60V INPUT, 5V 15mA REGULATOR TRANSISTOR IN SOT23F

Description

This regulator transistor is designed to meet the stringent requirements of automotive applications.

The ZXTR2105FFQ monolithically integrates a transistor, zener diode and resistor to function as a linear regulator. The device regulates with a 5V nominal output at 15mA. It is designed for use in high-voltage applications where standard linear regulators cannot be used. This function is fully integrated into a SOT23F package, minimizing PCB area and reducing the number of components when compared with a multi-chip discrete solution.

Applications

Supply voltage regulation for:

- 12V to 5V Rails
- 24V to 5V Rails
- Other Customized Input Rails

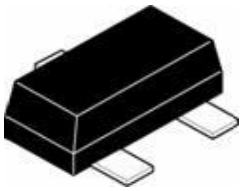
Features

- Series Linear Regulator Using Emitter-Follower Stage
- Input Voltage = 7V to 60V (For Regulated Output Voltage)
- Output Voltage = 5V ± 5%
- Fully Integrated into a SOT23F Package
- **Totally Lead-Free & Fully RoHS Compliant (Notes 1 & 2)**
- **Halogen and Antimony Free. "Green" Device (Note 3)**
- **Qualified to AEC-Q101 Standards for High Reliability**
- **PPAP Capable (Note 4)**

Mechanical Data

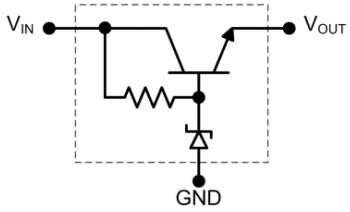
- Case: SOT23F
- Case Material: Molded Plastic "Green" Molding Compound; UL Flammability Rating 94V-0
- Moisture Sensitivity: Level 1 per J-STD-020
- Terminals: Finish - Matte Tin Plated Leads; Solderable per MIL-STD-202, Method 208 e3
- Weight: 0.008 grams (Approximate)

SOT23F

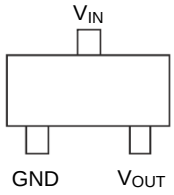


Top View

ZXTR2105FFQ



Internal Device Schematic



Top View Pin-Out

Pin Name	Pin Function
V_{IN}	Input Supply
GND	Power Ground
V_{OUT}	Voltage Output

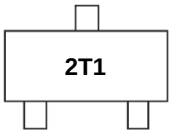
Ordering Information (Note 5)

Part Number	Compliance	Marking	Reel Size (inches)	Tape Width (mm)	Quantity per Reel
ZXTR2105FFQ-7	Automotive	2T1	7	8	3,000

Notes:
1. No purposely added lead. Fully EU Directive 2002/95/EC (RoHS), 2011/65/EU (RoHS 2) & 2015/863/EU (RoHS 3) compliant.
2. See https://www.diodes.com/quality/lead-free/ for more information about Diodes Incorporated's definitions of Halogen- and Antimony-free, "Green" and Lead-free.
3. Halogen- and Antimony-free "Green" products are defined as those which contain <900ppm bromine, <900ppm chlorine (<1500ppm total Br + Cl) and <1000ppm antimony compounds.
4. Automotive products are AEC-Q101 qualified and are PPAP capable. Refer to https://www.diodes.com/quality/.
5. For packaging details, go to our website at https://www.diodes.com/design/support/packaging/diodes-packaging/.

Marking Information

SOT23F



2T1 = Product Type Marking Code

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Absolute Maximum Ratings (Voltage relative to GND, @T_A = +25°C, unless otherwise specified.)

Characteristic	Symbol	Value	Unit
Input Voltage	V_{IN}	-0.3 to 60	V
Continuous Input and Output Current	I_{IN}, I_{OUT}	320	mA
Peak Pulsed Input and Output Current	I_{IM}, I_{OM}	2	A
Maximum Voltage Applied to V_{OUT}	$V_{OUT(MAX)}$	Smaller of V_{IN}+5V or 10V	V

Maximum Current at V_{IN} = 12V (@T_A = +25°C, unless otherwise specified.)

