

## RADIATION HARDENED NPN POWER SILICON TRANSISTOR

*Qualified per MIL-PRF-19500/544*

Qualified Levels:  
JANSM, JANSJ,  
JANSP, JANSL,  
JANSR, JANSF

### DESCRIPTION

These RHA level 2N5152U3 and 2N5154U3 silicon transistor devices are military Radiation Hardness Assurance qualified up to a JANSF level for high-reliability applications. Microsemi also offers numerous other products to meet higher and lower power voltage regulation applications.

**Important:** For the latest information, visit our website <http://www.microsemi.com>.

### FEATURES

- JEDEC registered 2N5152 and 2N5154.
- JANS RHA qualifications are available per MIL-PRF-19500/544.

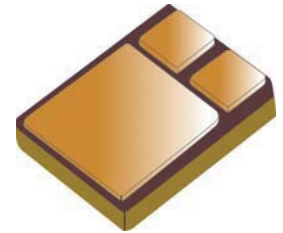
### APPLICATIONS / BENEFITS

- High frequency operation.
- Lightweight.
- High-speed power-switching applications.
- High-reliability applications.

### MAXIMUM RATINGS


Parameters/Test Conditions	Symbol	Value	Unit
Junction and Storage Temperature	$T_J$ and $T_{STG}$	-65 to +200	°C
Thermal Resistance Junction-to-Ambient	$R_{\theta JA}$	175	°C/W
Thermal Resistance Junction-to-Case	$R_{\theta JC}$	10	°C/W
Reverse Pulse Energy <sup>(1)</sup>		15	mJ
Collector Current (dc)	$I_C$	2	A
Collector to base voltage (static), emitter open	$V_{CBO}$	100	V
Collector to emitter voltage (static) base open	$V_{CEO}$	80	V
Emitter to base voltage (static) collector open	$V_{EBO}$	5.5	V
Steady-State Power Dissipation @ $T_A = +25\text{ °C}$	$P_D$	1	W
Steady-State Power Dissipation @ $T_C = +25\text{ °C}$	$P_D$	10	W


**Notes:** 1. This rating is based on the capability of the transistors to operate safely in the unclamped inductive load energy test circuit.



**U3 (SMD-0.5)  
Package**

Also available in:

 **TO-5 Package**  
(long-leaded)  
JANS\_2N5152L &  
JANS\_2N5154L

 **TO-39 Package**  
(leaded)  
JANS\_2N5152 &  
JANS\_2N5154

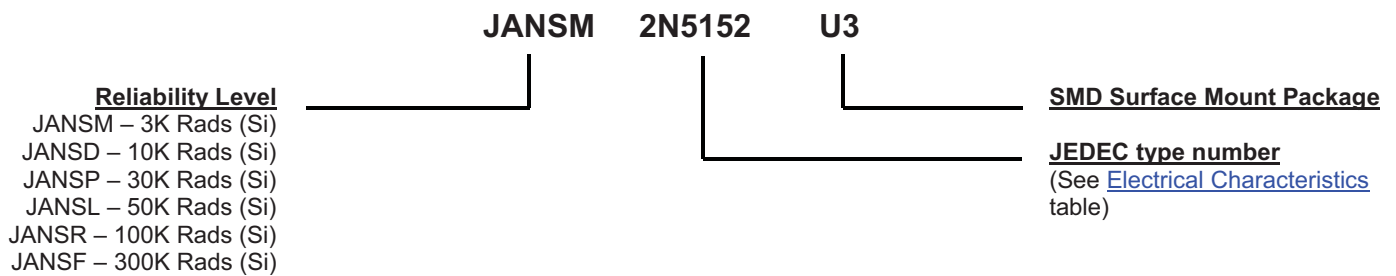
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6 Lake Street,  
Lawrence, MA 01841  
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**Website:**  
[www.microsemi.com](http://www.microsemi.com)

**MECHANICAL and PACKAGING**

- CASE: Ceramic and gold over nickel plated steel.
- TERMINALS: Gold over nickel plated tungsten/copper.
- MARKING: Part number, date code, A = anode.
- POLARITY: See [schematic](#) on last page.
- WEIGHT: 0.9 grams.
- See [Package Dimensions](#) on last page.

