SGS-THOMSON MICROELECTRONICS

BUH515FP

HIGH VOLTAGE FAST-SWITCHING NPN POWER TRANSISTOR

- HIGH VOLTAGE CAPABILITY
- FULLY MOLDED ISOLATED PACKAGE
- 2000 V DC ISOLATION (U.L. COMPLIANT)

APPLICATIONS:

- HORIZONTAL DEFLECTION FOR COLOUR TV AND MONITORS
- SWITCH MODE POWER SUPPLIES

TO-220FP

DESCRIPTION

The BUH515FP is manufactured using Multiepitaxial Mesa technology for cost-effective high performance and uses a Hollow Emitter structure to enhance switching speeds.

The BUH series is designed for use in horizontal deflection circuits in televisions and monitors.

INTERNAL SCHEMATIC DIAGRAM

C o (2)

B o (1)

E o (3)

SC06960
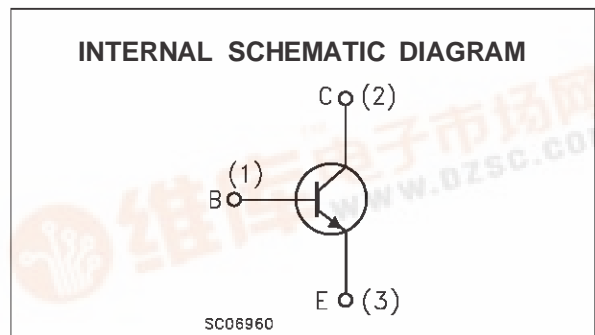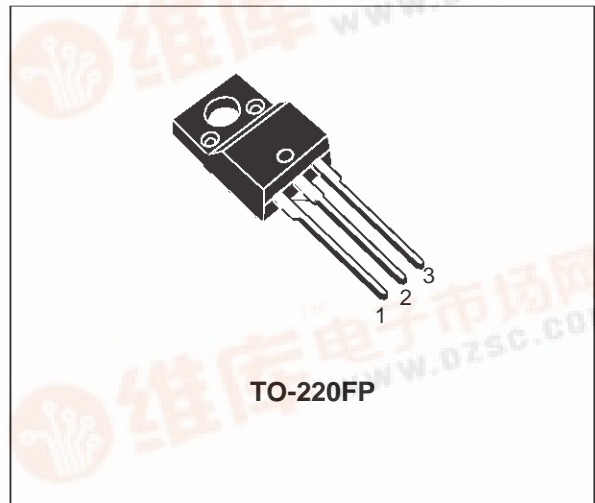
ABSOLUTE MAXIMUM RATINGS

Symbol	Parameter	Value	Unit
V_{CBO}	Collector-Base Voltage ($I_E = 0$)	1500	V
V_{CEO}	Collector-Emitter Voltage ($I_B = 0$)	700	V
V_{EBO}	Emitter-Base Voltage ($I_C = 0$)	10	V
I_C	Collector Current	8	A
I_{CM}	Collector Peak Current ($t_p < 5$ ms)	12	A
I_B	Base Current	5	A
I_{BM}	Base Peak Current ($t_p < 5$ ms)	8	A
P_{tot}	Total Dissipation at $T_c = 25\ ^{\circ}C$	38	W
T_{stg}	Storage Temperature	-65 to 150	$^{\circ}C$
T_j	Max. Operating Junction Temperature	150	$^{\circ}C$

THERMAL DATA

$R_{thj\text{-}case}$	Thermal Resistance Junction-case	Max	3.3	°C/W

ELECTRICAL CHARACTERISTICS (T_{case} = 25 °C unless otherwise specified)