Characteristic		Symbol	Value	Unit
Continuous Output Current	(Note 8)	I_{OUT}	89	mA
Pulsed Output Current	(Note 9)	I_{OM}	2,000	mA
	(Note 10)		890	

Thermal Characteristics

Characteristic		Symbol	Value	Unit
Power Dissipation	(Note 6)	P_D	1.3	W
	(Note 7)		1	
Thermal Resistance, Junction to Ambient	(Note 6)	$R_{\theta JA}$	95	°C/W
	(Note 7)		126	
Thermal Resistance, Junction to Lead	(Note 11)	$R_{\theta JL}$	59	
Thermal Resistance, Junction to Case	(Note 11)	$R_{\theta JC}$	38	
Maximum Operating Junction and Storage Temperature Range		T_J , T_{STG}	-65 to +150	°C

ESD Ratings (Note 12)

Characteristics	Symbol	Value	Unit	JEDEC Class
Electrostatic Discharge – Human Body Model	ESD HBM	4,000	V	3A
Electrostatic Discharge – Charge Device Model	ESD CDM	1,000	V	IV

Notes:
6. For a device mounted with the VIN lead on 25mm x 25mm 1oz copper that is on a single-sided 1.6mm FR-4 PCB; device is measured under still air conditions whilst operating in steady-state.
7. Same as Note 6, except mounted on 15mm x 15mm 1oz copper.
8. Same as Note 6, whilst operating at VIN=12V. Refer to Safe Operating Area for other Input Voltages.
9. Same as Note 6, except measured with a single pulse width = 100µs and V_{IN}=12V.
10. Same as Note 6, except measured with a single pulse width = 10ms and V_{IN}=12V.
11. $R_{\theta JL}$ = Thermal resistance from junction to solder-point (at the end of the VIN lead). $R_{\theta JC}$ = Thermal resistance from junction to the top of case.
12. Refer to JEDEC specification JESD22-A114 and JESD22-C101.

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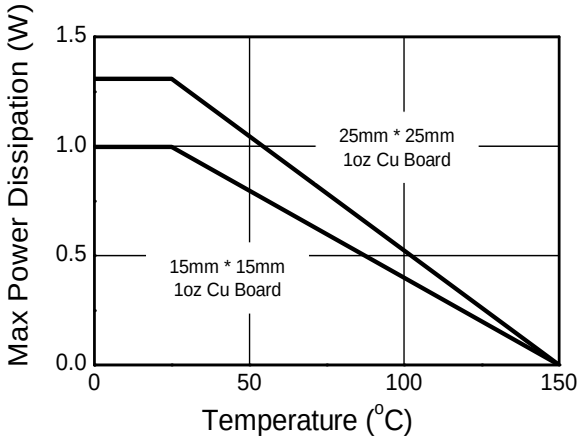
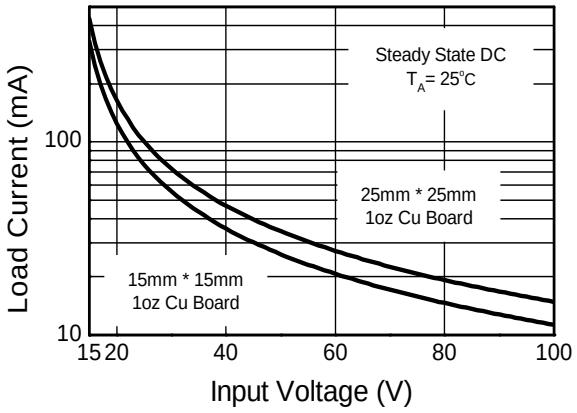
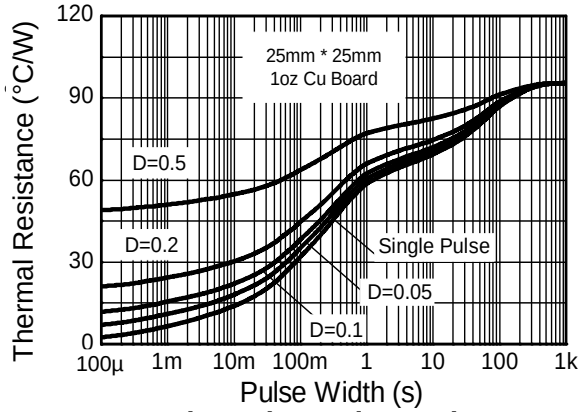
Thermal Characteristics and Derating Information



