Oct 2013

SemiHow
Know-How for Semiconductor

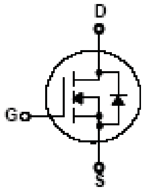
HFS10N65U

650V N-Channel MOSFET

BV_{DSS} = 650 V
$R_{DS(on)\ typ}$ = 0.8 Ω
I_D = 9.5 A

TO-220F

1.Gate 2. Drain 3. Source



FEATURES

- ☐ Originative New Design
- ☐ Superior Avalanche Rugged Technology
- ☐ Robust Gate Oxide Technology
- ☐ Very Low Intrinsic Capacitances
- ☐ Excellent Switching Characteristics
- ☐ Unrivalled Gate Charge : 29 nC (Typ.)
- ☐ Extended Safe Operating Area
- ☐ Lower $R_{DS(ON)}$: 0.8 Ω (Typ.) @V_{GS}=10V
- ☐ 100% Avalanche Tested

Absolute Maximum Ratings

T_C=25℃ unless otherwise specified

Symbol	Parameter	Value	Units
V_{DSS}	Drain-Source Voltage	650	V
I_D	Drain Current – Continuous (T_C = 25℃)	9.5*	A
	Drain Current – Continuous (T_C = 100℃)	6.0*	A
I_{DM}	Drain Current – Pulsed (Note 1)	38*	A
V_{GS}	Gate-Source Voltage	±30	V
E_{AS}	Single Pulsed Avalanche Energy (Note 2)	470	mJ
I_{AR}	Avalanche Current (Note 1)	9.5	A
E_{AR}	Repetitive Avalanche Energy (Note 1)	5.0	mJ
dv/dt	Peak Diode Recovery dv/dt (Note 3)	4.5	V/ns
P_D	Power Dissipation (T_C = 25℃)	50	W
	- Derate above 25℃	0.40	W/℃
T_J, T_{STG}	Operating and Storage Temperature Range	-55 to +150	℃
T_L	Maximum lead temperature for soldering purposes, 1/8" from case for 5 seconds	300	℃

* Drain current limited by maximum junction temperature

Thermal Resistance Characteristics

Symbol	Parameter	Typ.	Max.	Units
$R_{\theta JC}$	Junction-to-Case	--	2.5	℃/W
$R_{\theta JA}$	Junction-to-Ambient	--	62.5	

Package Marking and Odering Information

Device Marking	Week Marking	Package	Packing	Quantity	RoHS Status
HFS10N65U	YWWX	TO-220F	Tube	50	Pb Free
HFS10N65U	YWWXg	TO-220F	Tube	50	Halogen Free

Electrical Characteristics T_C=25 °C unless otherwise specified

Symbol	Parameter	Test Conditions	Min	Typ	Max	Units
On Characteristics						
V_{GS}	Gate Threshold Voltage	V_{DS} = V_{GS}, I_D = 250 ㎂	2.5	--	4.5	V
$R_{DS(ON)}$	Static Drain-Source On-Resistance	V_{GS} = 10 V, I_D = 4.75 A	--	0.80	0.98	Ω
Off Characteristics						
BV_{DSS}	Drain-Source Breakdown Voltage	V_{GS} = 0 V, I_D = 250 ㎂	650	--	--	V
ΔBV_{DSS} / ΔT_J	Breakdown Voltage Temperature Coefficient	I_D = 250 ㎂, Referenced to 25℃	--	0.6	--	V/℃
I_{DSS}	Zero Gate Voltage Drain Current	V_{DS} = 650 V, V_{GS} = 0 V	--	--	1	㎂
		V_{DS} = 520 V, T_C = 125℃	--	--	10	㎂
I_{GSS}	Gate-Body Leakage Current	V_{GS} = ±30 V, V_{DS} = 0 V	--	--	±100	㎁
Dynamic Characteristics						
C_{iss}	Input Capacitance	V_{DS} = 25 V, V_{GS} = 0 V, f = 1.0 MHz	--	1600	2100	㎊
C_{oss}	Output Capacitance		--	140	180	㎊
C_{rss}	Reverse Transfer Capacitance		--	11	14.5	㎊
Switching Characteristics						
$t_{d(on)}$	Turn-On Time	V_{DS} = 325 V, I_D = 9.5 A, R_G = 25 Ω (Note 4,5)	--	50	100	㎱
t_r	Turn-On Rise Time		--	70	140	㎱
$t_{d(off)}$	Turn-Off Delay Time		--	160	320	㎱
t_f	Turn-Off Fall Time		--	60	120	㎱
Q_g	Total Gate Charge	V_{DS} = 520V, I_D = 9.5 A, V_{GS} = 10 V (Note 4,5)	--	29	38	nC
Q_{gs}	Gate-Source Charge		--	8.5	--	nC
Q_{gd}	Gate-Drain Charge		--	9	--	nC
Source-Drain Diode Maximum Ratings and Characteristics						
I_S	Continuous Source-Drain Diode Forward Current		--	--	9.5	A
I_{SM}	Pulsed Source-Drain Diode Forward Current		--	--	38	
V_{SD}	Source-Drain Diode Forward Voltage	I_S = 9.5 A, V_{GS} = 0 V	--	--	1.4	V
trr	Reverse Recovery Time	I_S = 9.5 A, V_{GS} = 0 V di_F/dt = 100 A/μs (Note 4)	--	340	--	㎱
Qrr	Reverse Recovery Charge		--	3.3	--	μC

