1A Low-Dropout Linear Regulator with Inrush Current Limiting

Features

- Input voltage range: 1.2V to 5.5V
- Output current up to 1A
- Output voltage range: 1.0V to 5.0V
- Output voltage accuracy: ±1%
- 220mV typical dropout at 1A (V_{OUT} = 3.3V)
- 58μA typical quiescent current
- High power supply rejection at 3.3V with a 1μF output capacitor: 90dB at 1kHz, 70dB at 10kHz, 58dB at 100kHz and 45dB at 1MHz
- Built-in inrush current limiting
- Thermal shutdown and current limiting
- 0μA typical shutdown current

Applications

- Mobile phones
- Tablets and handheld terminals
- Battery-powered equipment
- RF equipment
- Cameras, camcorders and set-top boxes

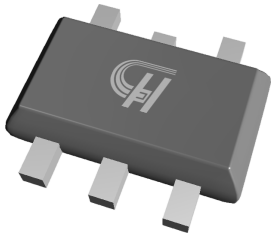
General Description

The HCR2155 is a low-dropout linear regulator that supplies up to 1A and limits inrush current at turn-on. It combines low quiescent current, high ripple rejection and ±1% output accuracy.

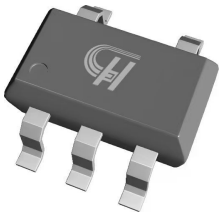
The regulator operates with 1μF ceramic capacitors at its input and output. Its fast response to changes in load current makes it suitable for noise-sensitive loads, including high-performance analog circuits. No separate noise-bypass capacitor is required.

Driving EN low turns the output off. Shutdown current is typically 0μA, which helps conserve battery power during standby.

Fixed-output versions are available in SOT89-5L and SOT23-5. The adjustable SOT23-5 version uses a 1.0V feedback reference.



SOT89-5L



SOT23-5

Figure 1. HCR2155 package options

1A Low-Dropout Linear Regulator with Inrush Current Limiting

Pin Configuration

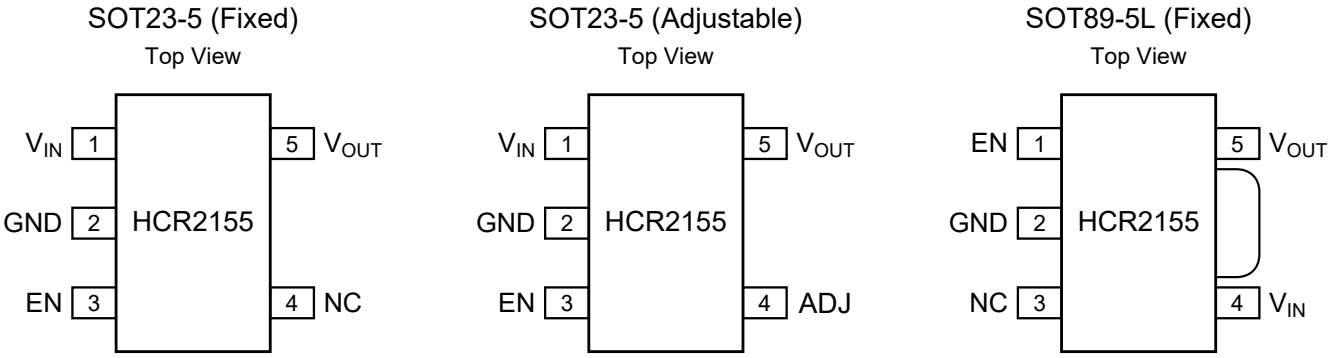


Figure 2. HCR2155 pin configurations (top view)

Pin Function Table

SOT23-5 Fixed	SOT23-5 Adjustable	SOT89-5L Fixed	Name	Function
1	1	4	VIN	Regulator input. Bypass VIN to GND with a 1μF ceramic capacitor.
2	2	2	GND	Ground.
3	3	1	EN	Enable input. Drive high to enable the output.
4	-	3	NC	No internal connection.
5	5	5	VOUT	Regulated output.
-	4	-	ADJ	Feedback input. Connect to VOUT for direct sensing or to the junction of the external divider.

Functional Diagram

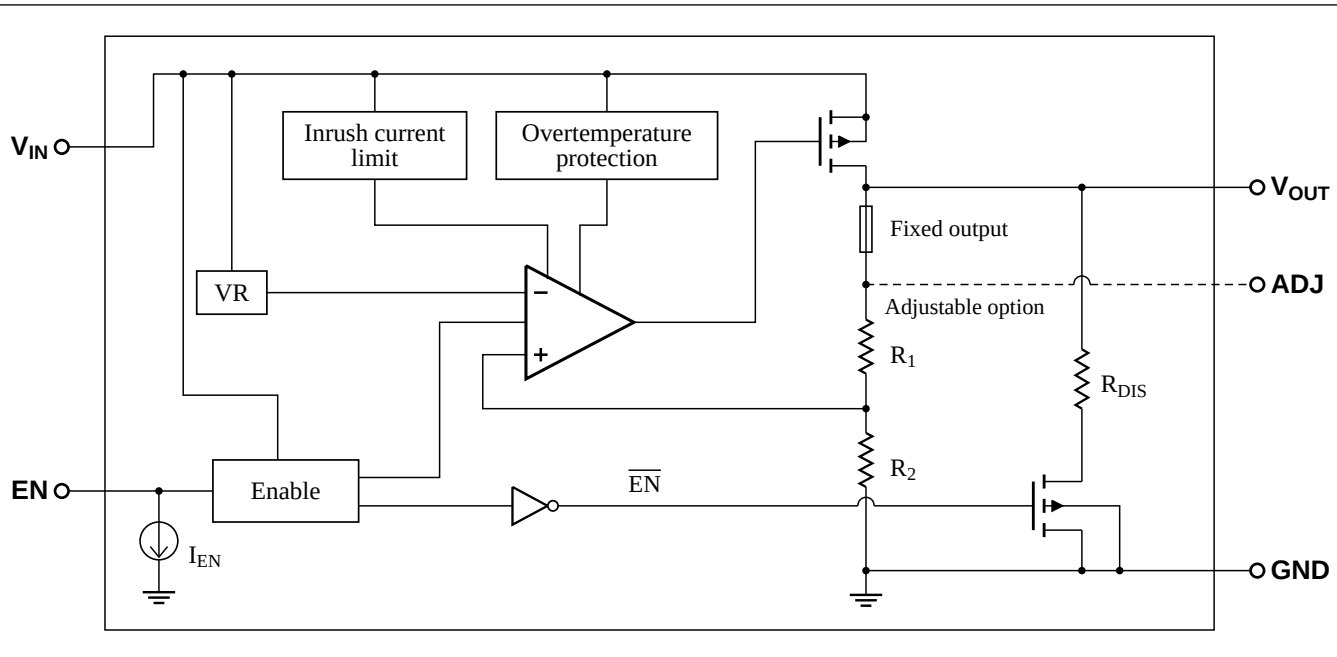
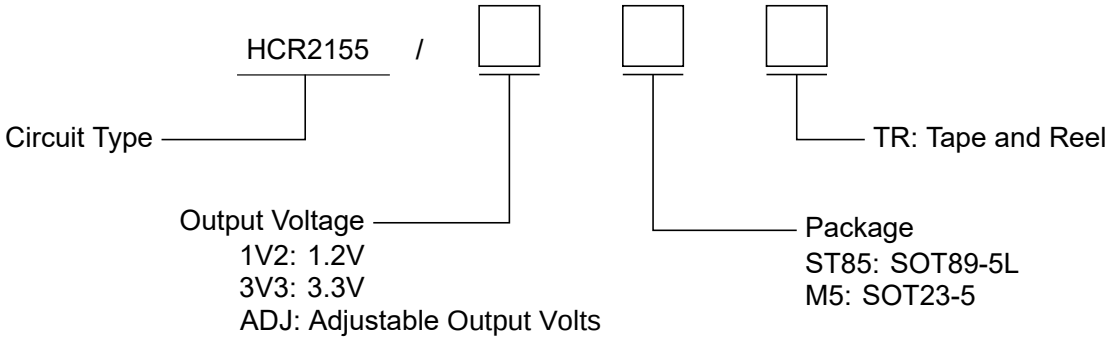