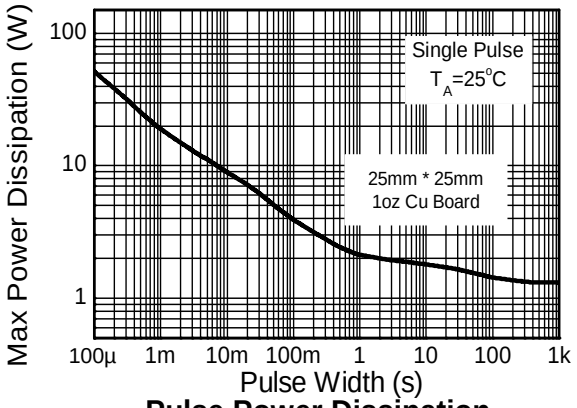
Derating Curve



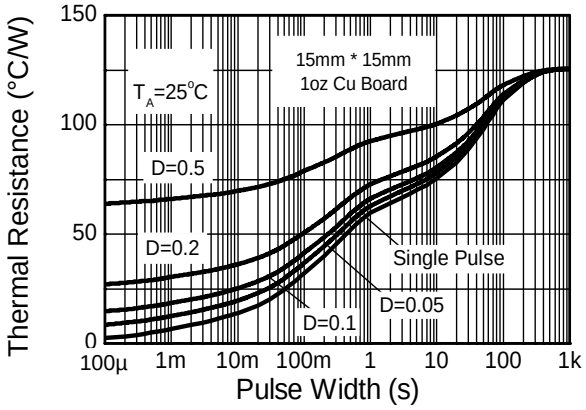
Safe Operating Area



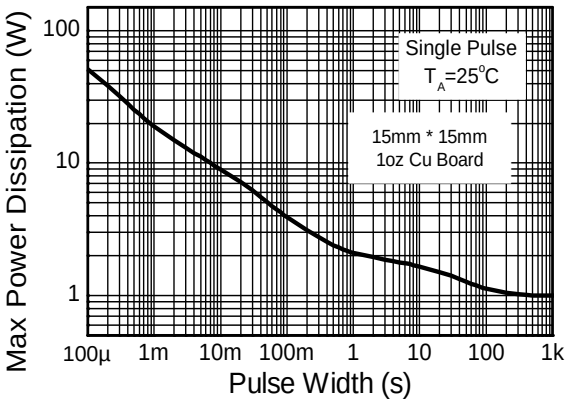
Transient Thermal Impedance



Pulse Power Dissipation



Transient Thermal Impedance



Pulse Power Dissipation

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Electrical Characteristics (@T_A = +25°C, unless otherwise specified.)

