MPQ2013D

40V, 100mA, Low Quiescent Current Linear Regulator, AEC-Q100 Qualified

DESCRIPTION

The MPQ2013D is a low-power linear regulator that supplies power to systems with high-voltage batteries. The device has a wide 2.5V to 40V input voltage (V_{IN}) range, low dropout voltage, and low quiescent supply current. The low quiescent current and low dropout voltage allow for operation at extremely low power levels. This makes the MPQ2013D well-suited for low-power microcontrollers (MCUs) and the battery-powered equipment.

The MPQ2013D provides wide variety of fixed output voltage (V_{OUT}) versions by request: 2.5V, 3.3V, and 5V. In addition, the MPQ2013D has an adjustable V_{OUT} version that can be set between 1.215V and 15V.

The MPQ2013D includes thermal shutdown and current limiting fault protection. The output current (I_{OUT}) is internally limited, and the device is protected against overload and over-temperature conditions.

The MPQ2013D is available in a TSOT23-4 package, and it is available in AEC-Q100 Grade 1.

FEATURES

- 2.5V to 40V Input Voltage (V_{IN}) Range
- 3.3µA Quiescent Supply Current
- Stable with Lower-Value (>0.47µF) Ceramic Output Capacitors
- 100mA Specified Current
- 385mV Dropout at 100mA Load
- Available in Fixed and Adjustable Output Voltage (V_{OUT}) (1.215V to 15V) Versions
- Output ±4% Accuracy
- Specified Current Limit
- Thermal Shutdown
- -40°C to +150°C Specified Junction Temperature (T_J) Range
- Available in a TSOT23-4 Package
- Available in AEC-Q100 Grade 1

APPLICATIONS

- Industrial/Automotive Applications
- Portable/Battery-Powered Equipment
- Ultra Low Power Microcontrollers (MCUs)
- Cellular Handsets
- Medical Imaging

TYPICAL APPLICATION

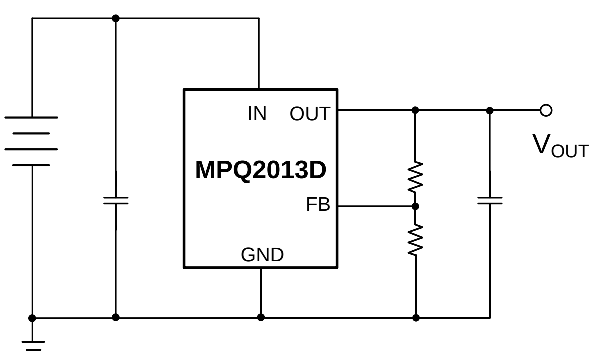


Figure 1: Adjustable-Output Version

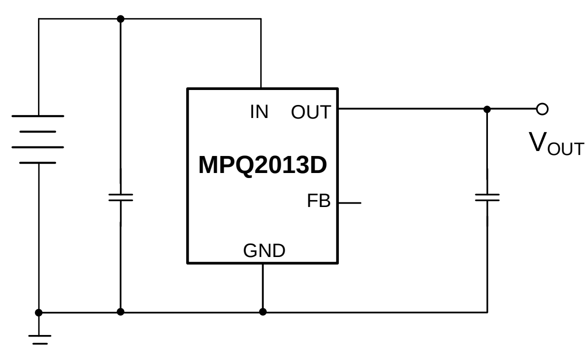


Figure 2: Fixed-Output Version

ORDERING INFORMATION

Part Number*	Package	Top Marking	MSL Rating**
MPQ2013DGJE-AEC1	TSOT23-4	*See below*	1
MPQ2013DGJE-25-AEC1	TSOT23-4		
MPQ2013DGJE-33-AEC1	TSOT23-4		
MPQ2013DGJE-5-AEC1	TSOT23-4		

***** For Tape & Reel, add suffix -Z (e.g. MPQ2013DGJE-AEC1-Z).

****** Moisture Sensitivity Level Rating

TOP MARKING

MPQ2013DGJE-AEC1

|AJDY

AJD: Part code of MPQ2013DGJE-AEC1
Y: Year code

MPQ2013DGJE-25-AEC1

|ALKY

ALK: Part code of MPQ2013DGJE-25-AEC1
Y: Year code

MPQ2013DGJE-33-AEC1

|AJZY

AJZ: Part code of MPQ2013DGJE-33-AEC1
Y: Year code

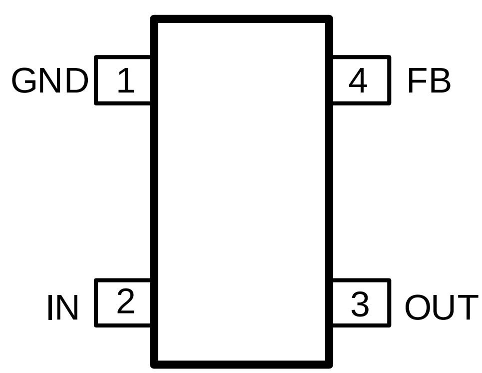
MPQ2013DGJE-5-AEC1

|ALJY

ALJ: Part code of MPQ2013DGJE-5-AEC1
Y: Year code

PACKAGE REFERENCE

TOP VIEW



TSOT23-4

PIN FUNCTIONS

Pin #	Name	Description
1	GND	**Ground.**
2	IN	**Input voltage.** Connect a 2.5V to 40V supply to the IN pin.
3	OUT	**Regulated output voltage**. For stability, place a low-value ceramic capacitor (≥0.47µF) on the output.
4	FB	**Feedback input pin.** The FB pin is regulated to 1.215V nominally. Connected to an external resistor divider between OUT and GND to set the output voltage. For the fixed-output version, this pin can be just float.