Notes ;

1. Repetitive Rating : Pulse width limited by maximum junction temperature
2. L=9.6mH, I_{AS}=9.5A, V_{DD}=50V, R_G=25Ω, Starting T_J =25°C
3. I_{SD}≤9.5A, 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

Typical Characteristics

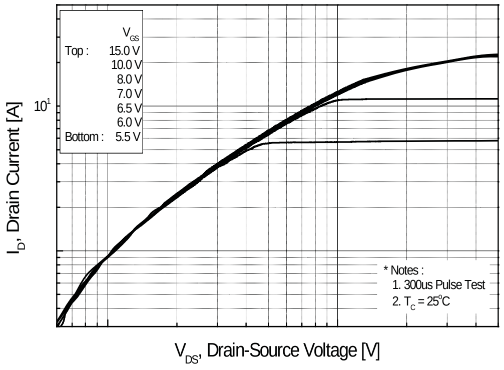


Figure 1. On Region Characteristics

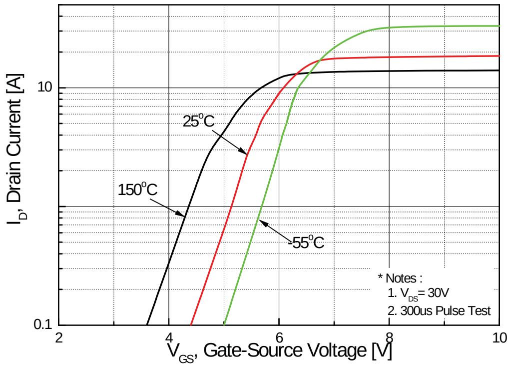


Figure 2. Transfer Characteristics

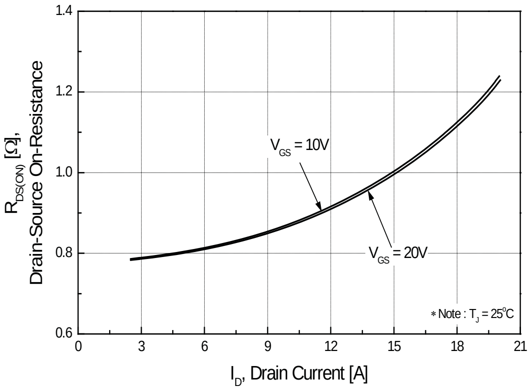


Figure 3. On Resistance Variation vs Drain Current and Gate Voltage

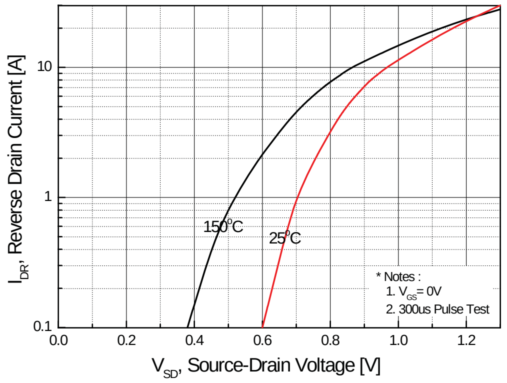


Figure 4. Body Diode Forward Voltage Variation with Source Current and Temperature