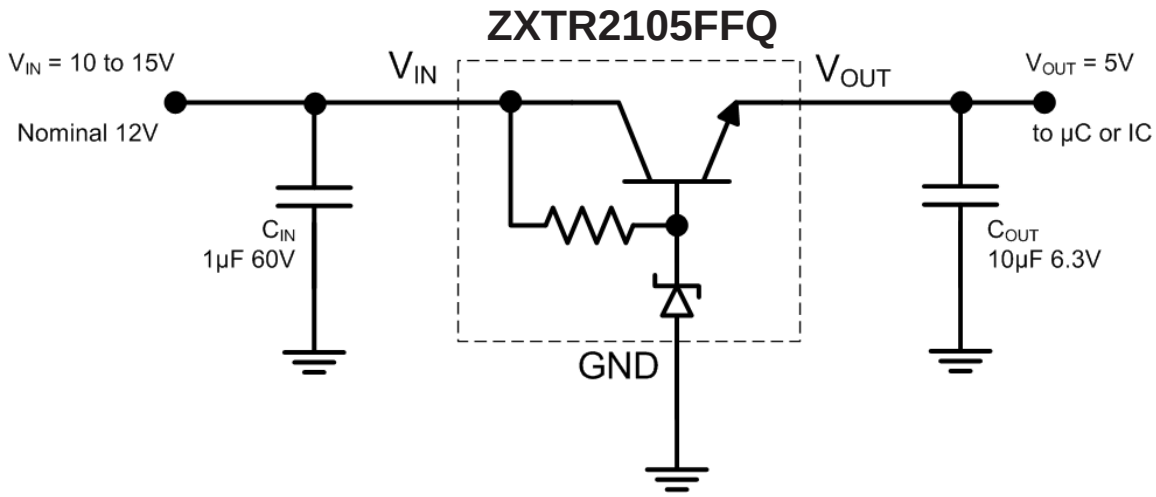
Characteristic	Symbol	Min	Typ	Max	Unit	Test Condition
Output Voltage (Note 13)	V_{OUT}	4.75	5.0	5.25	V	V_{IN} = 12V, I_{OUT} = 15mA
Line Regulation (Notes 13 & 14)	ΔV_{OUT}	—	33	220	mV	V_{IN} = 10V to 15V, I_{OUT} = 15mA
		—	400	700		V_{IN} = 7V to 60V, I_{OUT} = 15mA
		—	145	400		V_{IN} = 10V to 60V, I_{OUT} = 15mA
Temperature Coefficient	$\Delta V_{OUT}/\Delta T$	—	3.52	—	mV/°C	T_J = -40°C to +150°C V_{IN} = 12V, I_{OUT} = 15mA
Load Regulation (Notes 13 & 15)	ΔV_{OUT}	—	-20 -166	-130 -300	mV	I_{OUT} = 10mA to 20mA, V_{IN} = 12V I_{OUT} = 0.1mA to 50mA, V_{IN} = 12V
Minimum Value of Input Voltage Required to Maintain Line Regulation	$V_{IN(MIN)}$	7	—	—	V	—
Quiescent Current	I_Q	— —	450 4,000	800 6,700	µA	V_{IN} = 12V, I_{OUT} = 10µA V_{IN} = 60V, I_{OUT} = 10µA
Power Supply Rejection Ratio	$\Delta V_{IN}/\Delta V_{OUT}$	—	46	—	dB	C_{OUT} = 100nF, I_{OUT} = 15mA, V_{OUT} = 5V, V_{IN} = 7V to 60V, f = 100Hz

Notes: 13. Measured Under Pulsed Conditions; Pulse Width ≤ 300µs. Duty cycle ≤ 2%.

14. Line Regulation $\Delta V_{OUT} = V_{OUT}(@V_{IN} = 15V) – V_{OUT}(@V_{IN} = 10V)$
$\Delta V_{OUT} = V_{OUT}(@V_{IN} = 60V) – V_{OUT}(@V_{IN} = 7V)$
$\Delta V_{OUT} = V_{OUT}(@V_{IN} = 60V) – V_{OUT}(@V_{IN} = 10V)$

15. Load Regulation $\Delta V_{OUT} = V_{OUT}(@I_{OUT} = 20mA) – V_{OUT}(@I_{OUT} = 10mA)$
$\Delta V_{OUT} = V_{OUT}(@I_{OUT} = 50mA) – V_{OUT}(@I_{OUT} = 0.1mA)$

Typical Application Circuit



Example of a 5V regulated supply from a nominal 12V for powering a Controller IC.

Pin Functions

Pin Name	Pin Function	Notes
V_{IN}	Input Supply	Input voltage can vary from -0.3V to 60V with respect to GND; for V_{OUT} regulated then 7V ≤ V_{IN} ≤ 60V. It is recommended to connect a 1µF capacitor to GND.
GND	Power Ground	This pin should be tied to the system ground.
V_{OUT}	Voltage Output	Outputs a regulated 5V when 7V ≤ V_{IN} ≤ 60V. When V_{IN} < 7V, then V_{OUT} maximum = V_{IN} – 1V. The pin can be pulled high to a maximum of +10V with respect to GND, or +5V with respect to V_{IN}, whichever is lower. It is recommended to connect a 10µF capacitor to GND and a minimum of 10µA to be drawn from V_{OUT} to maintain regulation.