ABSOLUTE MAXIMUM RATINGS (1)

IN……………………………………-0.3V to +42V
OUT ....-0.3V to +17V
FB……………………………………-0.3V to +6V
Junction temperature (T_J) ....150°C
Lead temperature ....260°C
Storage temperature .... -65°C to +150°C
Continuous power dissipation (T_A = 25°C) (2)
TSOT23-4 .... 0.45W

ESD Ratings

Human body model (HBM)..................Class 2 (3)
Charged-device model (CDM)........Class C0b (4)

Recommended Operating Conditions (5)

Supply voltage (V_{IN}) ....2.5V to 40V
Output voltage (V_{OUT}) ....1.215V to 15V
Operating temperature (T_A = -40°C to +125°C)
……………………………….. $T_A \le T_J \le$ +150°C

Thermal Resistance θ_{JA} θ_{JC}

TSOT23-4.........................220.....110....°C/W (6)

Notes:

1) Exceeding these ratings may damage the device.
2) The maximum allowable power dissipation is a function of the maximum junction temperature, T_J (MAX), the junction-to-ambient thermal resistance, θ_{JA}, and the ambient temperature, T_A. The maximum allowable continuous power dissipation at any ambient temperature is calculated by P_D (MAX) = (T_J (MAX) - T_A) / θ_{JA}. Exceeding the maximum allowable power dissipation can cause excessive die temperature, and the regulator may go into thermal shutdown. Internal thermal shutdown circuitry protects the device from permanent damage.
3) Per AEC-Q100-002.
4) Per AEC-Q100-011.
5) The device is not guaranteed to function outside of its operating conditions.
6) Measured on a JESD51-7, 4-layer PCB. The values given in this table are only valid for comparison with other packages and cannot be used for design purposes. These values were calculated in accordance with JESD51-7, and simulated on a specified JEDEC board. They do not represent the performance obtained in an actual application. The value of θ_{JC} shows the thermal resistance from junction-to-case bottom.

ELECTRICAL CHARACTERISTICS

C_{OUT} = 1µF, T_A = -40°C to +125°C, $T_A \leq T_J \leq$ +150°C, unless otherwise noted. Typical values are at T_A = 25°C, unless otherwise noted.

Parameter	Symbol	Condition	Min	Typ	Max	Units
Input voltage	V_{IN}		2.5		40	V
Output voltage range	V_{OUT}		1.215		15	V
GND pin current	I_{GND}	MPQ2013DGJE-AEC1, 0mA < I_{OUT} < 1mA, V_{IN} = 2.5V to 40V, V_{OUT} = 5V (V_{IN} ≥ 6V) or FB (V_{IN} < 6V)		3.3	9	µA
		MPQ2013DGJE-AEC1, 1mA < I_{OUT} < 30mA, V_{IN} = 2.5V to 15V, V_{OUT} = 5V (V_{IN} ≥ 6V) or FB (V_{IN} < 6V)		11	22	
		MPQ2013DGJE-AEC1, 30mA < I_{OUT} < 100mA, V_{IN} = 2.5V, V_{OUT} = FB		35	50	
		MPQ2013DGJE-33-AEC1, 0mA < I_{OUT} < 1mA, V_{IN} = 4.3V to 40V		4.4	10	µA
		MPQ2013DGJE-33-AEC1, 1mA < I_{OUT} < 30mA, V_{IN} = 4.3V to 15V		15	25	
		MPQ2013DGJE-33-AEC1, 30mA < I_{OUT} < 100mA, V_{IN} = 4.3V		35	50	µA
		MPQ2013DGJE-5-AEC1, 0mA < I_{OUT} < 1mA, V_{IN} = 6V to 40V		4.4	10	µA
		MPQ2013DGJE-5-AEC1, 1mA < I_{OUT} < 30mA, V_{IN} = 6V to 15V		15	25	
		MPQ2013DGJE-5-AEC1, 30mA < I_{OUT} < 100mA, V_{IN} = 6V		35	50	
		MPQ2013DGJE-25-AEC1, 0mA < I_{OUT} < 1mA, V_{IN} = 3.5V to 40V		4.4	10	µA
		MPQ2013DGJE-25-AEC1, 1mA < I_{OUT} < 30mA, V_{IN} = 3.5V to 15V		15	25	
		MPQ2013DGJE-25-AEC1, 30mA < I_{OUT} < 100mA, V_{IN} = 3.5V		30	40	
Load current limit	I_{LIMIT}	MPQ2013DGJE-AEC1, MPQ2013DGJE-5-AEC1, V_{OUT} = 0V, V_{IN} = 6V to 15V	120	270	400	mA
		MPQ2013DGJE-33-AEC1, V_{OUT} = 0V, V_{IN} = 4.3V to 15V				
		MPQ2013DGJE-25-AEC1, V_{OUT} = 0V, V_{IN} = 3.5V to 15V				

ELECTRICAL CHARACTERISTICS *(continued)*

C_{OUT} = 1µF, T_A = -40°C to +125°C, $T_A \leq T_J \leq$ +150°C, unless otherwise noted. Typical values are at T_A = 25°C, unless otherwise noted.

Parameter	Symbol	Condition	Min	Typ	Max	Units
Output voltage accuracy		MPQ2013DGJE-25-AEC1, V_{IN} = 3.5V, I_{OUT} = 0mA, T_A = 25°C	2.463	2.5	2.537	V
		MPQ2013DGJE-25-AEC1, V_{IN} = 3.5V, I_{OUT} = 0mA, T_A = -40°C to +125°C	2.4	2.5	2.6	
		MPQ2013DGJE-33-AEC1, V_{IN} = 4.3V, I_{OUT} = 0mA, T_A = 25°C	3.251	3.3	3.349	
		MPQ2013DGJE-33-AEC1, V_{IN} = 4.3V, I_{OUT} = 0mA, T_A = -40°C to +125°C	3.168	3.3	3.432	
		MPQ2013DGJE-5-AEC1, V_{IN} = 6V, I_{OUT} = 0, T_A = 25°C	4.925	5	5.075	
		MPQ2013DGJE-5-AEC1, V_{IN} = 6V, I_{OUT} = 0, T_A = -40°C to +125°C	4.8	5	5.2	
FB voltage	V_{FB}	MPQ2013DGJE-AEC1, MPQ2013DGJE-25-AEC1, MPQ2013DGJE-33-AEC1, MPQ2013DGJE-5-AEC1, FB = V_{OUT}, V_{IN} = 6V, I_{OUT} = 0mA, T_A = 25°C	1.197	1.215	1.233	V
		MPQ2013DGJE-AEC1, MPQ2013DGJE-25-AEC1, MPQ2013DGJE-33-AEC1, MPQ2013DGJE-5-AEC1, FB = V_{OUT}, V_{IN} = 6V, I_{OUT} = 0mA, T_A = -40°C to +125°C	1.167	1.215	1.263	
Dropout voltage (V_{IN} = $V_{OUT(NOM)}$ - 0.1V)	$V_{DROPOUT}$	MPQ2013DGJE-25-AEC1, I_{OUT} = 100mA, $V_{OUT(NOM)}$ = 2.5V		550	900	mV
		MPQ2013DGJE-33-AEC1, I_{OUT} = 100mA, $V_{OUT(NOM)}$ = 3.3V		500	900	
		MPQ2013DGJE-AEC1, MPQ2013DGJE-5-AEC1, I_{OUT} = 100mA, $V_{OUT(NOM)}$ = 5V		400	900	
FB pin input current	I_{FB}	MPQ2013DGJE-25-AEC1, MPQ2013DGJE-33-AEC1, MPQ2013DGJE-5-AEC1, V_{FB} = 1.3V, V_{IN} = 6V, OUT floating	0.88	1.3	1.72	µA
		MPQ2013DGJE-AEC1, V_{FB} = 1.3V, V_{IN} = 6V, OUT floating	-50	0	+50	nA
Line regulation (7)		V_{IN} = 2.5 to 40V, I_{OUT} = 1mA, V_{OUT} = FB		0.01	0.05	% / V
Load regulation (8)		MPQ2013DGJE-AEC1, I_{OUT} = 100µA to 100mA, V_{IN} = 3V to 6V		0.005	0.012	% / mA
		MPQ2013DGJE-25-AEC1, I_{OUT} = 100µA to 100mA, V_{IN} = 3.5V to 6V				
		MPQ2013DGJE-33-AEC1, I_{OUT} = 100µA to 100mA ,V_{IN} = 4.3V to 6V				
		MPQ2013DGJE-5-AEC1, I_{OUT} = 100µA to 100mA ,V_{IN} = 6V				