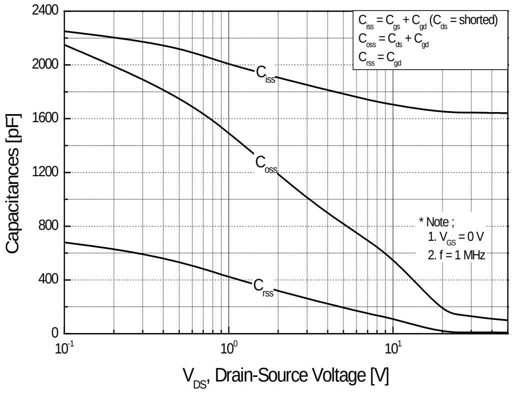


Figure 5. Capacitance Characteristics

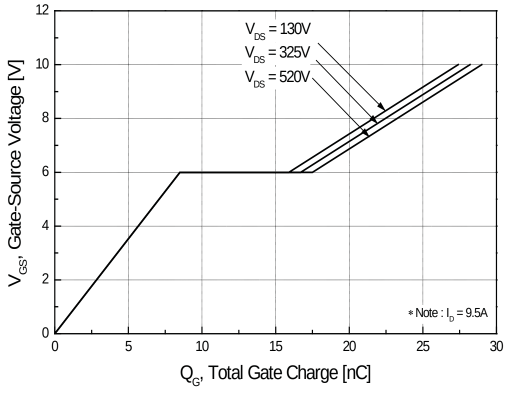


Figure 6. Gate Charge Characteristics

Typical Characteristics

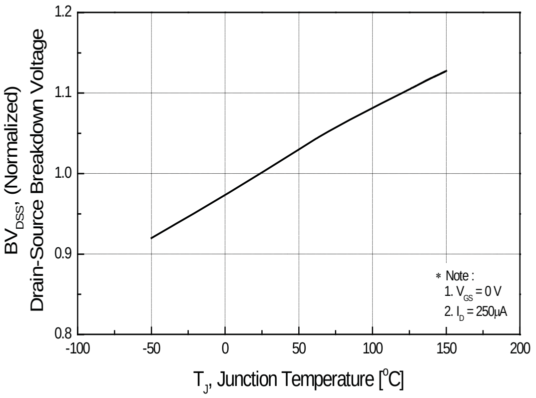


Figure 7. Breakdown Voltage Variation vs Temperature

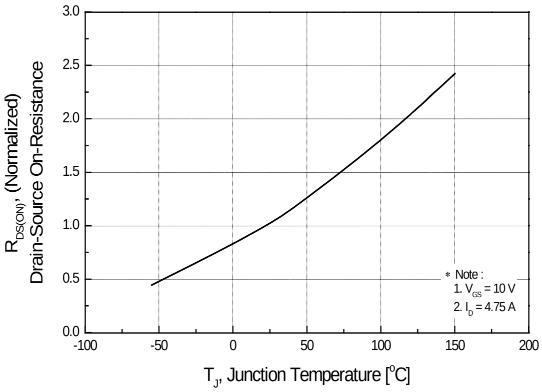