Figure 3. HCR2155 functional diagram

1A Low-Dropout Linear Regulator with Inrush Current Limiting

Ordering Information



Ordering Code

Part Number	Output	Marking ID [2]	Ambient Temp. Range	Package	Quantity per Reel
HCR2155/1V2ST85TR	1.2V	Hr12xx	−40°C to +85°C	SOT89-5L	1000 pcs
HCR2155/3V3ST85TR	3.3V	Hr33xx	−40°C to +85°C	SOT89-5L	1000 pcs
HCR2155/3V3M5TR	3.3V	Hr33xx	−40°C to +85°C	SOT23-5	3000 pcs
HCR2155/ADJM5TR	ADJ Volts	HrAdjxx	−40°C to +85°C	SOT23-5	3000 pcs

Note 2. the "xx" is date code .

The adjustable version uses a 1.0V feedback reference. For other output voltages or packages, contact sales.

Typical Application Circuits

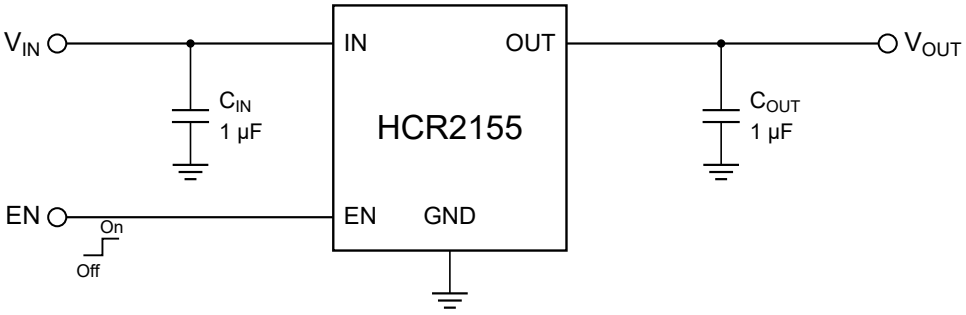


Figure 4. Fixed-output application circuit of HCR2155

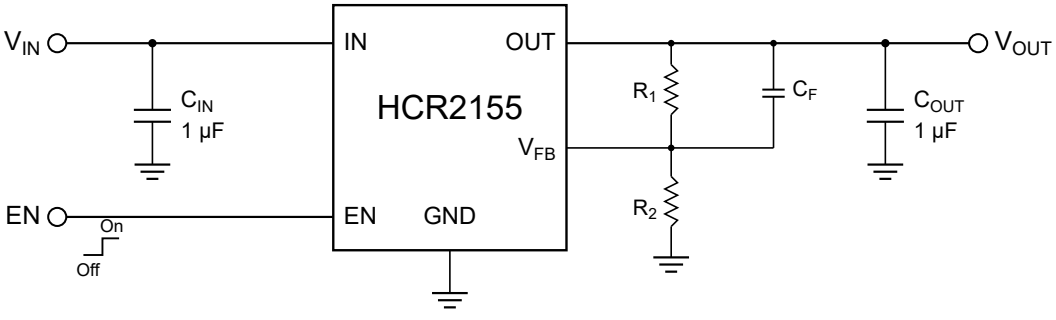


Figure 5. Adjustable-output application circuit of HCR2155

Absolute Maximum Ratings

Parameter	Package	Symbol	Rating	Unit
VIN pin voltage	-	V_{IN}	−0.3 to 6.5	V
EN pin voltage	-	V_{EN}	V_{IN} − 0.3 to V_{IN} + 0.3	V
VFB pin voltage	-	V_{FB}	V_{IN} − 0.3 to V_{IN} + 0.3	V
VOUT pin voltage	-	V_{OUT}	V_{IN} − 0.3 to V_{IN} + 0.3	V
VOUT pin current	-	I_{OUT}	1600	mA
Package power dissipation	SOT23-5	P_D	0.6	W
	SOT89-5L		1.25	
Junction-to-ambient thermal resistance	SOT23-5	θ_{JA}	210	°C/W
	SOT89-5L		100	
Operating ambient temperature	-	T_{Opr}	−40 to +85	°C
Storage temperature	-	T_{stg}	−55 to +150	°C
Junction temperature	-	T_J	−40 to +150	°C

(1) Exceeding an absolute maximum rating can permanently damage the device.

(2) Maximum allowable power dissipation depends on the maximum junction temperature, junction-to-ambient thermal resistance, and ambient temperature. Exceeding this power dissipation generates excessive heat and can cause the device to enter thermal shutdown.

$$P_{D(MAX)} = \frac{T_{J(MAX)} - T_A}{\theta_{JA}}$$

(3) The listed θ_{JA} values are for package comparison only. Actual thermal performance depends on the application and must be evaluated for the design.

Recommended Operating Conditions

Parameter	Symbol	Min.	Max.	Unit
Operating input voltage	V_{IN}	1.2	5.5	V
Operating ambient temperature	T_{Opr}	−40	+85	°C

Electrical Characteristics

Unless otherwise specified, V_{IN} = $V_{OUT(T)}$ + 0.5 V or $V_{OUT(T)}$ + 1.5 V (Notes 1 and 3), V_{EN} = V_{IN}, C_{IN} = C_{OUT} = 1 µF and T_A = 25 °C.