**PART NOMENCLATURE**

**SYMBOLS & DEFINITIONS**

Symbol	Definition
$C_{obo}$	Common-base open-circuit output capacitance.
$I_{CEO}$	Collector cutoff current, base open.
$I_{CEX}$	Collector cutoff current, circuit between base and emitter.
$I_{EBO}$	Emitter cutoff current, collector open.
$h_{FE}$	Common-emitter static forward current transfer ratio.
$V_{CEO}$	Collector-emitter voltage, base open.
$V_{CBO}$	Collector-emitter voltage, emitter open.
$V_{EBO}$	Emitter-base voltage, collector open.

**ELECTRICAL CHARACTERISTICS @  $T_A = +25^\circ\text{C}$  unless otherwise noted.**
**OFF CHARACTERISTICS**

Parameters / Test Conditions	Symbol	Min.	Max.	Unit
Collector-Emitter Breakdown Voltage $I_C = 100\text{ mA}, I_B = 0$	$V_{(BR)CEO}$	80		V
Emitter-Base Cutoff Current $V_{EB} = 4.0\text{ V}, I_C = 0$ $V_{EB} = 5.5\text{ V}, I_C = 0$	$I_{EBO}$		1.0 1.0	$\mu\text{A}$ mA
Collector-Emitter Cutoff Current $V_{CE} = 60\text{ V}, V_{BE} = 0$ $V_{CE} = 100\text{ V}, V_{BE} = 0$	$I_{CES}$		1.0 1.0	$\mu\text{A}$ mA
Collector-Emitter Cutoff Current $V_{CE} = 40\text{ V}, I_B = 0$	$I_{CEO}$		50	$\mu\text{A}$

**ON CHARACTERISTICS**

Parameters / Test Conditions	Symbol	Min.	Max.	Unit
Forward-Current Transfer Ratio $I_C = 50\text{ mA}, V_{CE} = 5\text{ V}$	$h_{FE}$	20	--	
2N5152U3		50	--	
$I_C = 2.5\text{ A}, V_{CE} = 5\text{ V}$		30	90	
2N5154U3		70	200	
$I_C = 5\text{ A}, V_{CE} = 5\text{ V}$		20	--	
2N5154U3		40	--	
Collector-Emitter Saturation Voltage $I_C = 2.5\text{ A}, I_B = 250\text{ mA}$ $I_C = 5.0\text{ A}, I_B = 500\text{ mA}$	$V_{CE(sat)}$		0.75 1.5	V
Base-Emitter Voltage Non-Saturation $I_C = 2.5\text{ A}, V_{CE} = 5\text{ V}$	$V_{BE}$		1.45	V
Base-Emitter Saturation Voltage $I_C = 2.5\text{ A}, I_B = 250\text{ mA}$ $I_C = 5.0\text{ A}, I_B = 500\text{ mA}$	$V_{BE(sat)}$		1.45 2.2	V

