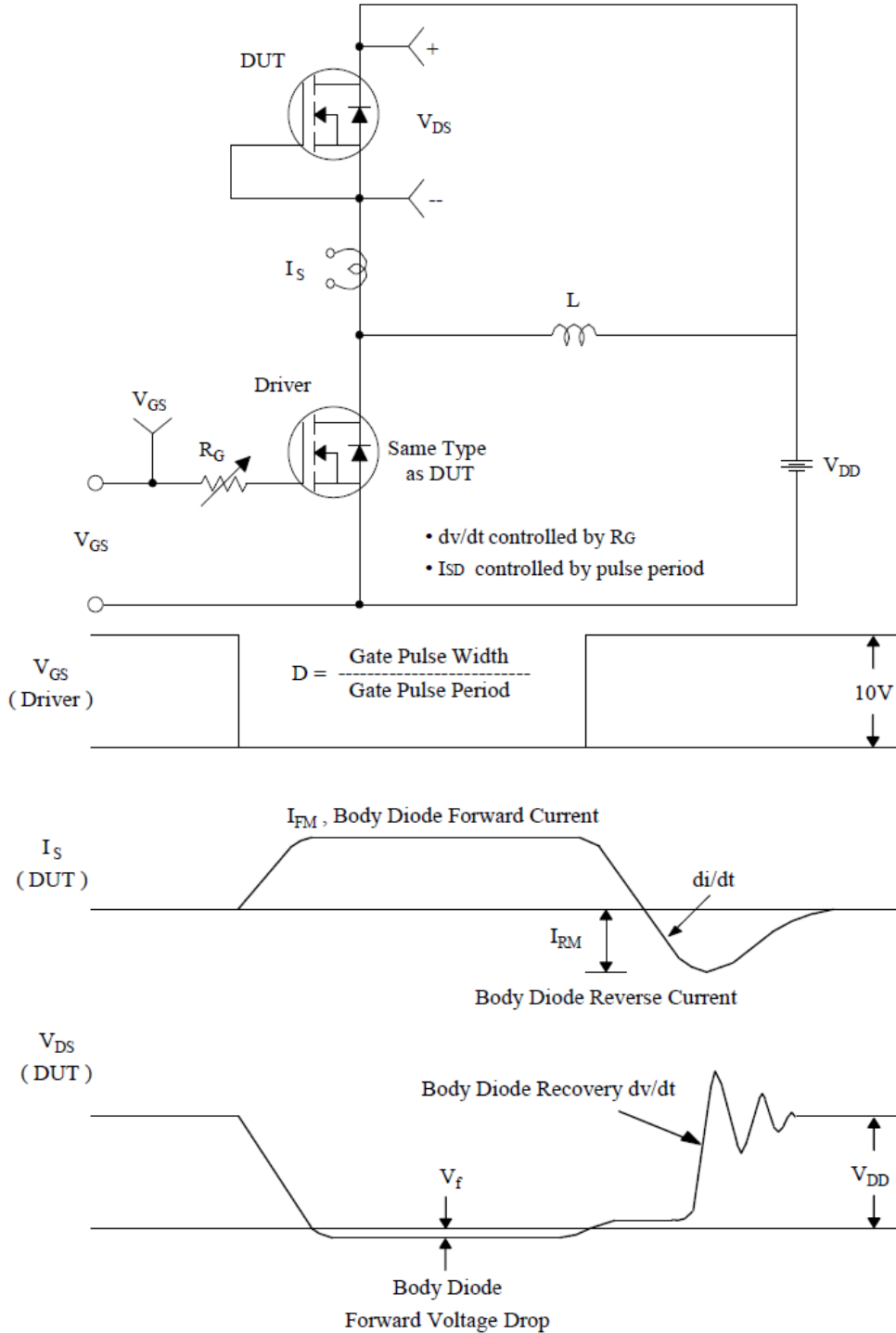


Resistive Switching Test Circuit & Waveforms



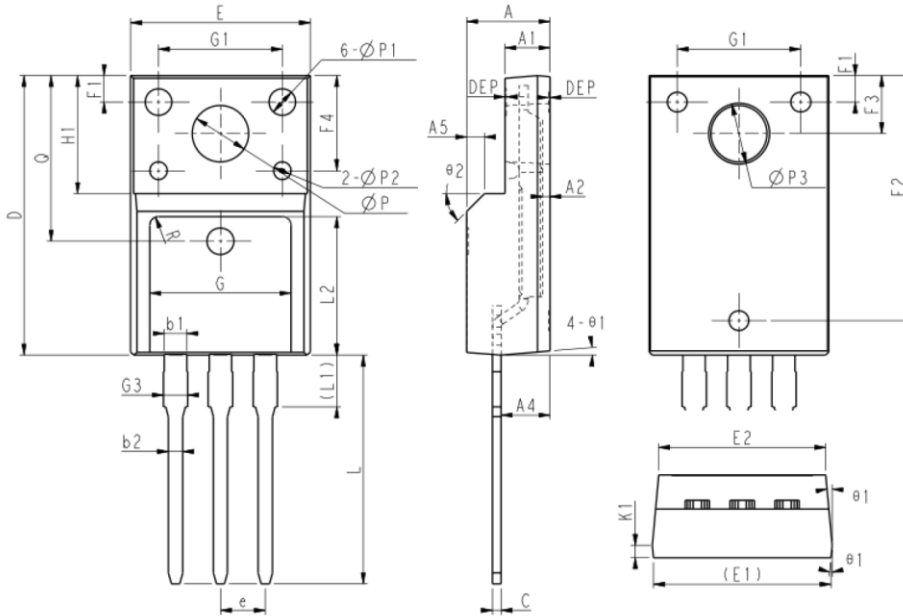
Unclamped Inductive Switching Test Circuit & Waveforms

Test Circuit & Waveform



Peak Diode Recovery  $dv/dt$  Test Circuit & Waveforms

## Package



COMMON DIMENSIONS

SYMBOL	MM		
	MIN	NOM	MAX
E	10.00	10.16	10.32
E1	9.94	10.04	10.14
E2	9.36	9.46	9.56
A	4.50	4.70	4.90
A1	2.34	2.54	2.74
A2	0.43	-	0.48
A4	2.66	2.76	2.86
A5	1.00REF		
c	0.45	0.50	0.60
D	15.67	15.87	16.07
Q	9.40REF		
H1	6.70REF		
e	2.54BSC		
ΦP	3.18REF		
L	12.78	12.98	13.18
L1	2.83	2.93	3.03
L2	7.70	7.80	7.90
ΦP1	1.40	1.50	1.60
ΦP2	0.95	1.00	1.05
ΦP3	3.45REF		
θ1	3°	5°	7°
θ2	45°		
DEP	0.05	0.10	0.15
F1	1.00	1.50	2.00
F2	13.80	13.90	14.00
F3	3.20	3.30	3.40
F4	5.30	5.40	5.50
G	7.80	8.00	8.20
G1	6.90	7.00	7.10
G3	1.25	1.35	1.45
b1	1.23	1.28	1.38
b2	0.75	0.80	0.90
K1	0.65	0.70	0.75
R	0.50REF		

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