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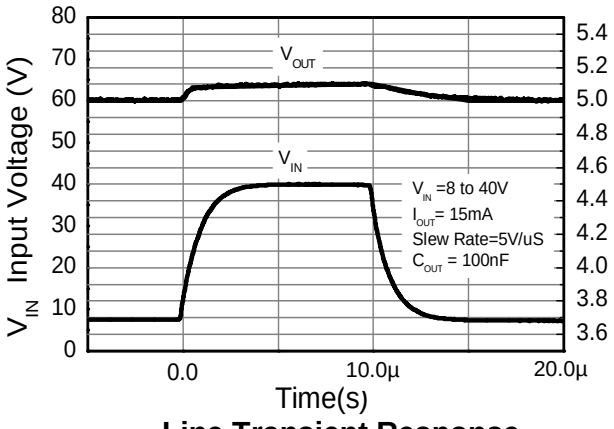
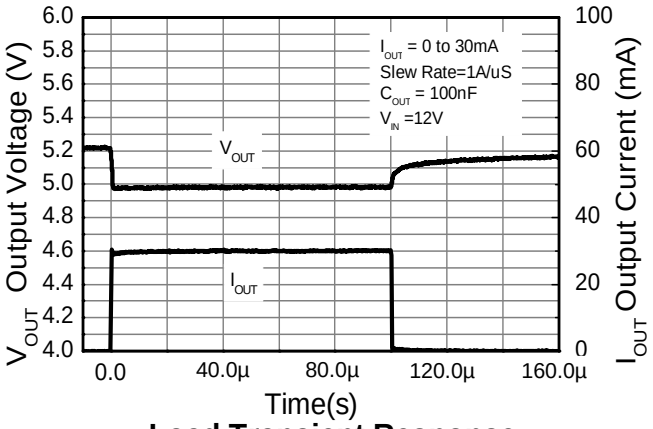
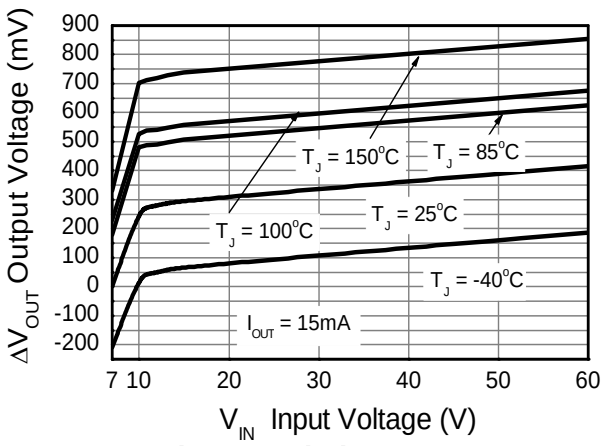
Typical Electrical Characteristics (@T_A = +25°C, unless otherwise specified.)