Parameter	Symbol	Test Conditions		Min.	Typ.	Max.	Unit
Operating input voltage	V_{IN}	-		1.2	-	5.5	V
Output voltage	V_{OUT}	I_{OUT} = 10 mA, V_{IN} = V_{OUT} + 0.5 V		1.0	-	5.0	V
Feedback voltage	V_{FB}	Adjustable version		0.99	1.0	1.01	V
Feedback pin current	I_{VFB}	Adjustable version, V_{FB} = 1.0 V, V_{EN} = 0 V		-	1	2	µA
Maximum output current	I_{OUTMAX}	V_{IN} = V_{OUT} + 0.5 V		1000	-	-	mA
Load regulation	ΔV_{OUT}	V_{IN} = V_{OUT} + 0.5 V, 1 mA ≤ I_{OUT} ≤ 1000 mA		-	7	20	mV
Dropout voltage (Note 2)	V_{DO}	I_{OUT} = 0.5 A, V_{OUT} = 1 V		-	400	600	mV
		I_{OUT} = 1 A, V_{OUT} = 1 V		-	700	1000	mV
		I_{OUT} = 0.5 A, V_{OUT} = 1.2 V		-	320	480	mV
		I_{OUT} = 1 A, V_{OUT} = 1.2 V		-	600	900	mV
		I_{OUT} = 0.5 A, V_{OUT} = 3.3 V		-	110	200	mV
		I_{OUT} = 1 A, V_{OUT} = 3.3 V		-	220	400	mV
Quiescent current	I_Q	I_{OUT} = 0 mA		-	58	80	µA
Shutdown current	I_{SS}	V_{EN} = 0 V		-	0	0.2	µA
Line regulation	$\frac{\Delta V_{OUT}}{\Delta V_{IN} \cdot V_{OUT}}$	I_{OUT} = 30 mA, V_{OUT} + 0.5 V ≤ V_{IN} ≤ 5.5 V		-	0.035	-	%/V
Output current limit	I_{LIM}	-		-	1300	-	mA
Short-circuit current	I_{SC}	-		-	100	-	mA
Inrush current	I_{Inrush}	-		-	400	-	mA
EN high-level voltage	V_{ENH}	Enabled		1.2	-	-	V
EN low-level voltage	V_{ENL}	Disabled		-	-	0.5	V
EN pin current	I_{ENH}	V_{EN} = 5.5 V, V_{IN} = 5.5 V		-	0.3	-	µA
	I_{ENL}	V_{EN} = 0 V, V_{IN} = 5.5 V		-	0	-	µA
Active output discharge resistance	R_{DIS}	V_{CE} < 0.5 V		-	350	-	Ω
Power supply rejection ratio	PSRR	V_{IN} = (V_{OUT} + 0.5 V) + 0.2 V_{pp}, I_{OUT} = 10 mA	1 kHz	-	90	-	dB
			10 kHz	-	70	-	
			100 kHz	-	58	-	
			1 MHz	-	45	-	
Thermal shutdown temperature	T_{SD}	Temperature rising, I_{OUT} = 15 mA		-	165	-	°C
Thermal shutdown hysteresis	ΔT_{SD}	Temperature falling		-	40	-	°C

(1) $V_{OUT(T)}$ is the specified output voltage.
(2) V_{DO} is the input-to-output voltage difference when the output falls 100 mV below its nominal value.
(3) For V_{OUT} ≤ 1.5 V, V_{IN} = $V_{OUT(T)}$ + 1.5 V. Otherwise, V_{IN} = $V_{OUT(T)}$ + 0.5 V.

Typical Performance Characteristics

Fixed 3.3 V output, SOT23-5. Unless otherwise specified, V_{EN} = V_{IN} = 3.8 V, C_{IN} = C_{OUT} = 1 µF and T_A = 25 °C.