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
I_{CES}	Collector Cut-off Current (V_{BE} = 0)	V_{CE} = 1500 V V_{CE} = 1500 V T_j = 125 °C			0.2 2	mA mA
I_{EBO}	Emitter Cut-off Current (I_C = 0)	V_{EB} = 5 V			100	μA
$V_{CEO(sus)}$	Collector-Emitter Sustaining Voltage	I_C = 100 mA	700			V
V_{EBO}	Emitter-Base Voltage (I_C = 0)	I_E = 10 mA	10			V
$V_{CE(sat)}*$	Collector-Emitter Saturation Voltage	I_C = 5 A I_B = 1.25 A			1.5	V
$V_{BE(sat)}*$	Base-Emitter Saturation Voltage	I_C = 5 A I_B = 1.25 A			1.3	V
$h_{FE}*$	DC Current Gain	I_C = 5 A V_{CE} = 5 V I_C = 5 A V_{CE} = 5 V T_j = 100 °C	6 4		12	
t_s t_f	RESISTIVE LOAD Storage Time Fall Time	V_{CC} = 400 V I_C = 5 A I_{B1} = 1.25 A I_{B2} = 2.5 A		2.7 190	3.9 280	μs ns
t_s t_f	INDUCTIVE LOAD Storage Time Fall Time	I_C = 5 A f = 15625 Hz I_{B1} = 1.25 A I_{B2} = -1.5 A $V_{ceflyback} = 1050\ \sin\!\left(\dfrac{\pi}{5}10^6\right)t$ V		2.3 350		μs ns
t_s t_f	INDUCTIVE LOAD Storage Time Fall Time	I_C = 5A f = 31250 Hz I_{B1} = 1.25 A I_{B2} = -1.5 A $V_{ceflyback} = 1200\ \sin\!\left(\dfrac{\pi}{5}10^6\right)t$ V		2.3 200		μs ns

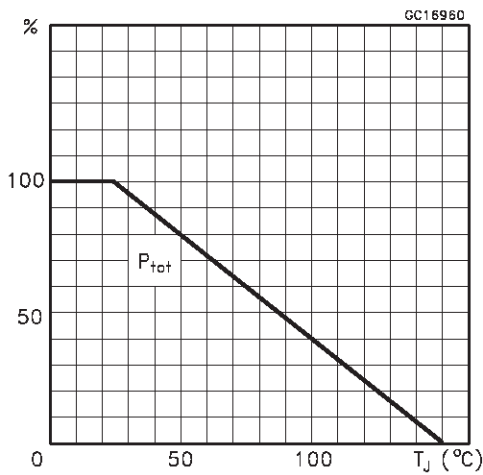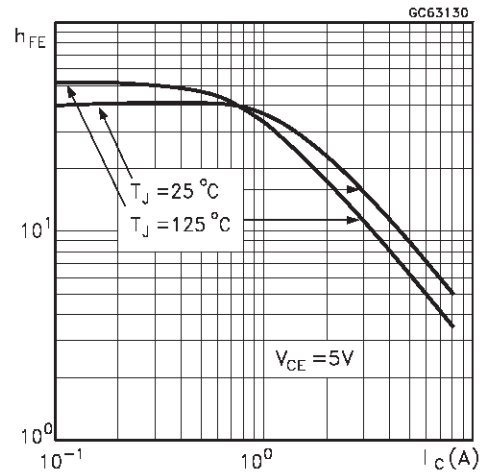∗ Pulsed: Pulse duration = 300 μs, duty cycle 1.5 %
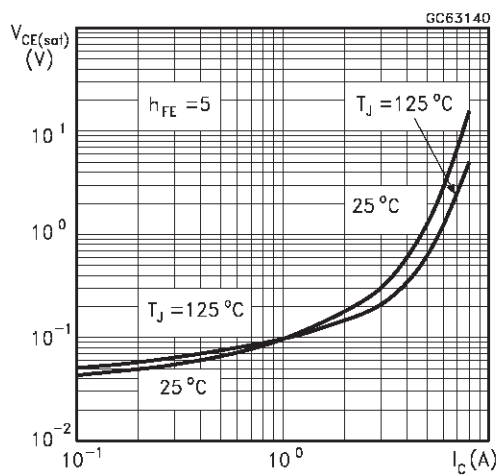
Safe Operating Area