Figure 8. On-Resistance Variation vs Temperature

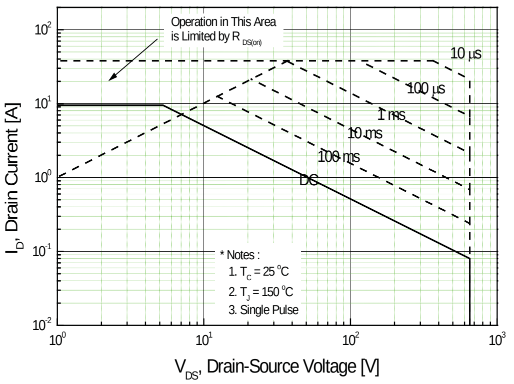


Figure 9. Maximum Safe Operating Area

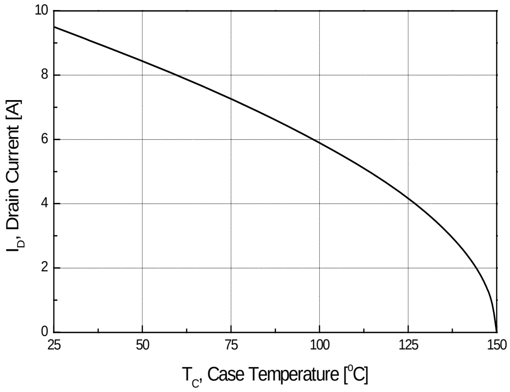


Figure 10. Maximum Drain Current vs Case Temperature

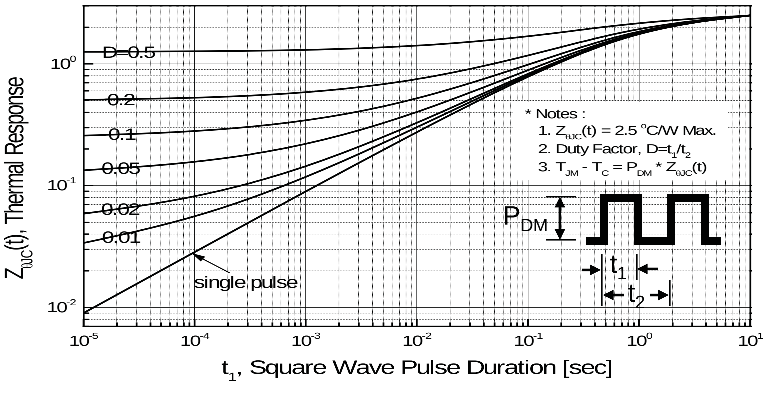


Figure 11. Transient Thermal Response Curve