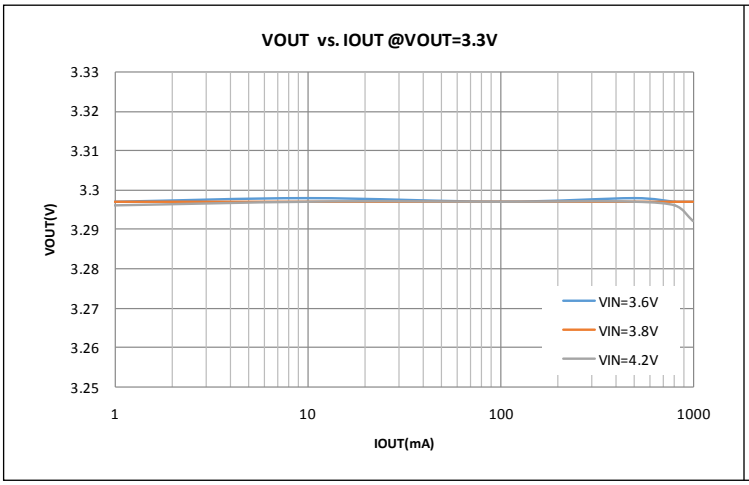


Figure 6. Output voltage vs. output current

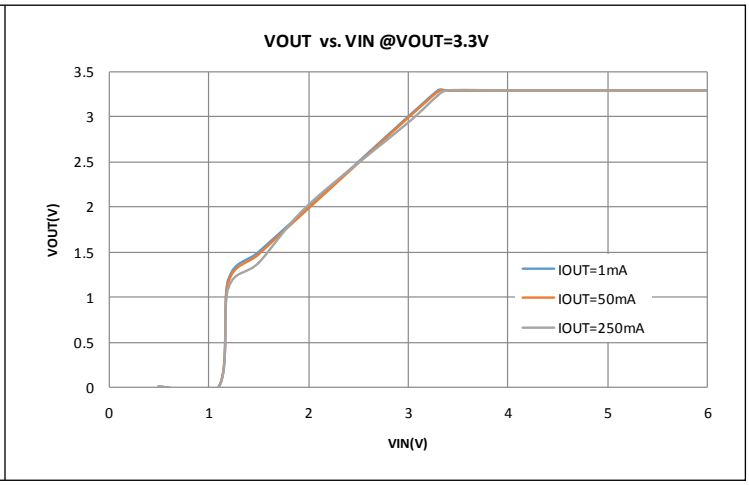


Figure 7. Output voltage vs. input voltage

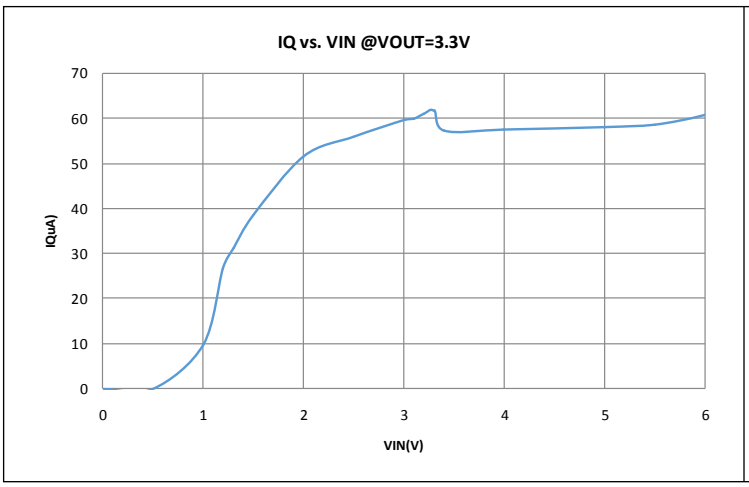


Figure 8. Quiescent current vs. input voltage

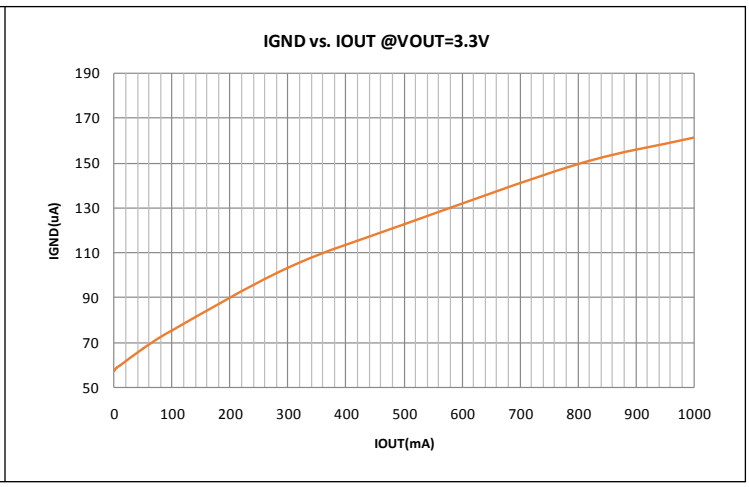


Figure 9. Ground current vs. output current

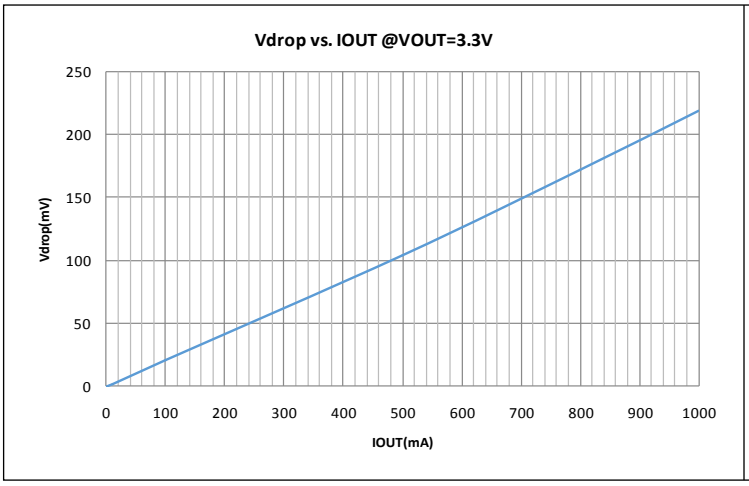


Figure 10. Dropout voltage vs. output current

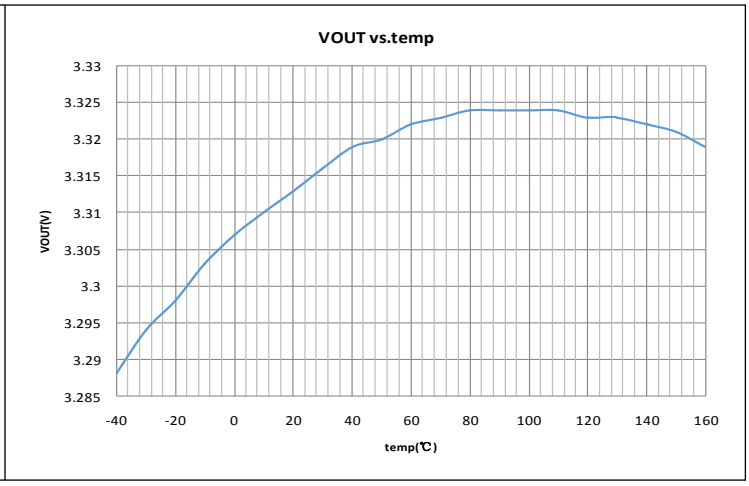


Figure 11. Output voltage vs. temperature

Typical Performance Characteristics (continued)