ELECTRICAL CHARACTERISTICS *(continued)*

C_{OUT} = 1µF, T_A = -40°C to +125°C, $T_A \leq T_J \leq$ +150°C, unless otherwise noted. Typical values are at T_A = 25°C, unless otherwise noted.

Parameter	Symbol	Condition	Min	Typ	Max	Units
Output voltage PSRR (9)		100Hz, C_{IN} = 100pF, C_{OUT} = 4.7µF, I_{OUT} = 10mA, V_{IN} = 6V, V_{OUT} = 5V		58		dB
		1kHz, C_{IN} = 100pF, C_{OUT} = 4.7µF, I_{OUT} = 10mA, V_{IN} = 6V, V_{OUT} = 5V		41		dB
		100kHz, C_{IN} = 100pF, C_{OUT} = 4.7µF, I_{OUT} = 10mA, V_{IN} = 6V, V_{OUT} = 5V		55		dB
Start-up response time		MPQ2013DGJE-AEC1, I_{OUT} = 100mA, C_{OUT} = 6.8µF, V_{OUT} = 5V			3	ms
		MPQ2013DGJE-25-AEC1, I_{OUT} = 10mA, C_{OUT} = 6.8µF, V_{OUT} = 2.5V			1.5	
		MPQ2013DGJE-33-AEC1, I_{OUT} = 10mA, C_{OUT} = 6.8µF, V_{OUT} = 3.3V			1.8	
		MPQ2013DGJE-5-AEC1, I_{OUT} = 10mA, C_{OUT} = 6.8µF, V_{OUT} = 5V			3	
Thermal shutdown (9)	T_{SD}		150	165		°C
Thermal shutdown hysteresis (9)	ΔT_{SD}			20		°C

Notes:

7) The line regulation can be calculated with the following equation:

$$\text{Line Regulation} = \frac{|V_{OUT[V_{IN(MAX)}]} - V_{OUT[V_{IN(MIN)}]}|}{(V_{IN(MAX)} - V_{IN(MIN)}) \times V_{OUT(NOM)}} \times (\%/V)$$

8) The load regulation can be calculated with the following equation:

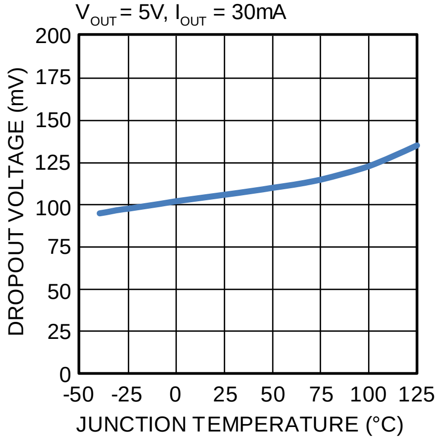
$$\text{Load Regulation} = \frac{|V_{OUT[I_{OUT(MAX)}]} - V_{OUT[I_{OUT(MIN)}]}|}{(I_{OUT(MAX)} - I_{OUT(MIN)}) \times V_{OUT(NOM)}} \times (\%/mA)$$

9) Derived from bench characterization. Not tested in production.

TYPICAL CHARACTERISTICS

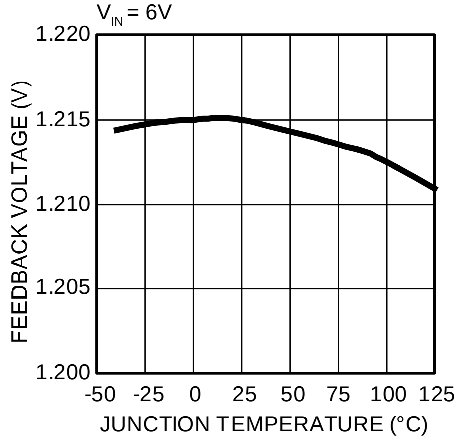
Dropout Voltage vs. Junction Temperature

V_{OUT} = 5V, I_{OUT} = 30mA



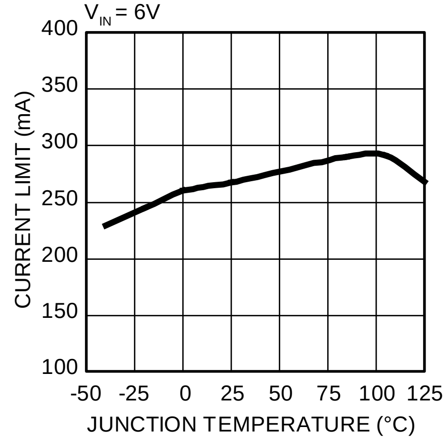
Feedback Voltage vs. Junction Temperature

V_{IN} = 6V



Current Limit vs. Junction Temperature

V_{IN} = 6V

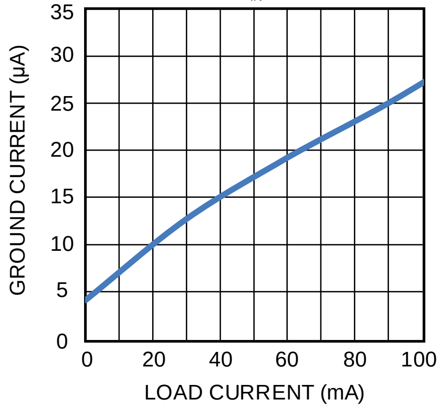


TYPICAL PERFORMANCE CHARACTERISTICS

C_{IN} = 1µF, C_{OUT} = 4.7µF, V_{OUT} = 5V, T_A = 25°C, unless otherwise noted.