Fig 12. Gate Charge Test Circuit & Waveform

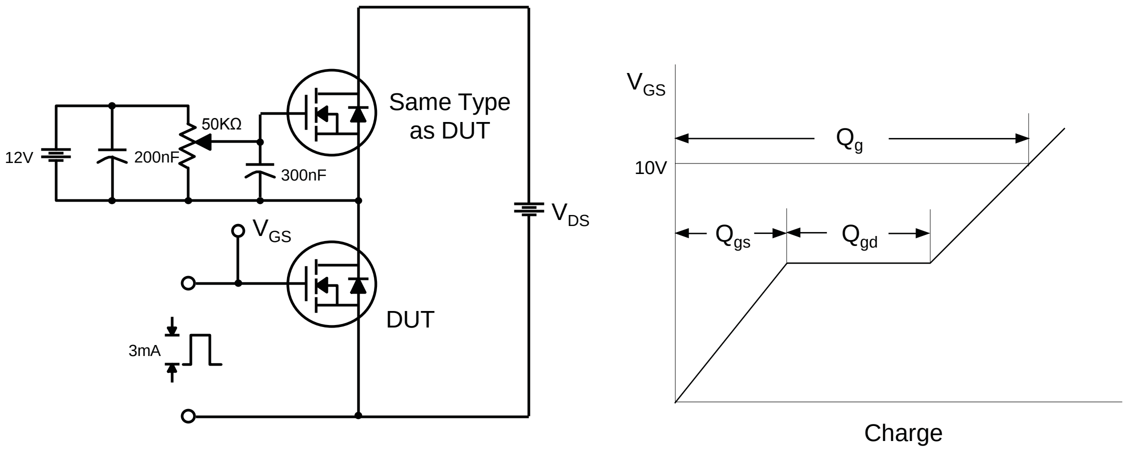


Fig 13. Resistive Switching Test Circuit & Waveforms

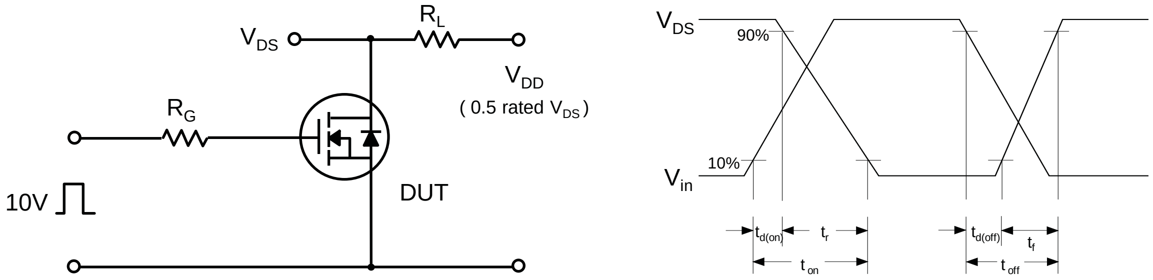
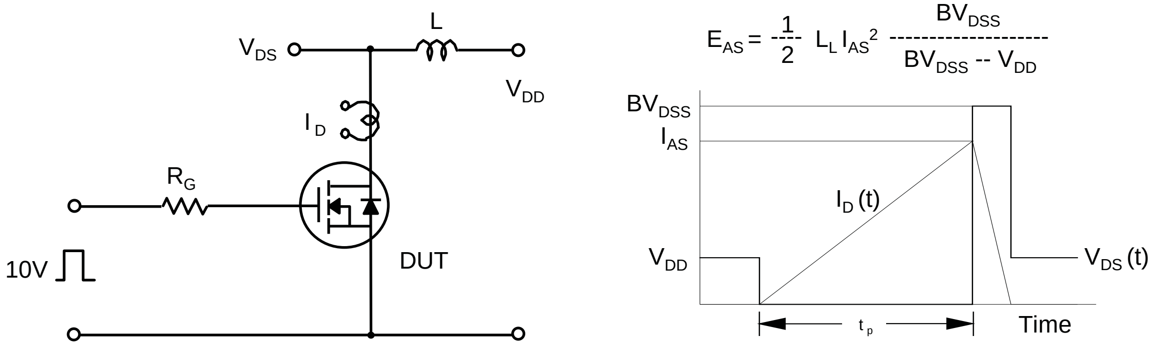


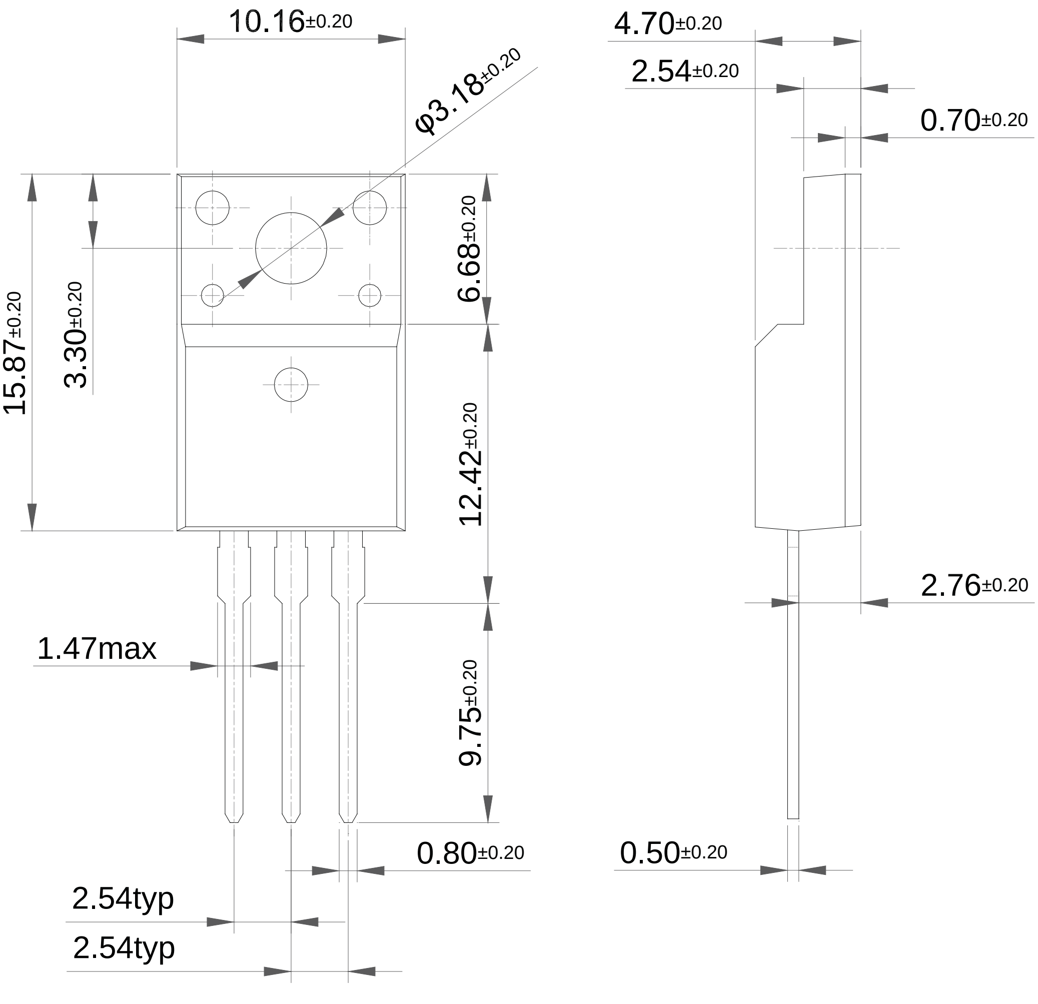
Fig 14. Unclamped Inductive Switching Test Circuit & Waveforms