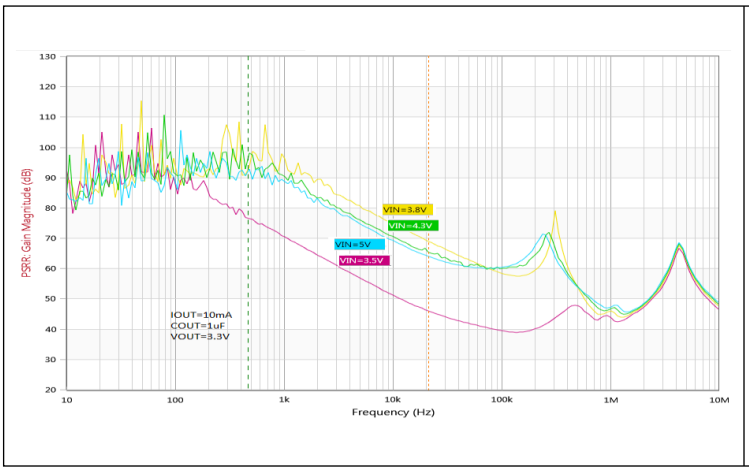


Figure 12. PSRR vs. frequency, V_{OUT} = 3.3 V

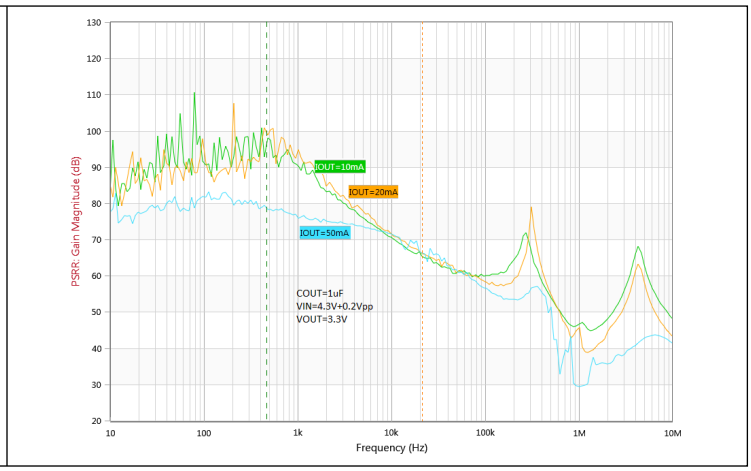


Figure 13. PSRR vs. frequency
V_{IN} = 4.3 V, V_{OUT} = 3.3 V

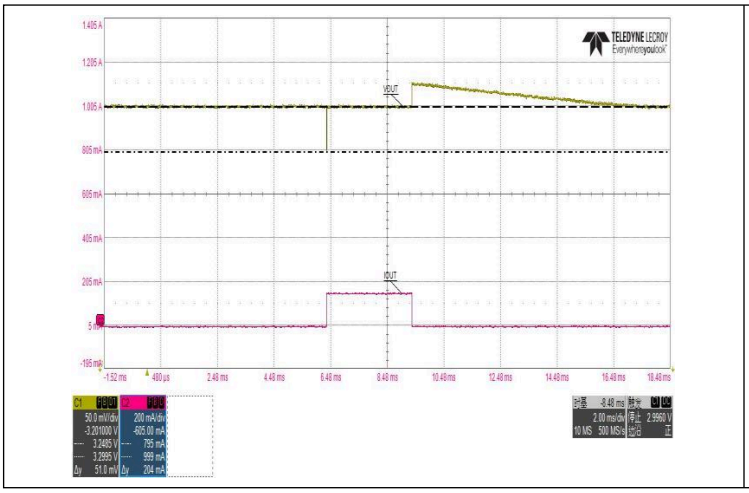


Figure 14. Load transient, 0 to 150 mA
0.5 µs transition, C_{OUT} = 10 µF

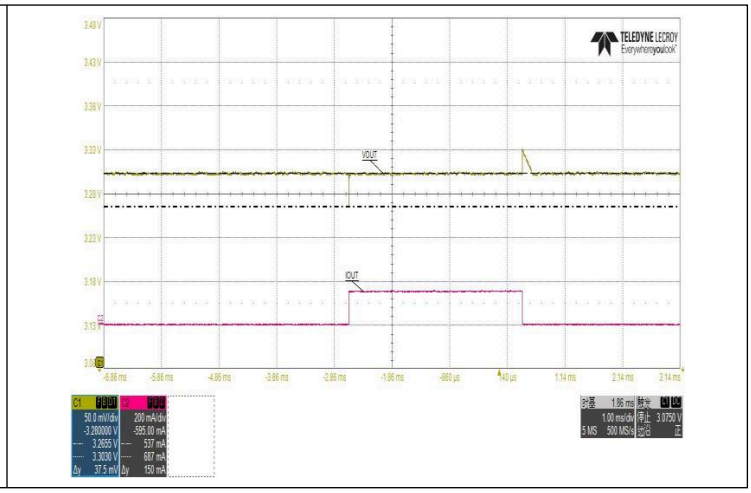


Figure 15. Load transient, 1 to 150 mA
0.5 µs transition, C_{OUT} = 10 µF

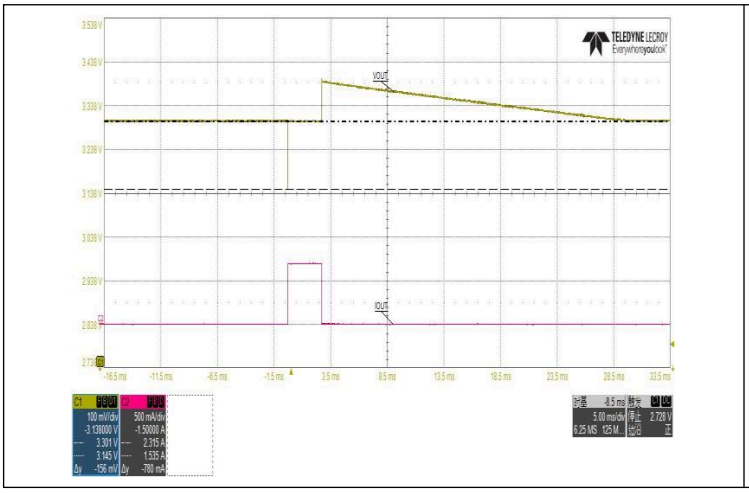


Figure 16. Load transient, 0 to 700 mA
0.5 µs transition, C_{OUT} = 10 µF



Figure 17. Load transient, 1 to 500 mA
0.5 µs transition, C_{OUT} = 10 µF

Typical Performance Characteristics (continued)