Thermal Impedance

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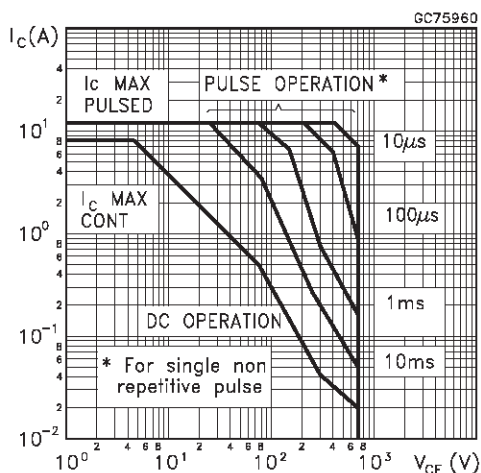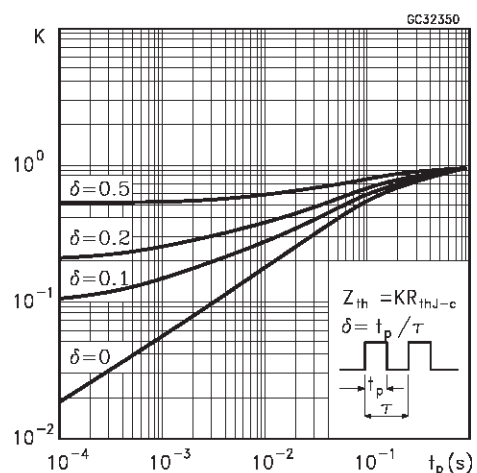
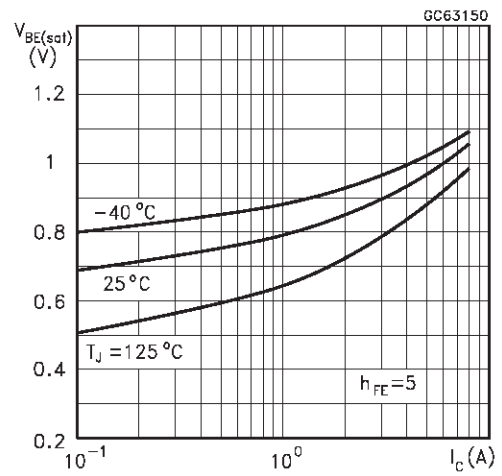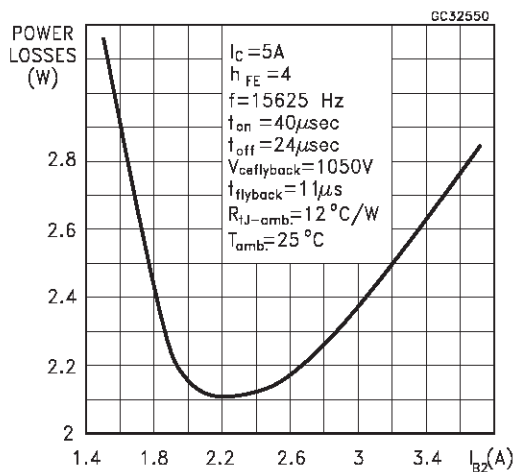## Derating Curve

DC Current Gain
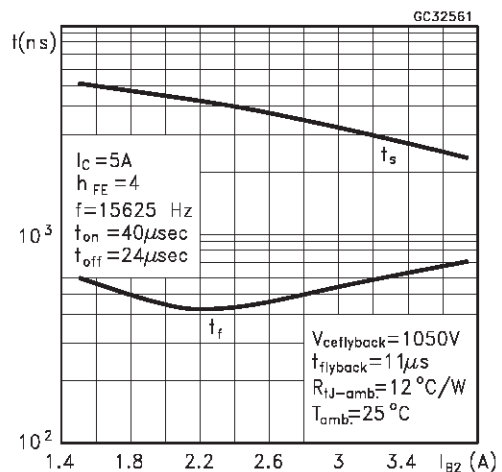

Collector Emitter Saturation Voltage

Base Emitter Saturation Voltage

Power Losses at 16 KHz
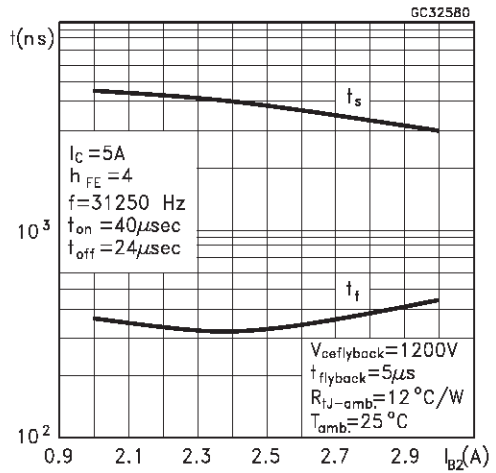

Switching Time Inductive Load at 16KHz
(see figure 2)