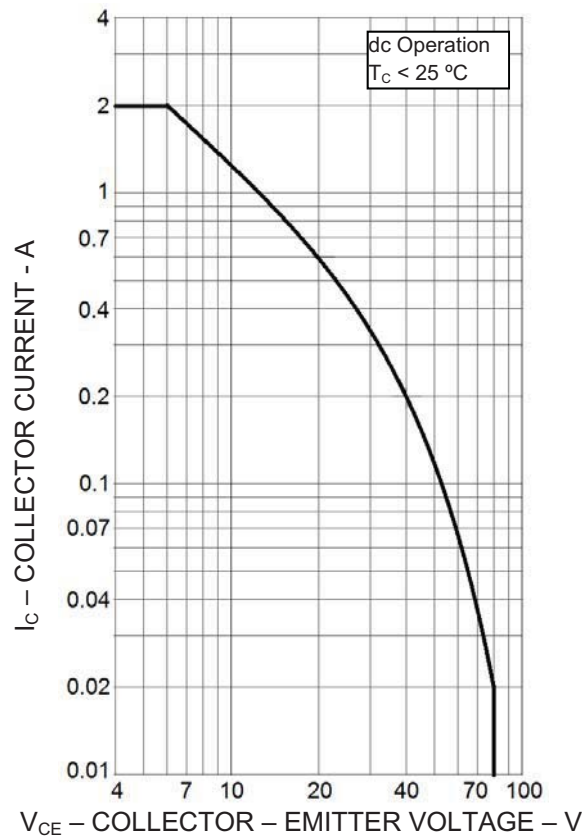
**DYNAMIC CHARACTERISTICS**

Parameters / Test Conditions	Symbol	Min.	Max.	Unit
Magnitude of Common Emitter Small-Signal Short-Circuit Forward Current Transfer Ratio 2N5152U3 2N5154U3 $I_C = 500\text{ mA}, V_{CE} = 5\text{ V}, f = 10\text{ MHz}$	$ h_{fe} $	6 7		
Small-signal short Circuit Forward-Current Transfer Ratio 2N5152U3 2N5154U3 $I_C = 100\text{ mA}, V_{CE} = 5\text{ V}, f = 1\text{ KHz}$	$h_{fe}$	20 50		
Output Capacitance $V_{CB} = 10\text{ V}, I_E = 0, f = 1.0\text{ MHz}$	$C_{obo}$		250	pF

**ELECTRICAL CHARACTERISTICS @  $T_A = +25^\circ\text{C}$  unless otherwise noted. (continued)**
**SWITCHING CHARACTERISTICS**

Parameters / Test Conditions	Symbol	Min.	Max.	Unit
Turn-On Time $I_C = 5\text{ A}, I_{B1} = 500\text{ mA}$	$t_{on}$		0.5	$\mu\text{s}$
Turn-Off Time $R_L = 6\Omega$	$t_{off}$		1.5	$\mu\text{s}$
Storage Time $I_{B2} = -500\text{ mA}$	$t_s$		1.4	$\mu\text{s}$
Fall Time $V_{BE(OFF)} = 3.7\text{ V}$	$t_f$		0.5	$\mu\text{s}$

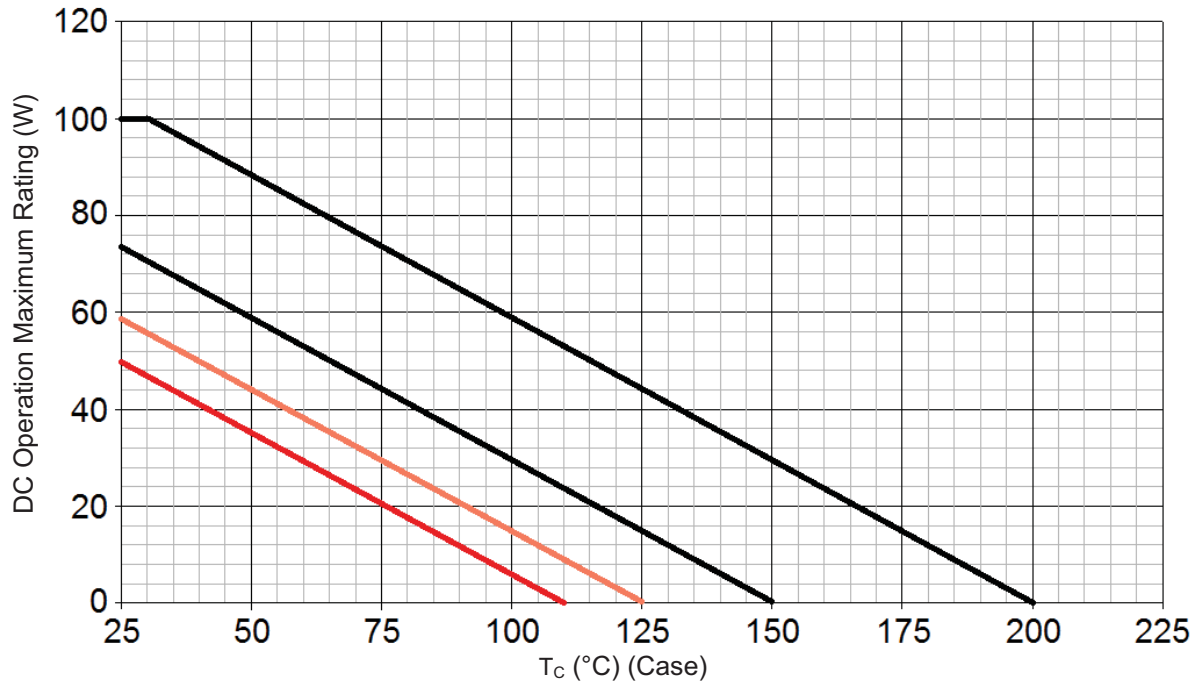
**SAFE OPERATING AREA** (See SOA graph below and [MIL-STD-750, method 3053](#))