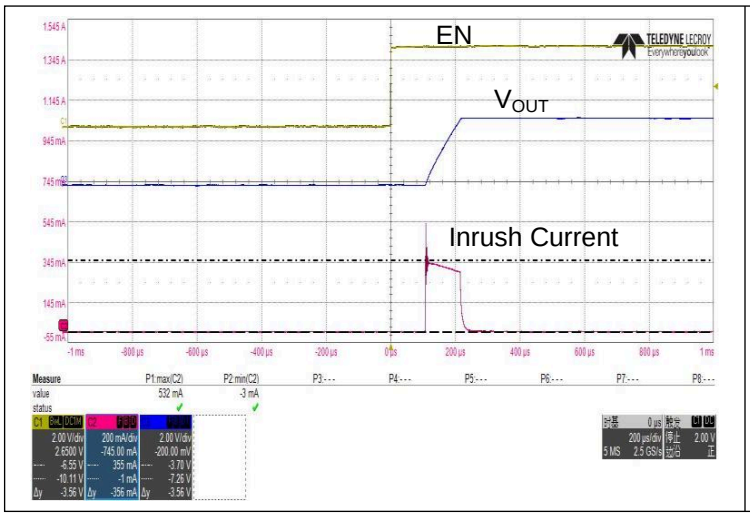


Figure 18. Inrush current, C_{OUT} = 10 µF

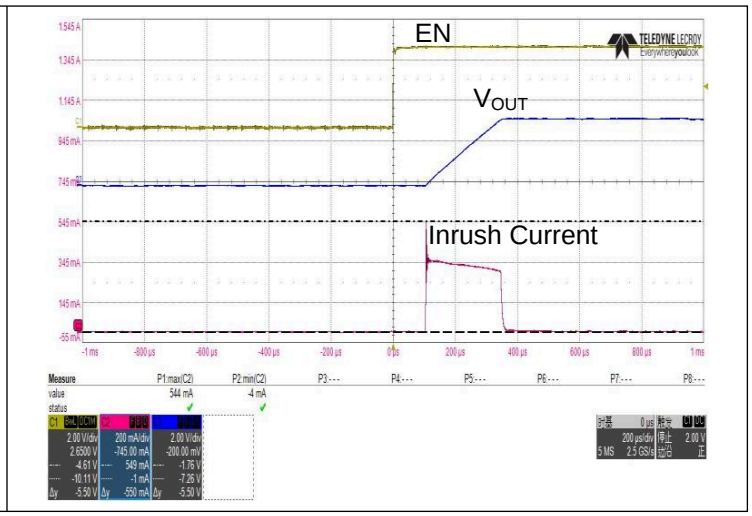


Figure 19. Inrush current, C_{OUT} = 22 µF

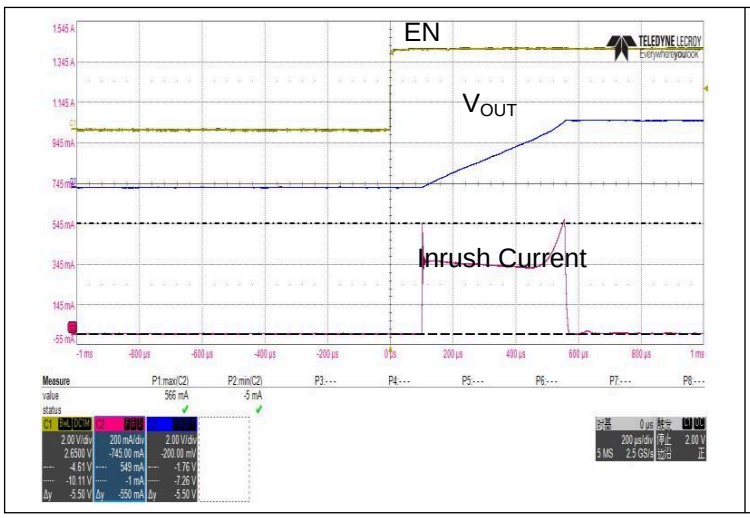


Figure 20. Inrush current, C_{OUT} = 47 µF

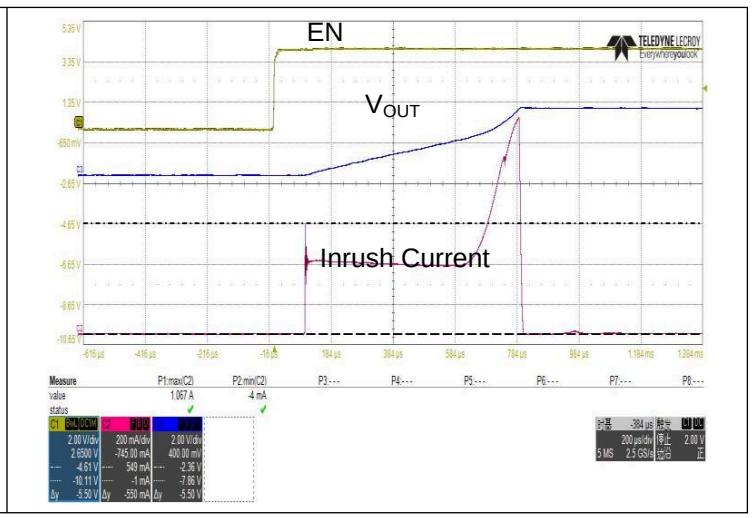


Figure 21. Inrush current, C_{OUT} = 100 µF

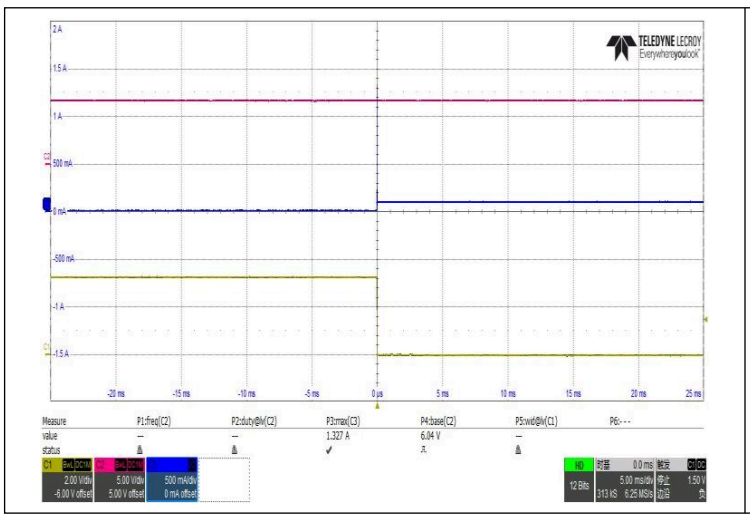


Figure 22. Output short-circuit protection

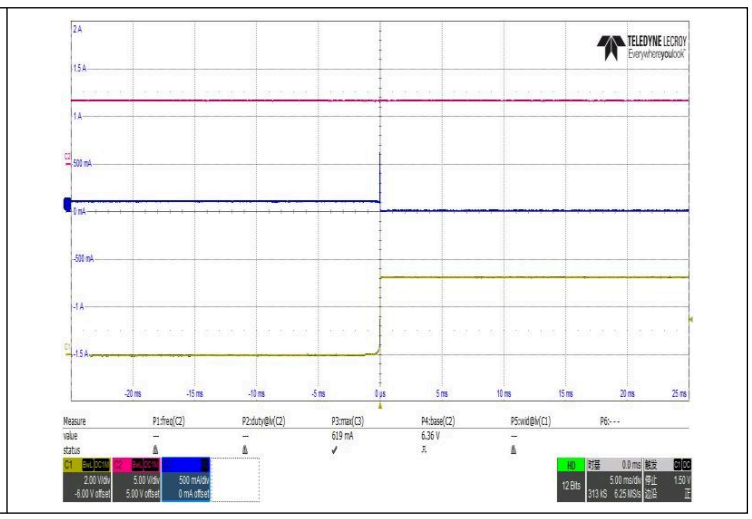


Figure 23. Output short-circuit recovery

Typical Performance Characteristics (continued)

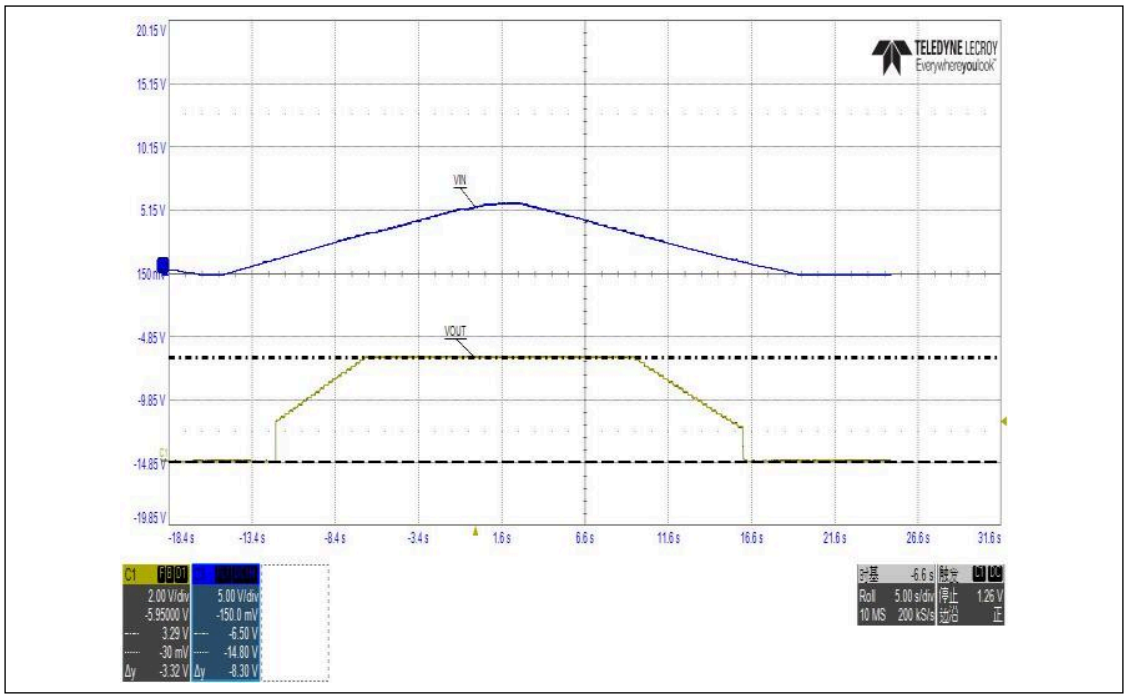


Figure 24. Power-up and power-down response, V_{OUT} = 3.3 V, I_{OUT} = 1 mA

Application Information

Input Capacitor

Place C_{IN} close to the VIN and GND pins for stability. Use an X7R or X5R ceramic capacitor of at least 1µF. The input capacitance has no specified upper limit. The capacitor provides a low-impedance path for AC noise. The regulator has no specific input ESR requirement. Choose a capacitor with low ESR and low ESL.

Output Capacitor

Place C_{OUT} close to VOUT and GND. The regulator is stable with an effective output capacitance of 1µF to 100µF and an ESR of 1mΩ to 200mΩ. Use X7R or X5R ceramic capacitors for their low ESR and stable capacitance over temperature. Account for both temperature and DC bias when selecting the nominal capacitance. Higher capacitance and lower ESR improve load-transient response and supply rejection.

Application Information (Continued)

Setting the Output Voltage

The HCR2155 offers fixed and adjustable outputs. On the adjustable version, VFB can sense VOUT directly to compensate for voltage drops in the internal interconnect and PCB traces. Alternatively, connect VFB to the midpoint of a resistor divider as shown in Figure 25.

$$V_{OUT} = V_{FB}\left(1 + \frac{R_1}{R_2}\right) + I_{VFB}R_1$$

Here V_{FB} is the 1.0V feedback reference and I_{VFB} is the current flowing into VFB. R_1 connects VOUT to VFB, and R_2 connects VFB to ground.