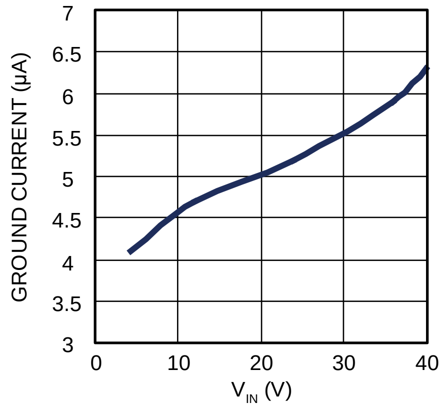
Ground Current vs. Load Current

MPQ2013D-33, V_{IN} = 4.3V



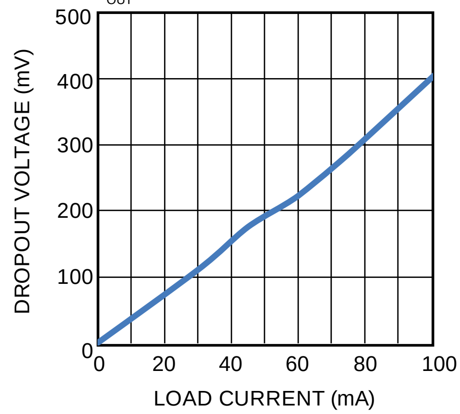
Ground Current vs. V_{IN}

MPQ2013D-33, I_{OUT} = 0mA

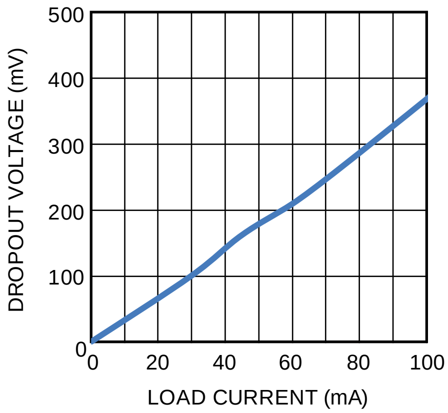


Dropout Voltage vs. Load Current

V_{OUT} = 3.3V

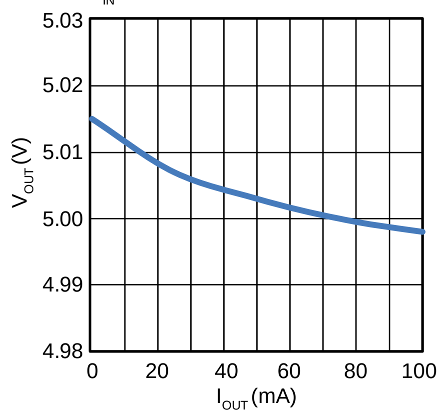


Dropout Voltage vs. Load Current



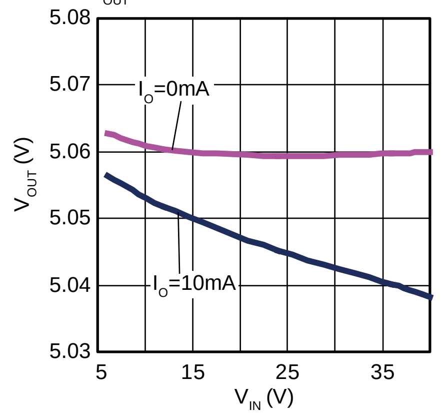
V_{OUT} vs. I_{OUT}

V_{IN} = 6V



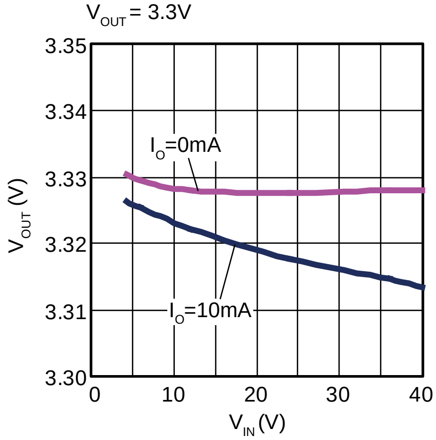
V_{OUT} vs. V_{IN}

V_{OUT} = 5V



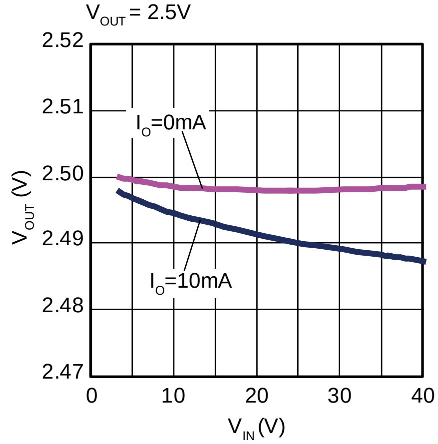
V_{OUT} vs. V_{IN}

V_{OUT} = 3.3V



V_{OUT} vs. V_{IN}

V_{OUT} = 2.5V

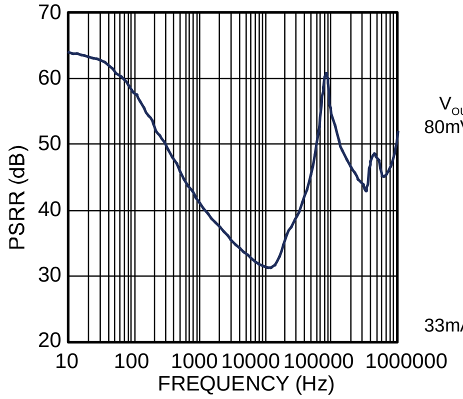


TYPICAL PERFORMANCE CHARACTERISTICS *(continued)*

C_{IN} = 1μF, C_{OUT} = 4.7μF, V_{OUT} = 5V, T_A = 25°C, unless otherwise noted

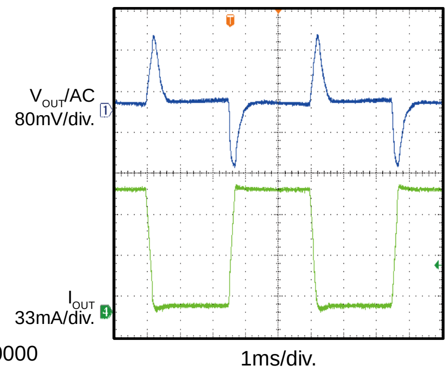
PSRR vs. Frequency

V_{IN1} = V_{IN2} = 6V, I_{OUT} = 10mA, C_{IN} = 100pF



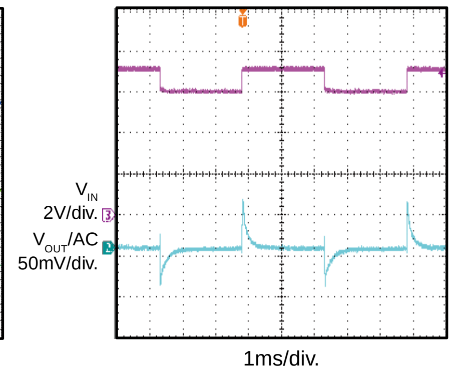