**DC Tests**
 $T_C = +25^\circ\text{C}, t_p = 1.0\text{ s}, 1\text{ Cycle}$ 
**Test 1**
 $V_{CE} = 5.0\text{ V}, I_C = 2.0\text{ A}$ 
**Test 2**
 $V_{CE} = 32\text{ V}, I_C = 310\text{ mA}$ 
**Test 3**
 $V_{CE} = 80\text{ V}, I_C = 12.5\text{ mA}$ 

Maximum Safe Operating Area

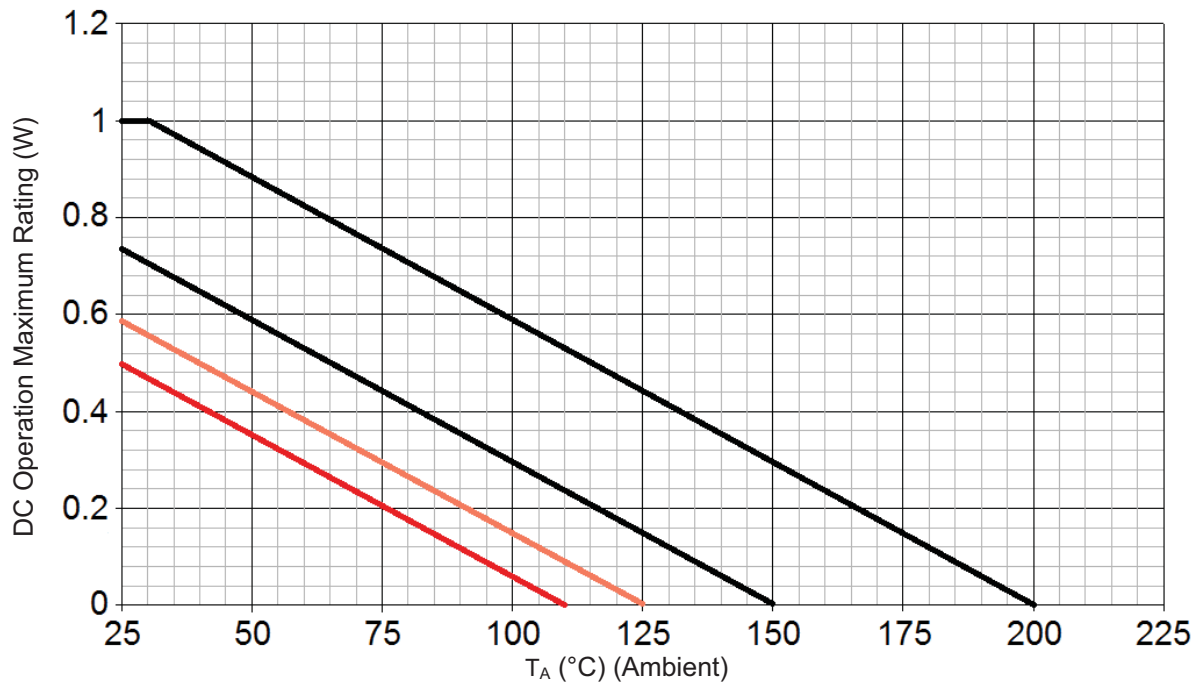
**ELECTRICAL CHARACTERISTICS @  $T_A = +25\text{ }^\circ\text{C}$ , unless otherwise noted (continued)**
**POST RADIATION ELECTRICAL CHARACTERISTICS**