Selecting the Divider Resistors

Higher resistances reduce divider current, but increase the output error term $I_{VFB}R_1$. Feedback current varies with temperature. Choose a lower R_1 to reduce this error, and design for a current through R_2 of at least 100 times I_{VFB}.

Feedback Divider Examples

Output Voltage	R_1	R_2
2.5V	15kΩ	10kΩ
3.3V	23kΩ	10kΩ
5V	40kΩ	10kΩ

Adjustable-Output Application Circuit

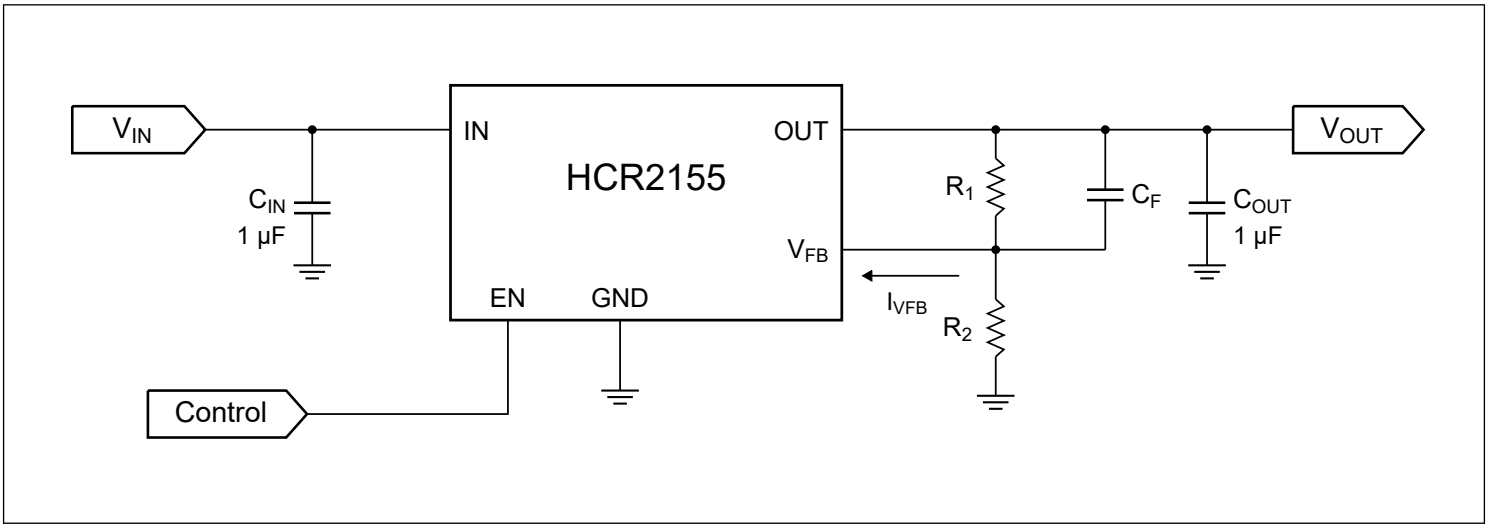
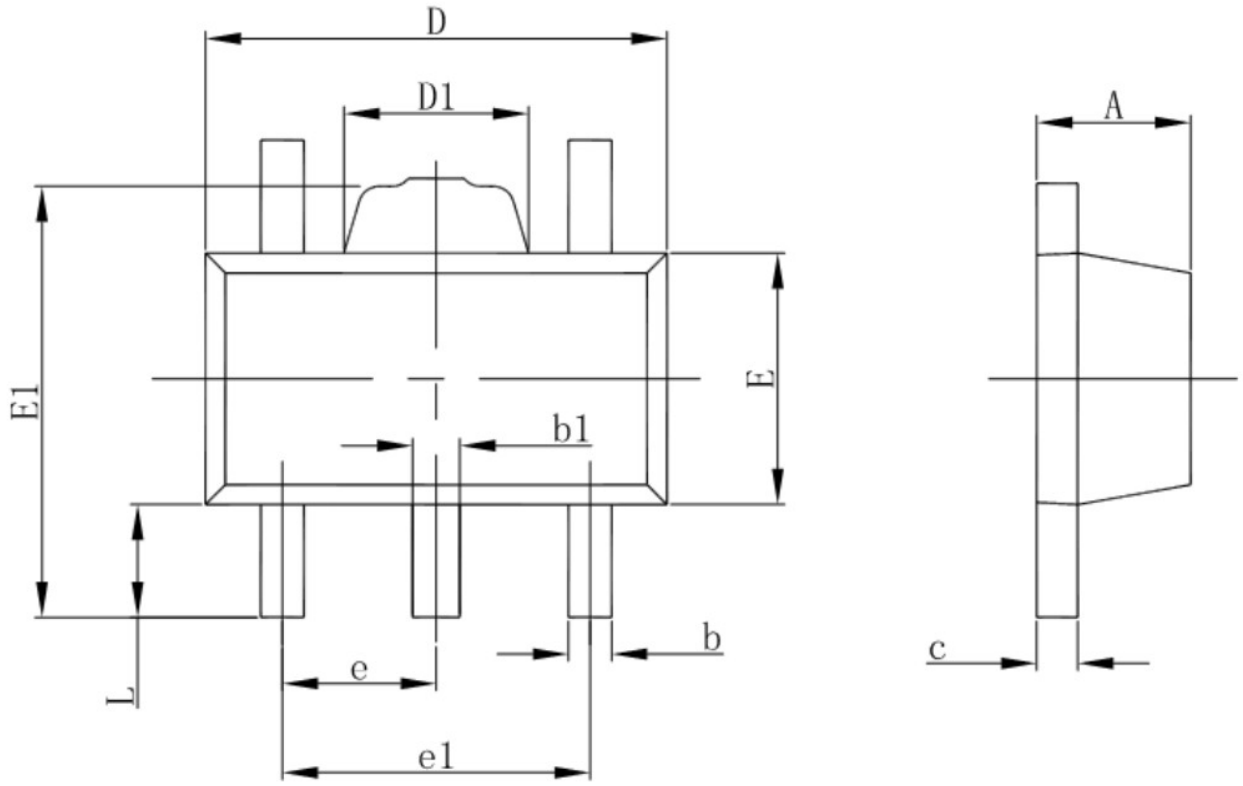