Load Transient

V_{IN} = 12V, I_{OUT} = 8mA to 100mA



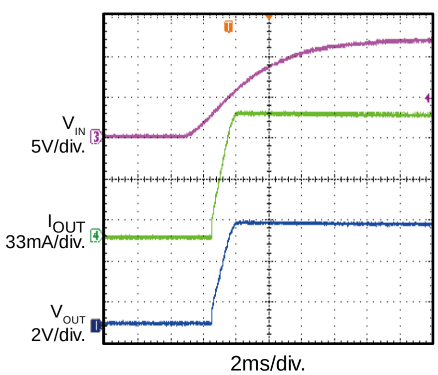
Line Transient

V_{IN} = 6V to 7V, I_{OUT} = 100mA



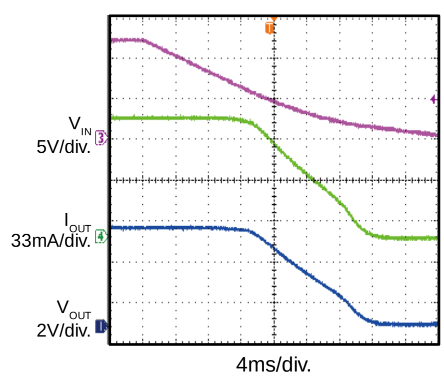
Start-Up through VIN

V_{IN} = 12V, I_{OUT} = 100mA



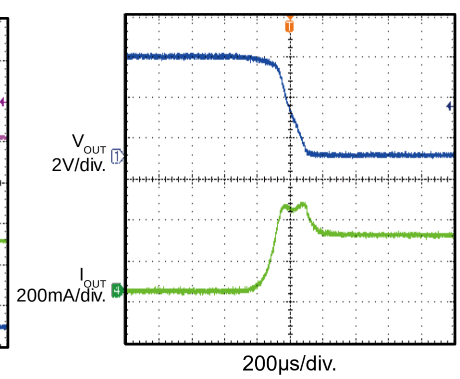
Shutdown through VIN

V_{IN} = 12V, I_{OUT} = 100mA



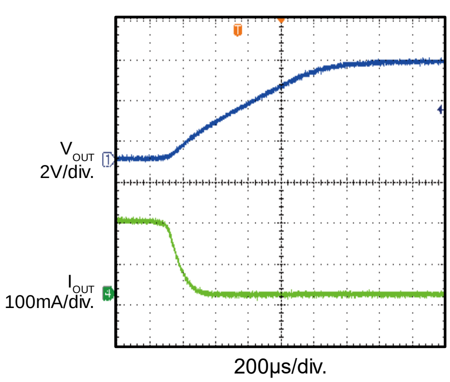
Short Circuit Entry

V_{IN} = 12V, I_{OUT} = 0mA to short circuit



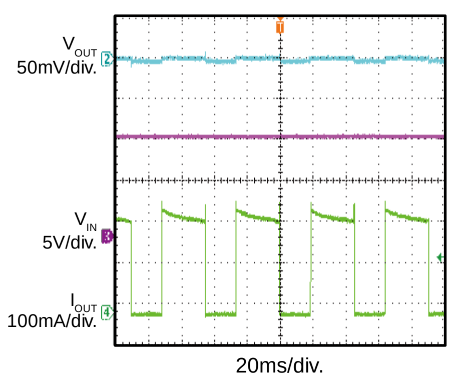
Short Circuit Recovery

V_{IN} = 12V, short circuit to I_{OUT} = 0mA



Short Circuit Steady State

V_{IN} = 12V



FUNCTIONAL BLOCK DIAGRAM

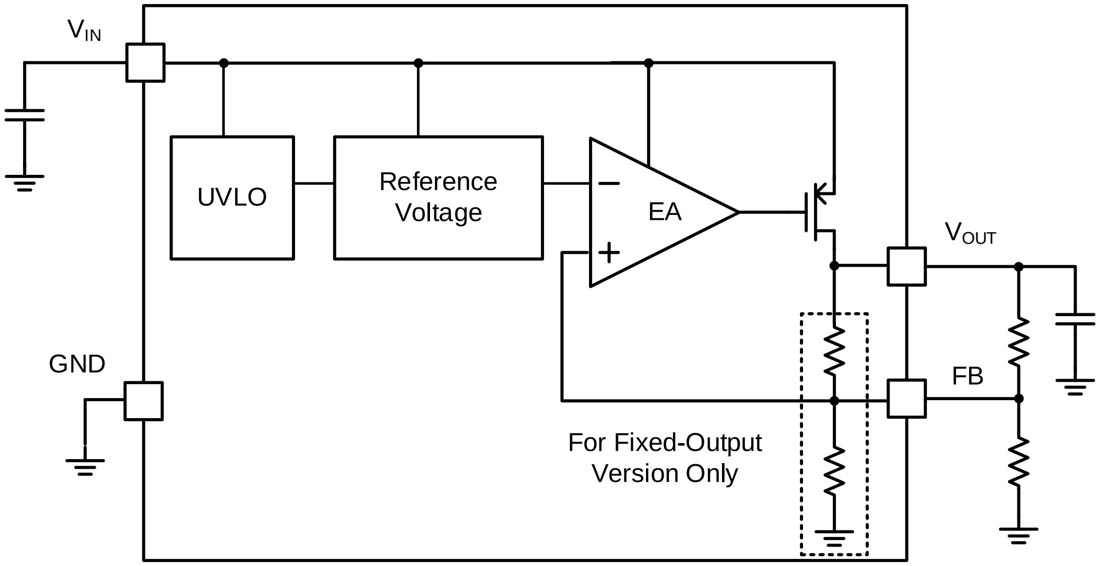


Figure 3: Functional Block Diagram

OPERATION

The MPQ2013D is a linear regulator that supplies power to systems with high-voltage batteries. The device features a wide 2.5V to 40V input voltage (V_{IN}) range, low dropout voltage and low quiescent supply current.