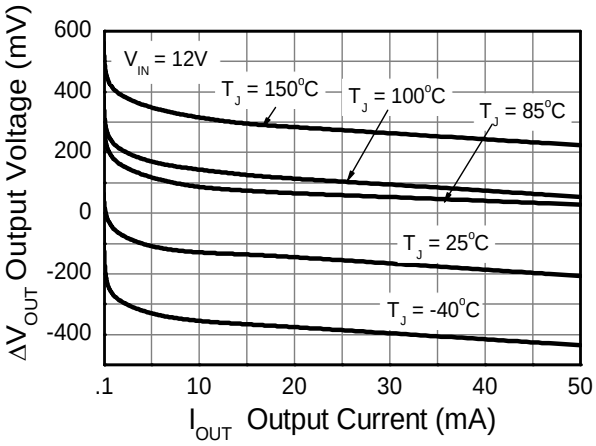
Line Transient Response



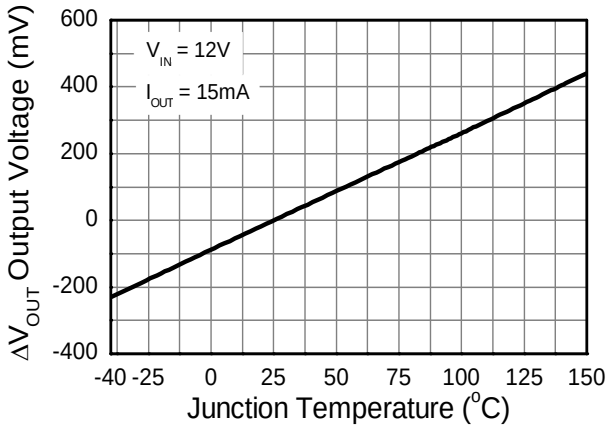
Load Transient Response



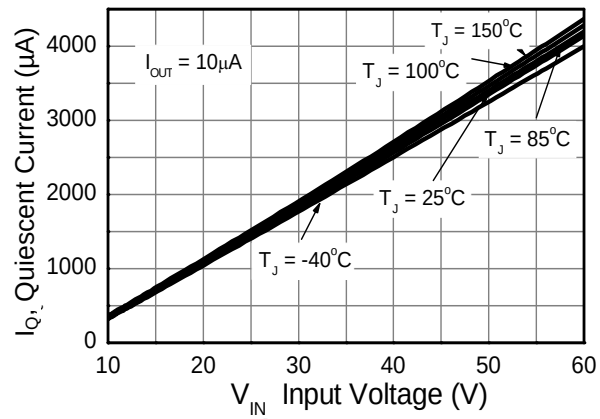
Line Regulation (Note 16)



Load Regulation (Note 17)



Temperature Coefficient (Note 18)



Quiescent Current

Notes: 16. Line Regulation $\Delta V_{OUT} = V_{OUT} - V_{OUT}$(@ V_{IN} = 7V, I_{OUT} = 15mA, T_J = +25°C).
17. Load Regulation $\Delta V_{OUT} = V_{OUT} - V_{OUT}$(@ V_{IN} = 12V, I_{OUT} = 0.1mA, T_J = +25°C).
18. Temperature Coefficient $\Delta V_{OUT} = V_{OUT} - V_{OUT}$(@ V_{IN} = 12V, I_{OUT} = 15mA, T_J = +25°C).

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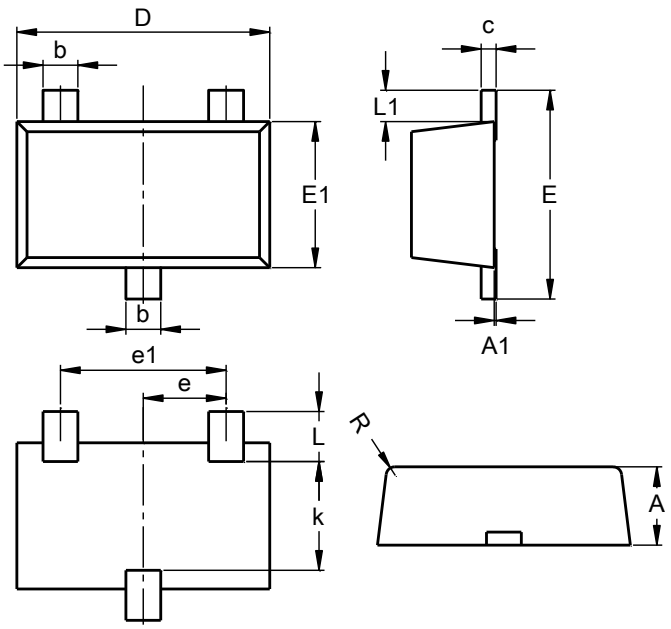
Package Outline Dimensions

Please see http://www.diodes.com/package-outlines.html for the latest version.

SOT23F

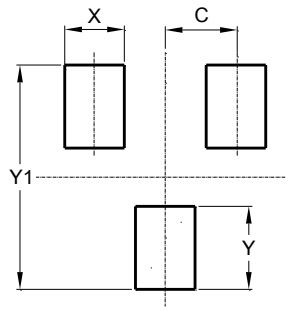


SOT23F			
Dim	**Min**	**Max**	**Typ**
A	0.80	1.00	0.90
A1	0.00	0.10	0.01
b	0.35	0.50	0.44
c	0.10	0.20	0.16
D	2.80	3.00	2.90
e	0.95 REF		
e1	1.90 REF		
E	2.30	2.50	2.40
E1	1.50	1.70	1.65
k	1.20	-	-
L	0.30	0.65	0.50
L1	0.30	0.50	0.40
R	0.05	0.15	-
All Dimensions in mm			

Suggested Pad Layout

Please see http://www.diodes.com/package-outlines.html for the latest version.

SOT23F



Dimensions	Value (in mm)
C	0.95
X	0.80
Y	1.110
Y1	3.000

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