Figure 25. Output-voltage setting and feedback current

Mechanical Dimensions

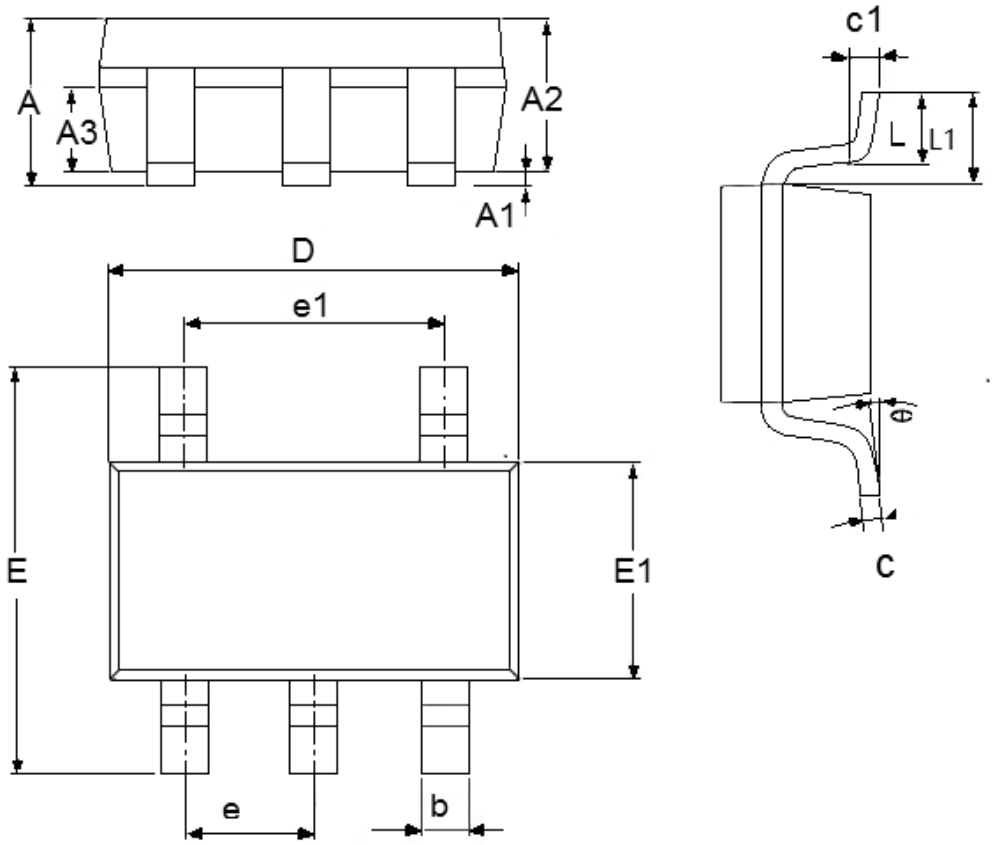
ST85 PKG: SOT89-5L



Symbol	Dimensions in Millimeters		Dimensions in Inches	
	Min.	Max.	Min.	Max.
A	1.400	1.600	0.055	0.063
b	0.320	0.520	0.013	0.020
b1	0.360	0.560	0.014	0.022
c	0.350	0.440	0.014	0.017
D	4.400	4.600	0.173	0.181
D1	1.400	1.800	0.055	0.071
E	2.300	2.600	0.091	0.102
E1	3.940	4.250	0.155	0.167
e	1.500 TYP.		0.060 TYP.	
e1	2.900	3.100	0.114	0.122
L	0.900	1.100	0.035	0.043

Mechanical Dimensions(Con.)

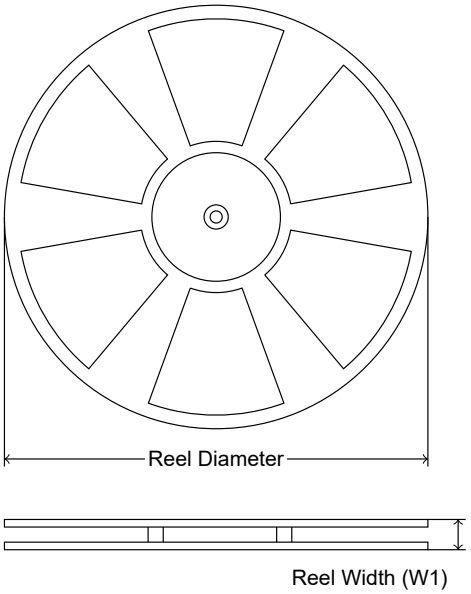
M5 PKG: SOT23-5



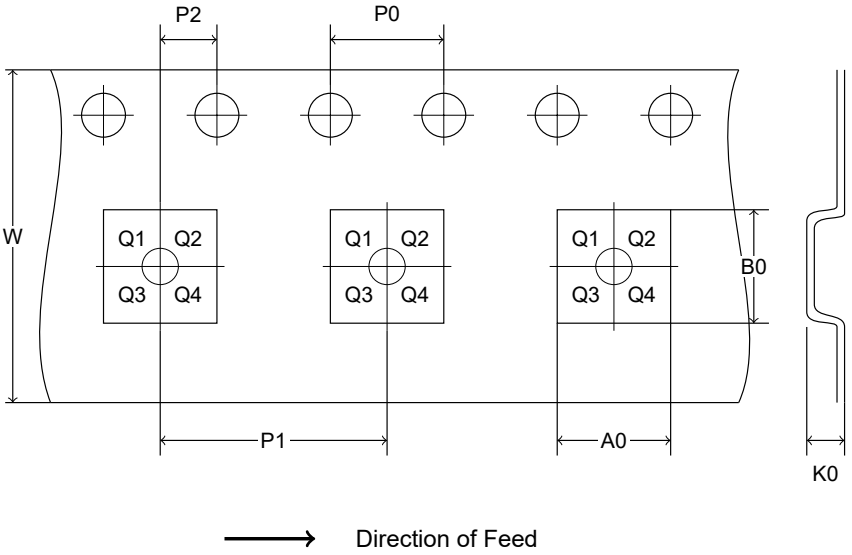
Symbol	Dimensions in Millimeters		Dimensions in Inches	
	Min.	Max.	Min.	Max.
A	1.05	1.45	0.0413	0.0571
A1	0	0.15	0.0000	0.0059
A2	0.9	1.3	0.0354	0.0512
A3	0.6	0.7	0.0236	0.0276
b	0.25	0.5	0.0098	0.0197
c	0.1	0.23	0.0039	0.0091
D	2.82	3.05	0.1110	0.1201
e1	1.9 (TYP)		0.0748 (TYP)	
E	2.6	3.05	0.1024	0.1201
E1	1.5	1.75	0.0512	0.0689
e	0.95 (TYP)		0.0374 (TYP)	
L	0.25	0.6	0.0098	0.0236
L1	0.59 (TYP)		0.0232 (TYP)	
θ	0	8°	0.0000	8°
c1	0.2 (TYP)		0.0079 (TYP)	

Tape and Reel Information

Reel Dimensions



Tape Dimensions



Note. The drawing identifies the reel and carrier tape dimensions.

Key Parameter List of Tape and Reel

Package Type	Reel Diameter	Reel Width W1 (mm)	A0 (mm)	B0 (mm)	K0 (mm)	P0 (mm)	P1 (mm)	P2 (mm)	W (mm)	Pin1 Quadrant
SOT89-5L	7"	13.2	4.85	4.45	1.85	4.0	8.0	2.0	12.0	Q3
SOT23-5	7"	9.5	3.20	3.20	1.40	4.0	4.0	2.0	8.0	Q3

Part Number	HCR2155-1V2ST85TR HCR2155-3V3ST85TR	HCR2155-3V3M5TR HCR2155-ADJM5TR
Packing Method	Tape and Reel	Tape and Reel
Quantity per Reel	1,000 pcs	3,000 pcs
Quantity per Small Box	10,000 pcs	30,000 pcs
Quantity per Outer Carton	40,000 pcs	120,000 pcs