The MPQ2013D provides wide variety of fixed output voltage (V_{OUT}) options: 2.5V, 3.3V, and 5V. In addition, the MPQ2013D has an adjustable V_{OUT} version that can be set between 1.215V and 15V.

The output adjustable version sets V_{OUT} with a simple resistor divider. With external feedback, the user can set V_{OUT} with an external resistor divider. The typical FB pin voltage is 1.215V.

The output current (I_{OUT}) is internally limited, and the device is protected against overload and over-temperature conditions.

The peak I_{OUT} is limited to about 270mA; however, the recommended continuous I_{OUT} is 100mA.

When the junction temperature (T_J) exceeds its limit, the thermal sensor sends a signal to the control logic that shuts down the MPQ2013D. The device restarts when the temperature has sufficiently cooled.

The maximum output current is a function of the package's maximum power dissipation for a given temperature.

The maximum power dissipation is dependent on the thermal resistance of the case and the circuit board, the temperature difference between the die junction and the ambient air, and the rate of air flow.

APPLICATION INFORMATION

Figure 2 shows MPQ2013D typical application circuit.

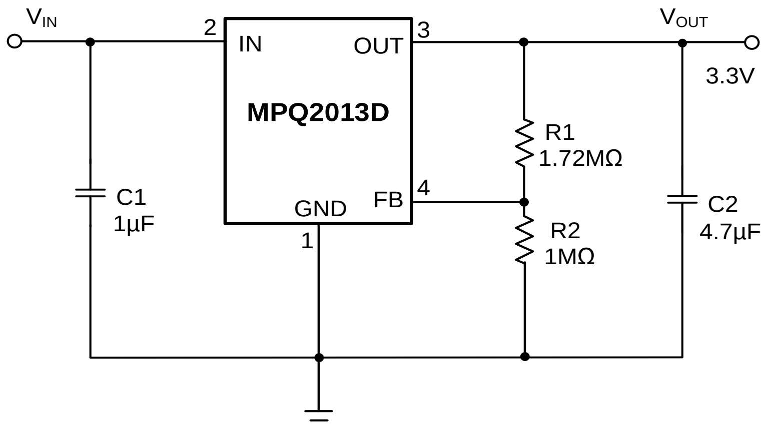


Figure 4: Typical Application Circuit (V_{OUT} = 3.3V)

Table 1 shows the design guide index. For more details, see Figure 4 above.

Table 1: Design Guide Index

Pin #	Name	Components	Design Guide Index
2	IN	C1	Selecting the Input Capacitor (IN, Pin 2)
3	OUT	C2	Selecting the Output Capacitor (OUT, Pin 3)
4	FB	R1, R2	Setting the Output Voltage (FB, Pin 4)
1	GND	-	GND Connection (GND, Pin 1)

Selecting the Input Capacitor (IN, Pin 2)

For proper operation, place a 1μF to 10μF ceramic capacitor (C1) with X5R or X7R dielectrics between the input pin and ground. A larger-value capacitor improves line transient response.

Selecting the Output Capacitor (OUT, Pin 3)

For stable operation, use a 1μF to 10μF ceramic capacitor (C2) with X5R or X7R dielectrics. A larger-value capacitor improves load transient response and reduces noise.

Output capacitors with other dielectric types may be used, but they are not recommended, as their capacitance can deviate greatly from their rated value across different temperatures.

To improve load transient response, add a small (X5R, X7R or Y5V dielectric), 22nF, feed-forward ceramic capacitor in parallel with R1. The feed-forward capacitor is not required for stable operation.

Setting the Output Voltage (FB, Pin 4)

Set V_{OUT} using a resistor divider (see Figure 5).

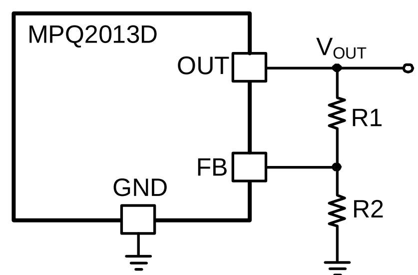


Figure 5: FB Resistor Divider Sets V_{OUT}

Choose R2 = 1MΩ to maintain a 1.215μA minimum load. Calculate R1 with Equation (1):

$$R1 = R2 \times \left(\frac{V_{OUT}}{1.215V} - 1 \right) \quad (1)$$

For the fixed V_{OUT} versions, V_{OUT} also can be adjusted by adding an external resistor divider (see Figure 6 on page 13). Consider the internal FB resistor divider when selecting the external divider.

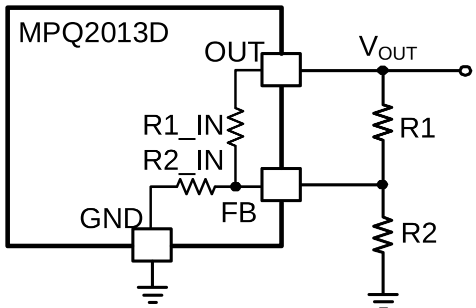


Figure 6: FB Divider for Fixed V_{OUT} Version

When R2 is selected, estimate R1 with Equation (2):

$$R1 = \frac{R1\_IN}{\frac{1.215 \times R1\_IN \times (R2 + R2\_IN)}{(V_{OUT} - 1.215) \times R2 \times R2\_IN} - 1} \quad (2)$$

Table 2 shows the internal FB resistor dividers for different fixed V_{OUT} versions.

Table 2: Internal FB Resistor Divider

Fixed Output Voltage (V)	R1_IN (MΩ)	R2_IN (MΩ)
2.5	1.058	1
3.3	1.716	1
5	3.117	1

Table 3 shows an example of an external FB divider being used to change V_{OUT} for the fixed 3.3V V_{OUT} version.