Parameters / Test Conditions	Symbol	Min.	Max.	Unit
Collector to Emitter Cutoff Current $V_{CE} = 40\text{ V}$	$I_{CEO}$		100	$\mu\text{A}$
Emitter to Base Cutoff Current $V_{EB} = 4\text{ V}$	$I_{EBO}$		2.0	$\mu\text{A}$
Breakdown Voltage, Collector to Emitter $I_C = 100\text{ mA}$	$V_{(BR)CEO}$	80		V
Collector to Emitter Cutoff Current $V_{CE} = 60\text{ V}$	$I_{CES}$		2.0	$\mu\text{A}$
Emitter to Base Cutoff Current $V_{EB} = 5.5\text{ V}$	$I_{EBO}$		2.0	mA
Forward-Current Transfer Ratio <sup>(1)</sup> $I_C = 50\text{ mA}$ , $V_{CE} = 5\text{ V}$				
	2N5152U3	[10]		
	2N5154U3	[25]		
$I_C = 2.5\text{ A}$ , $V_{CE} = 5\text{ V}$				
	2N5152U3	[15]	90	
	2N5154U3	[35]	200	
$I_C = 5\text{ A}$ pulsed, $V_{CE} = 5\text{ V}$				
	2N5152U3	[10]		
	2N5154U3	[20]		
Base to Emitter voltage (non-saturated) $V_{CE} = 5\text{ V}$ , $I_C = 2.5\text{ A}$ , pulsed	$V_{BE}$		1.45	V
Collector-Emitter Saturation Voltage $I_C = 2.5\text{ mA}$ , $I_B = 250\text{ mA}$ , pulsed $I_C = 500\text{ mA}$ , $I_B = 500\text{ mA}$ , pulsed	$V_{CE(sat)}$		0.86 1.73	V
Base-Emitter Saturation Voltage $I_C = 2.5\text{ A}$ , $I_B = 250\text{ mA}$ , pulsed $I_C = 5\text{ A}$ , $I_B = 500\text{ mA}$ , pulsed	$V_{BE(sat)}$		1.67 2.53	V

- (1) See method 1019 of MIL-STD-750 for how to determine  $[h_{FE}]$  by first calculating the delta ( $1/h_{FE}$ ) from the pre- and post-radiation  $h_{FE}$ . Notice the  $[h_{FE}]$  is not the same as  $h_{FE}$  and cannot be measured directly. The  $[h_{FE}]$  value can never exceed the pre-radiation minimum  $h_{FE}$  that it is based upon.