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

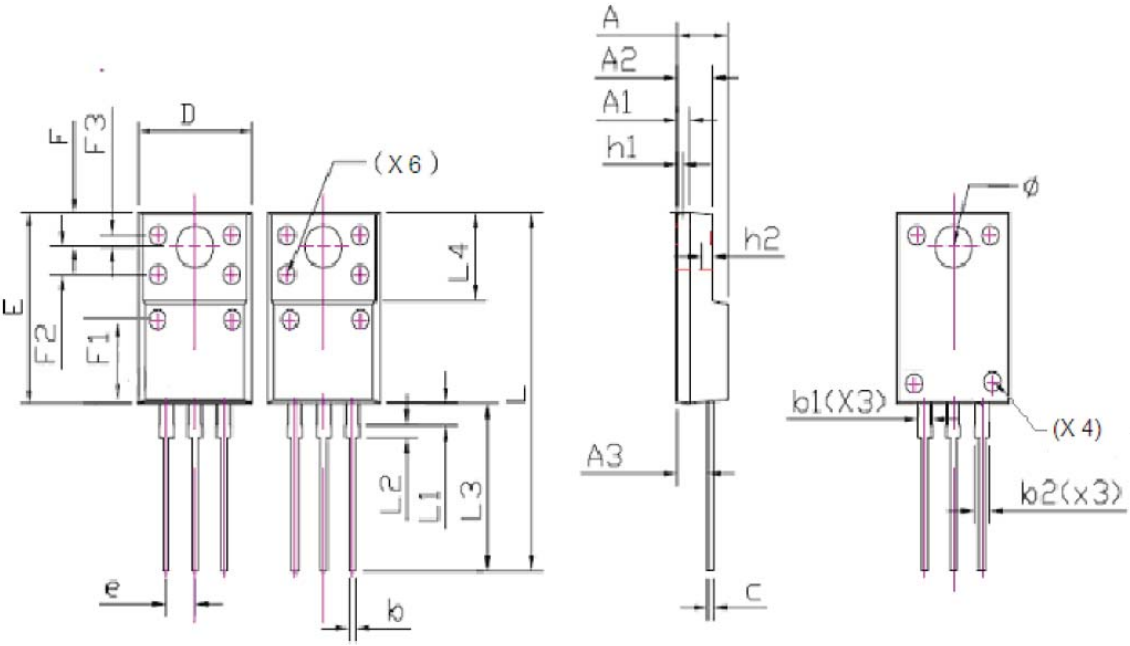
Package Dimension

TO-220F (A)



Package Dimension

TO-220F (B)



Symbol	Dimensions In Millimeters		Dimensions In Inches	
	Min.	Max.	Min.	Max.
A	4.300	4.700	0.169	0.185
A1	1.300 REF.		0.051 REF.	
A2	2.800	3.300	0.110	0.130
A3	2.500	2.900	0.098	0.114
b	0.500	0.750	0.020	0.030
b1	1.150	1.300	0.045	0.051
b2	1.150	1.400	0.045	0.055
c	0.500	0.750	0.020	0.030
D	9.900	10.360	0.390	0.408
E	14.800	15.200	0.583	0.598
e	2.540 TYP.		0.100 TYP.	
F	2.700 REF.		0.106 REF.	
F1	6.300 REF.		0.248 REF.	
F2	2.200 REF.		0.087 REF.	
F3	0.900 REF.		0.035 REF.	
Φ	3.200	3.500	0.126	0.138
h1	0.500 REF.		0.020 REF.	
h2	0.800 REF.		0.031 REF.	
L	28.000	29.000	1.102	1.142
L1	1.400	1.800	0.055	0.071
L2	1.200	2.000	0.047	0.079
L3	13.0	13.8	0.512	0.543
L4	7.000 REF.		0.276 REF.	