Table 3: 3.3V Fixed-Output Version External FB Divider

V_{OUT} (V)	R1 (kΩ)	R2 (kΩ)
11	84.5	10
8.5	61.9	10
8	57.6	10
6.5	44.2	10
5	31.6	10

GND Connection (GND, Pin 1)

See the PCB Layout Guidelines section on page 14 for more details.

Output Noise

The MPQ2013D exhibits noise on the output during normal operation. This noise is negligible for most applications. However, in applications that include analog-to-digital converters (ADCs) of more than 12 bits, consider the ADC's power supply rejection specifications.

The feed-forward capacitor (C2) across R1 can significantly reduce output noise.

External Reverse-Voltage Protection (RVP)

In some situations (e.g. a backup battery is connected as the MPQ2013D's load), V_{OUT} may be held at a higher value while the input is pulled to ground, pulled to an intermediate voltage, or is floating. In this scenario, V_{OUT} exceeds V_{IN}.

Since the MPQ2013D's P-channel MOSFET pass element has a body diode, a current conducts from the output to the input, and it is not internally limited. The MPQ2013D may be damaged by this unlimited reverse current. To prevent damage, it is recommended to place an external diode at the input (see Figure 7).

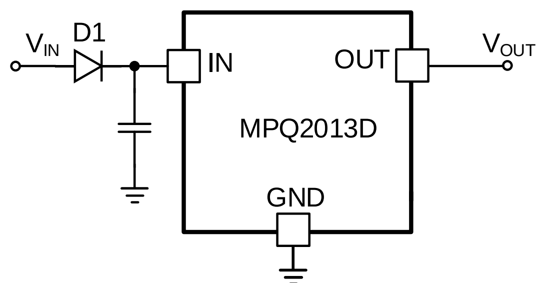


Figure 7: External Reverse-Voltage Protection

Design Example

Figure 8 shows a design example following the application guidelines for V_{OUT} = 3.3V with a feed-forward capacitor.

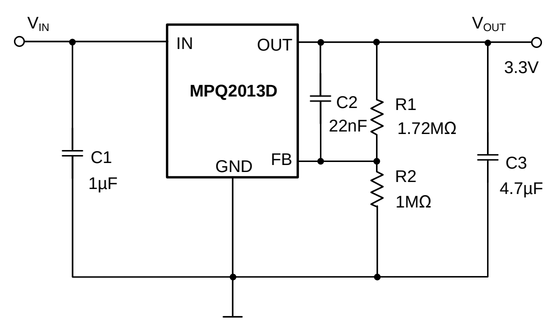


Figure 8: Design Example

PCB Layout Guidelines

PCB layout is very important to achieve excellent regulation, ripple rejection, transient response, and thermal performance. It is recommended to duplicate the EVB layout for optimal performance. For the best results, refer to Figure 9 and Figure 10, and follow the guidelines below:

1. Place the input bypass ceramic capacitor as close as possible to the IN pin.
2. Place the output bypass ceramic capacitor as close as possible to the OUT pin.
3. Ensure that all feedback connections are short and direct.
4. Place the feedback resistors and compensation components as close to the chip as possible.
5. Connect IN, OUT, and GND to a large copper area to cool the chip, and improve thermal performance and long-term reliability. This is particularly important for GND.

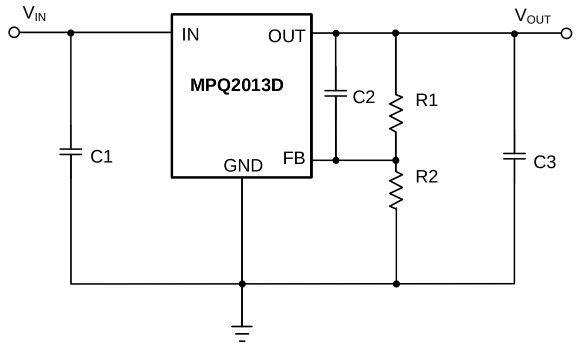


Figure 9: Typical Application Circuit

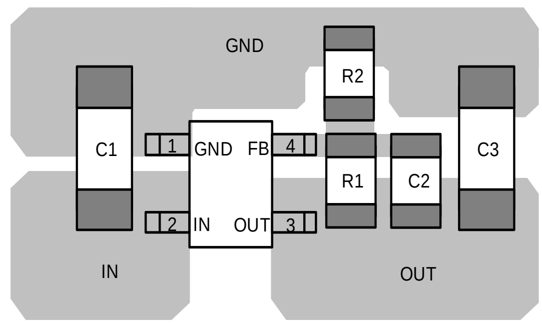


Figure 10: Recommended PCB Layout (Top Layer)

TYPICAL APPLICATION CIRCUITS

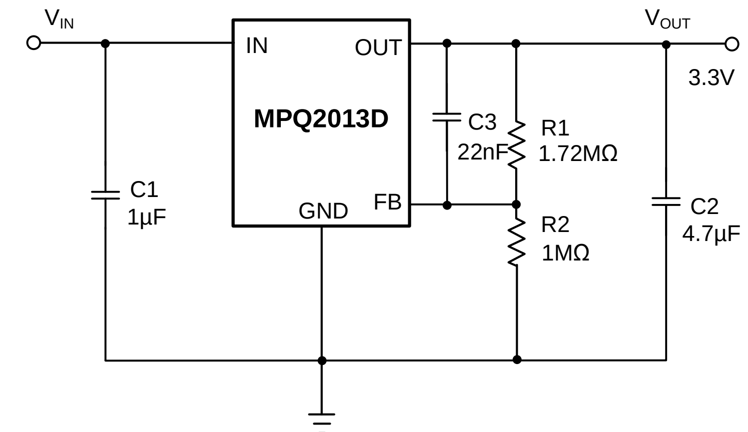


Figure 11: Typical Application Circuit (3.3V Output with Feed-Forward Capacitor)

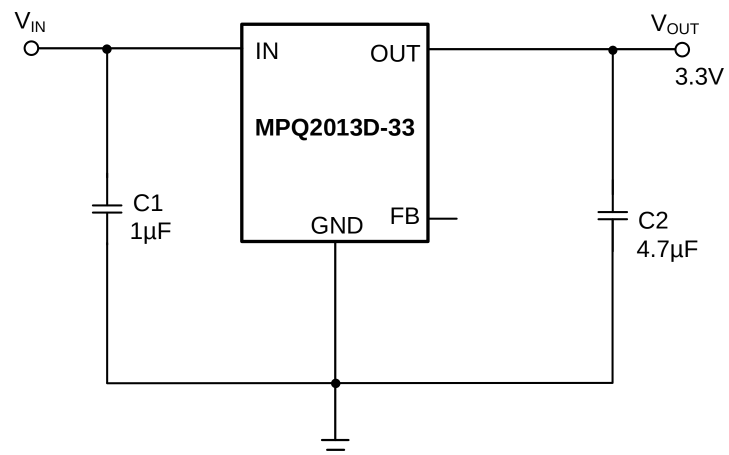


Figure 12: Typical Application Circuit (3.3V Fixed Output)