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Power Losses at 32 KHz

```
GC32570
POWER
LOSSES
(W)
        I_C = 5A
        h_FE = 4
        f = 31250 Hz
        t_on = 40μsec
        t_off = 24μsec
4.5     V_ceflyback = 1200V
        t_flyback = 5μs
        R_tJ-amb = 12 °C/W
4.4     T_amb = 25 °C

4.3

4.2

4.1
   1.9  2.1  2.3  2.5  2.7  2.9   I_B2(A)
```
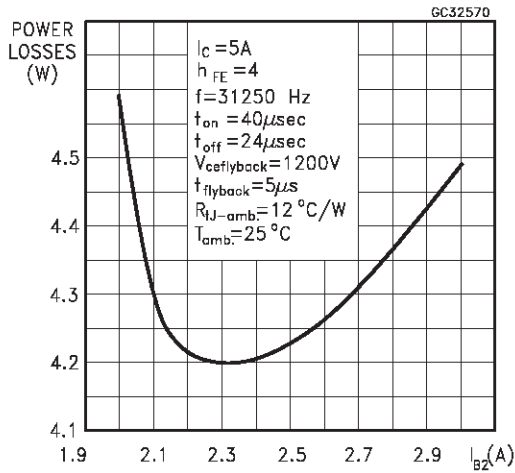
Switching Time Inductive Load at 32 KHz (see figure 2)

```
GC32580
t(ns)
                                    t_s

        I_C = 5A
        h_FE = 4
        f = 31250 Hz
10³     t_on = 40μsec
        t_off = 24μsec

                                    t_f

                          V_ceflyback = 1200V
                          t_flyback = 5μs
                          R_tJ-amb = 12 °C/W
10²                       T_amb = 25 °C
   0.9  2.1  2.3  2.5  2.7  2.9   I_B2(A)
```

Reverse Biased SOA

```
GC17090
I_C(A)

            h_FE = 5
            R_BB(off) = 0 Ω
12          V_BE(off) = -5V
            T_C ≤ 125 °C
10

8

6

4

2

0
  10⁰      10¹      10²      10³      V_CE (V)
```
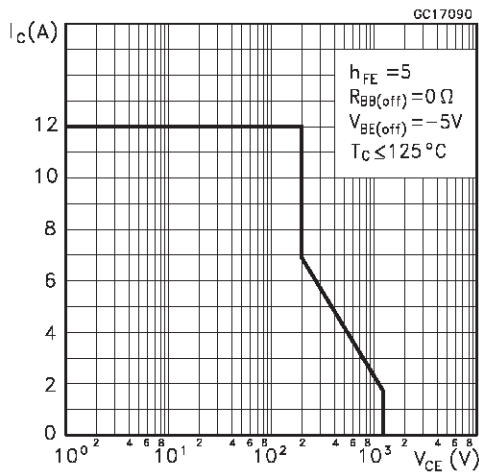
Switching Time Resistive Load

```
GC32590
t(ns)
                        I_C = 5V
                        h_FE = 4
            t_s         V_CC = 400V
                        T_C = 25 °C

10³

            t_f

10²
   1.1  1.5  1.9  2.3  2.7  3.1   I_B2(A)
```
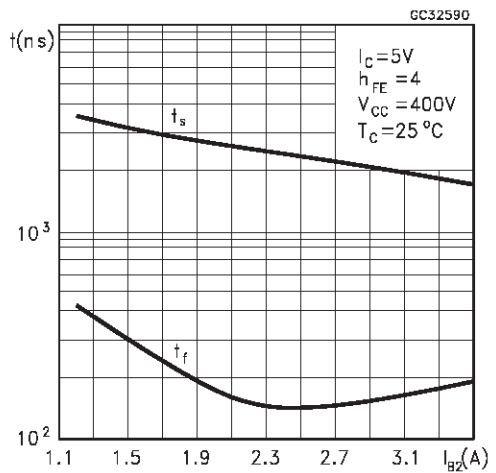
BASE DRIVE INFORMATION

In order to saturate the power switch and reduce conduction losses, adequate direct base current I_{B1} has to be provided for the lowest gain h_{FE} at 100 °C (line scan phase). On the other hand, negative base current I_{B2} must be provided to turn off the power transistor (retrace phase).

Most of the dissipation, in the deflection application, occurs at switch-off. Therefore it is essential to determine the value of I_{B2} which minimizes power losses, fall time t_f and, consequently, T_j. A new set of curves have been defined to give total power losses, t_s and t_f as a function of I_{B2} at both 16 KHz and 32 KHz scanning frequencies for choosing the optimum negative drive. The test circuit is illustrated in figure 1.