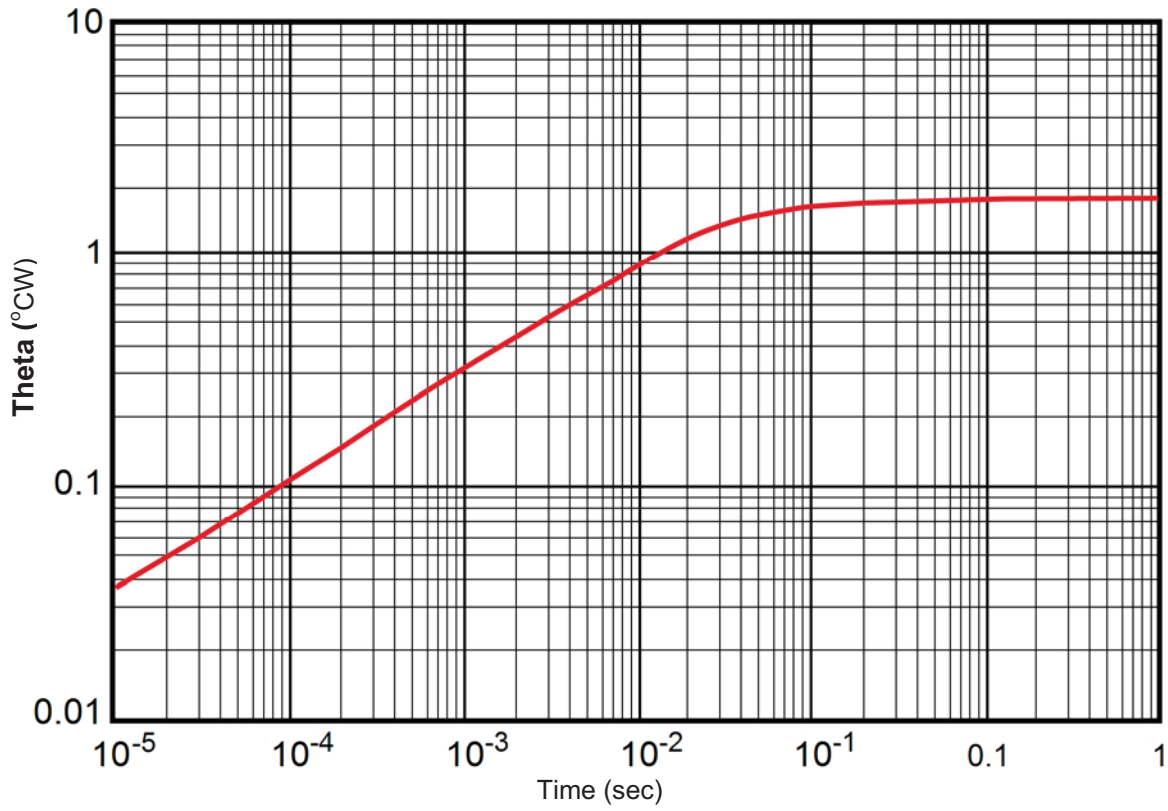
**GRAPHS**


**FIGURE 1**  
Temperature-Power Derating Curve

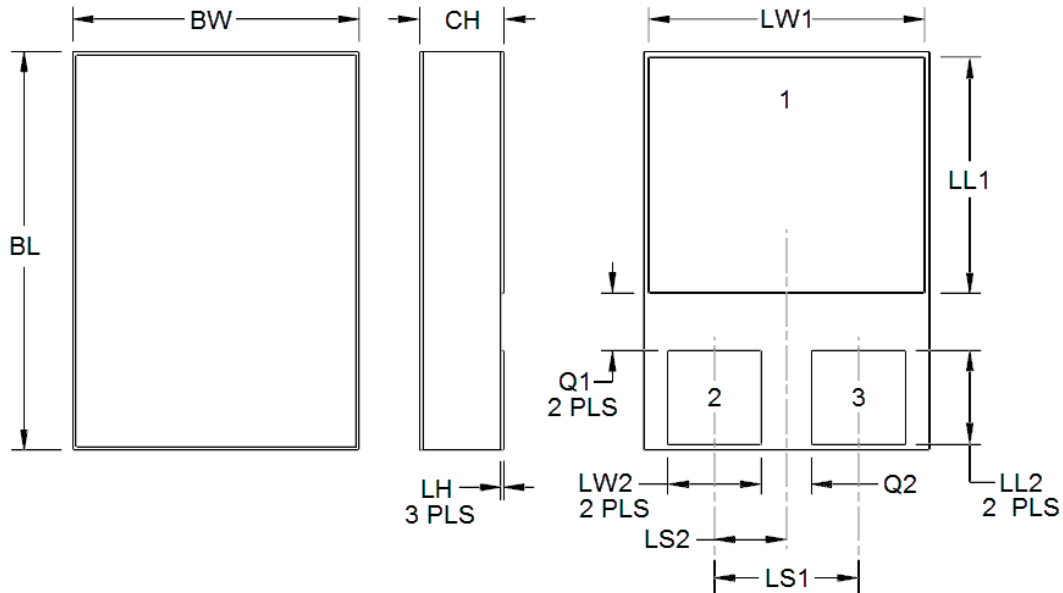


**FIGURE 2**  
Temperature-Power Derating Curve

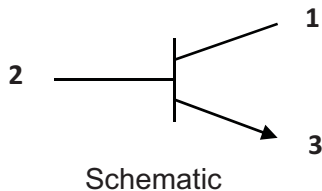
GRAPHS (continued)



**FIGURE 3**  
Maximum Thermal Impedance ( $R_{\theta JC}$ )

**PACKAGE DIMENSIONS**

**NOTES:**

1. Dimensions are in inches.
2. Millimeters are given for general information only.
3. In accordance with ASME Y14.5M, diameters are equivalent to  $\Phi$ x symbology.



Symbol	DIMENSIONS			
	INCH		MILLIMETERS	
	Min	Max	Min	Max
<b>BL</b>	.395	.405	10.03	10.29
<b>BW</b>	.291	.301	7.39	7.65
<b>CH</b>	.112	.124	2.84	3.15
<b>LH</b>	.010	.020	0.25	0.51
<b>LL1</b>	.220	.230	5.59	5.84
<b>LL2</b>	.115	.125	2.92	3.18
<b>LS1</b>	.150 BSC		3.81 BSC	
<b>LS2</b>	.075 BSC		1.91 BSC	
<b>LW1</b>	.281	.291	7.14	7.39
<b>LW2</b>	.090	.100	2.29	2.54
<b>Q1</b>	.030		0.76	
<b>Q2</b>	.030		0.76	
<b>Term 1</b>	Collector			
<b>Term 2</b>	Base			
<b>Term 3</b>	Emitter			