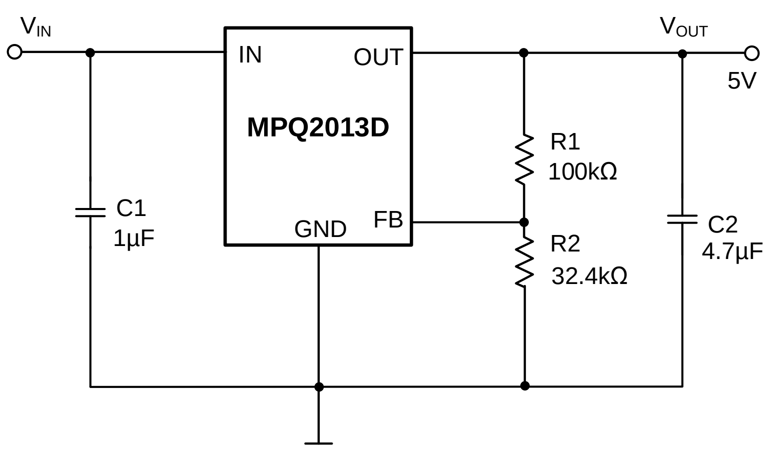
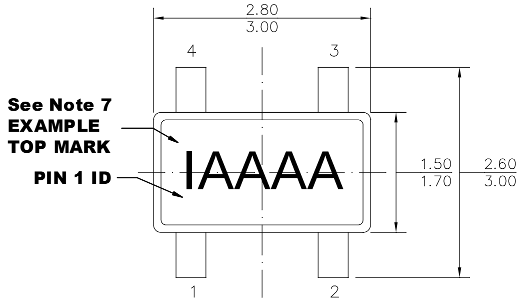


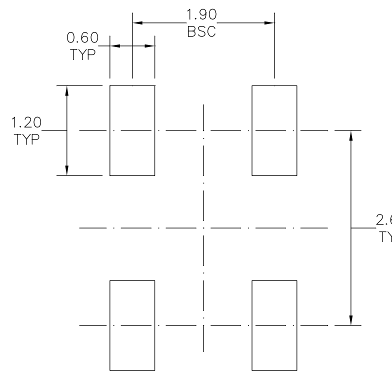
Figure 13: Typical Application Circuit (5V Output)

PACKAGE INFORMATION

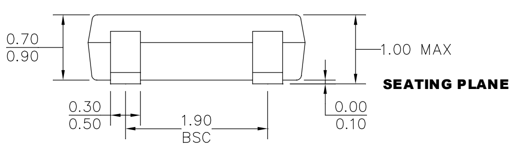
TSOT23-4



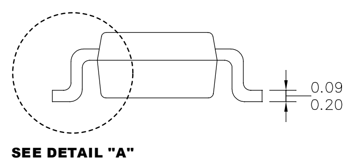
TOP VIEW



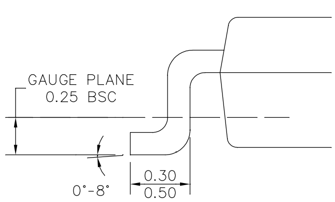
RECOMMENDED LAND PATTERN



FRONT VIEW



SIDE VIEW

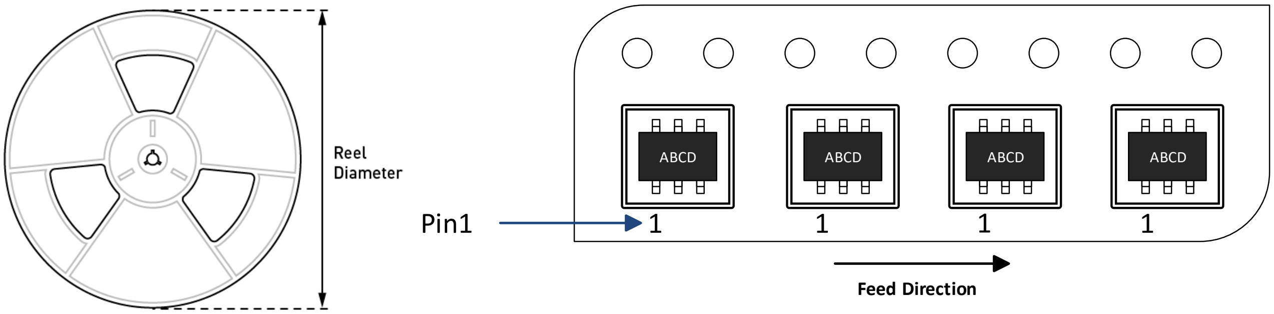


DETAIL A

NOTE:

1) ALL DIMENSIONS ARE IN MILLIMETERS.
2) PACKAGE LENGTH DOES NOT INCLUDE MOLD FLASH, PROTRUSION, OR GATE BURR.
3) PACKAGE WIDTH DOES NOT INCLUDE INTERLEAD FLASH OR PROTRUSION.
4) LEAD COPLANARITY (BOTTOM OF LEADS AFTER FORMING) SHALL BE 0.10 MILLIMETERS MAX.
5) DRAWING CONFORMS TO JEDEC MO-193, VARIATION AA.
6) DRAWING IS NOT TO SCALE.
7) PIN 1 IS THE LOWER LEFT PIN WHEN READING TOP MARK FROM LEFT TO RIGHT (SEE EXAMPLE TOP MARK).

CARRIER INFORMATION



Part Number	Package Description	Quantity/ Reel	Quantity/ Tube	Quantity/ Tray	Reel Diameter	Carrier Tape Width	Carrier Tape Pitch
MPQ2013DGJE-AEC1-Z	TSOT23-4	3000	N/A	N/A	7in	8mm	4mm
MPQ2013DGJE-25-AEC1-Z							
MPQ2013DGJE-33-AEC1-Z							
MPQ2013DGJE-5-AEC1-Z							

REVISION HISTORY

Revision #	Revision Date	Description	Pages Updated
1.0	5/22/2023	Initial Release	-