Inductance L_1 serves to control the slope of the negative base current I_{B2} to recombine the excess carrier in the collector when base current is still present, this would avoid any tailing phenomenon in the collector current.

The values of L and C are calculated from the following equations:

$$\frac{1}{2} L (I_C)^2 = \frac{1}{2} C (V_{CEfly})^2 \qquad \omega = 2 \pi f = \frac{1}{\sqrt{L C}}$$

Where I_C= operating collector current, V_{CEfly}= flyback voltage, f= frequency of oscillation during retrace.

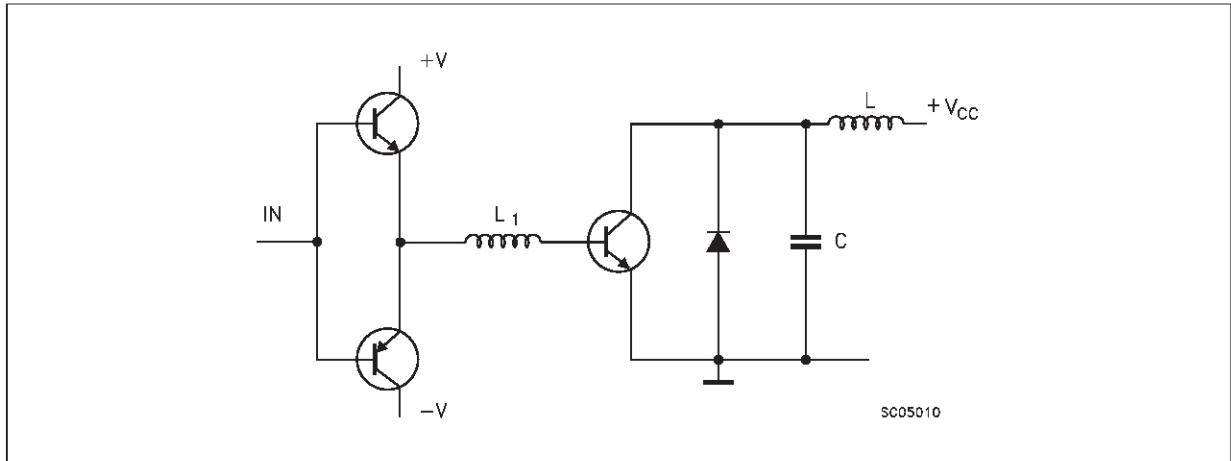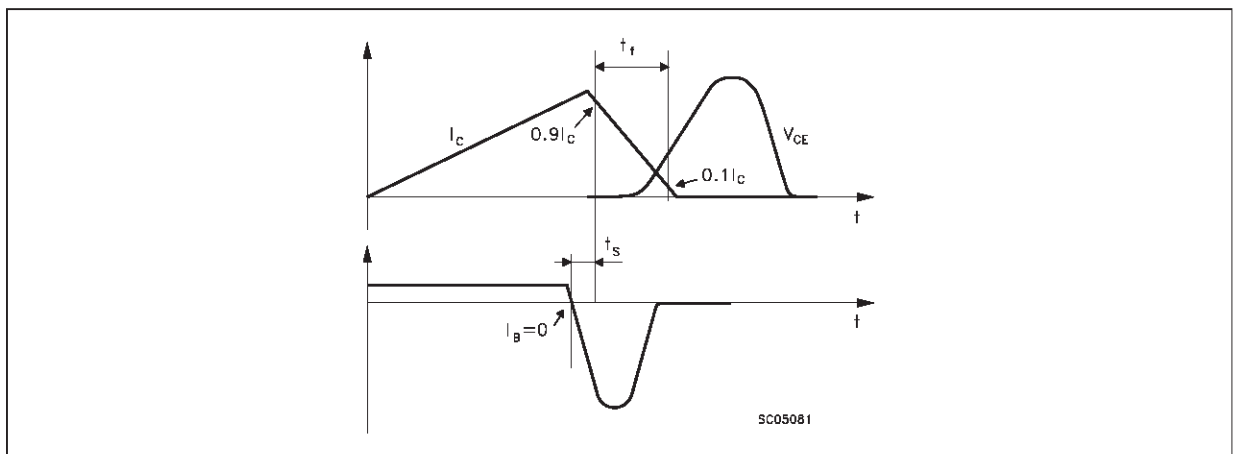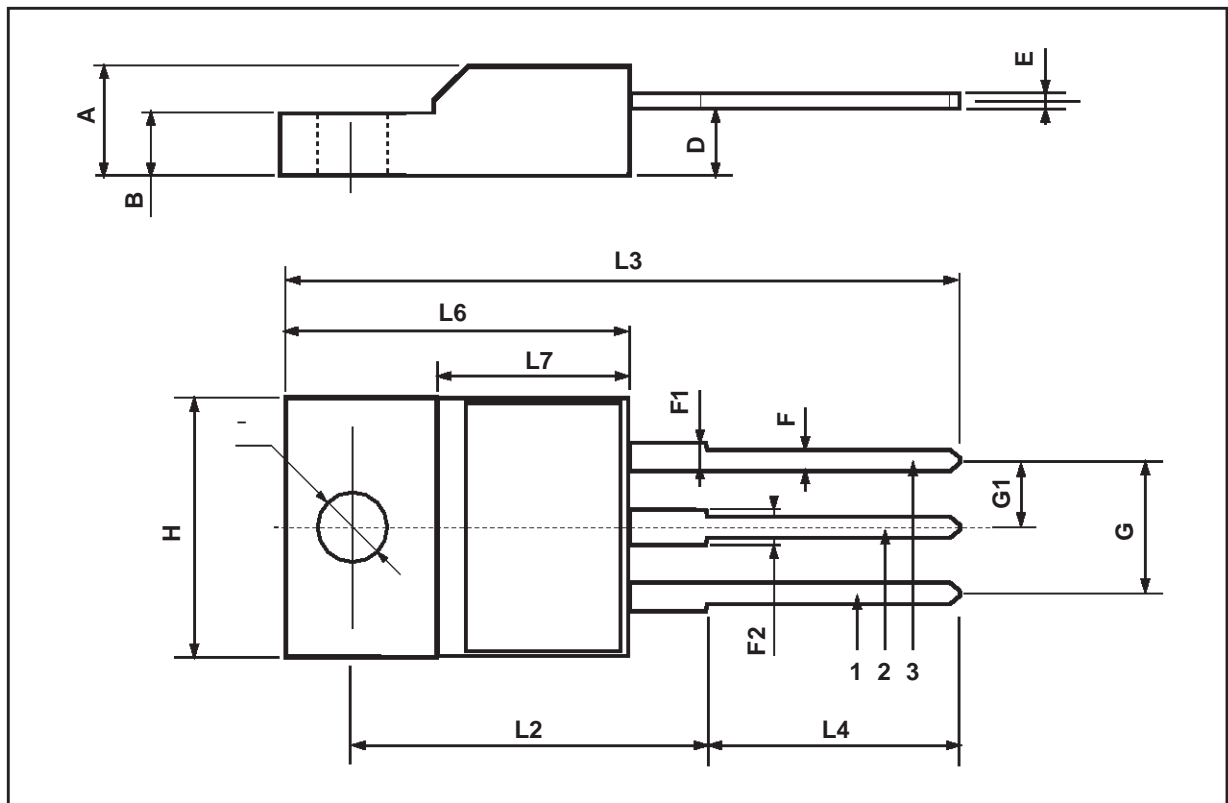**Figure 1:** Inductive Load Switching Test Circuit.

Figure 2: Switching Waveforms in a Deflection Circuit

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TO-220FP MECHANICAL DATA

DIM.	mm			inch		
	MIN.	TYP.	MAX.	MIN.	TYP.	MAX.
A	4.4		4.6	0.173		0.181
B	2.5		2.7	0.098		0.106
D	2.5		2.75	0.098		0.108
E	0.45		0.7	0.017		0.027
F	0.75		1	0.030		0.039
F1	1.15		1.7	0.045		0.067
F2	1.15		1.7	0.045		0.067
G	4.95		5.2	0.195		0.204
G1	2.4		2.7	0.094		0.106
H	10		10.4	0.393		0.409
L2		16			0.630	
L3	28.6		30.6	1.126		1.204
L4	9.8		10.6	0.385		0.417
L6	15.9		16.4	0.626		0.645
L7	9		9.3	0.354		0.366
Ø	3		3.2	0.118		0.126

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