

MLSR05DFW Series

Ultra-Miniature "Chip" 0.5A Surface Mount Switching Regulators



Key Features:

- Ultra-Miniature DFN Case
- 0.5A Output Current
- Efficiency to 92%
- Short Circuit Protected
- 0.2 mA No-Load In. Current
- Wide -40 - +105°C Range
- Adjustable Output Voltage
- AEC-Q100 Approved
- Low Cost

Electrical Specifications

Specifications typical @ +25°C, nominal input voltage & rated output current, unless otherwise noted. Specifications subject to change without notice.

Parameter	Conditions	Min.	Typ.	Max.	Units
No Load Input Current	Nominal Input Voltage		0.1		mA
Input Filter	Capacitor Filter				
Reverse Polarity Protection	See Note 1				

Parameter	Conditions	Min.	Typ.	Max.	Units
Output Voltage Accuracy, See Note 2	3.3V Output Models		±2.0	±4.0	%
	All Other Models		±2.0	±3.0	
Output Voltage Adjust			±10		%
Line Regulation	V _{IN} = Min to Max		±0.2		%
Load Regulation	I _{OUT} = 10% to 100%		±0.4		%
Ripple & Noise (20 MHz)	See Note 3		20	45	mV P - P
Temperature Coefficient			0.02		%/°C
Transient Response Time	See Note 4		0.2	0.8	mS
Transient Response Deviation			±50	±120	mV
Output Short Circuit	Continuous (Autorecovery)				

Parameter	Conditions	Min.	Typ.	Max.	Units
Isolation Voltage	Not Isolated				
Switching Frequency			2.0		MHz

Parameter	Conditions	Min.	Typ.	Max.	Units
Operating Temperature Range	Ambient	-40	+25	+105	°C
Storage Temperature Range		-55		+125	°C
Cooling	Free Air Convection				
Humidity	RH, Non-condensing			95	%

Parameter	Conditions	Min.	Typ.	Max.	Units
Unit On	See Note 5	2.5		5.0	VDC
Unit Off	See Note 5	0		0.6	VDC
Input Current When Off			240		µA

Parameter	Conditions	Min.	Typ.	Max.	Units
Case Size	See Mechanical Diagram (Page 6)				
Case Material	Non-Conductive Black Plastic (UL-94V0)				
Weight	See Mechanical Diagram (Page 6)				

Parameter	Conditions	Min.	Typ.	Max.	Units
MTBF	MIL HDBK 217F, 25°C, Gnd Benign	9.1			MHours
Peak Reflow Temperature	See Note 6			245	°C
Moisture Sensitivity Level (MSL)	IPC/JEDEC J-STD-020D.1	Level 3 (See Note 7)			



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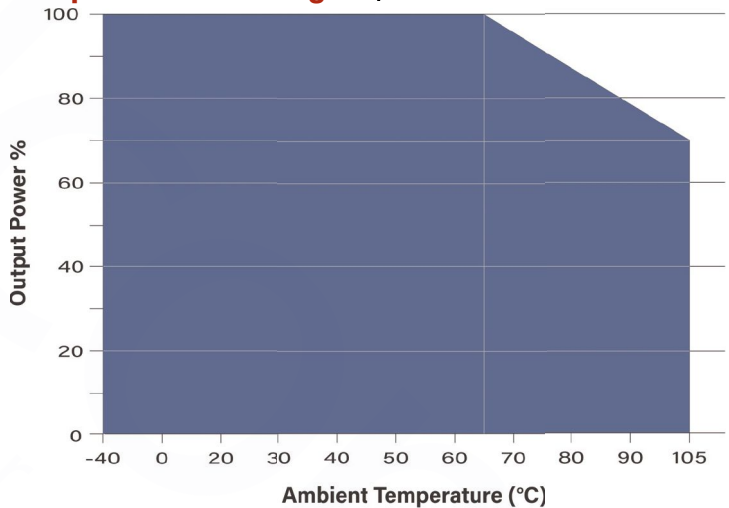
Model Selection Guide

Model Number	Input Voltage (VDC)		Output		Efficiency (% Typ)			Capacitive Load (μ F, Max)
	Nom.	Range	Voltage (VDC)	Current (mA, Max)	Min V_{IN}	Nom V_{IN}	Max V_{IN}	
MLSR05-03DFW	24	4.50 - 36.0	3.3	500	89	79	71	680
	12	7.00 - 32.0	-3.3	-300	80	82	71	470
MLSR05-05DFW	24	6.50 - 36.0	5.0	500	91	83	78	680
	12	7.00 - 31.0	-5.0	-300	78	78	71	470
MLSR05-06DFW	24	8.00 - 36.0	6.5	500	91	85	81	680
	12	7.00 - 28.0	-6.5	-250	80	79	73	470
MLSR05-09DFW	24	12.0 - 36.0	9.0	500	92	90	86	680
	12	8.00 - 27.0	-9.0	-200	82	82	77	470
MLSR05-12DFW	24	15.0 - 36.0	12.0	500	92	91	86	680
	12	8.00 - 24.0	-12.0	-150	81	83	79	470
MLSR05-15DFW	24	18.0 - 36.0	15.0	500	91	91	87	680
	12	8.00 - 21.0	-15.0	-150	80	81	84	470

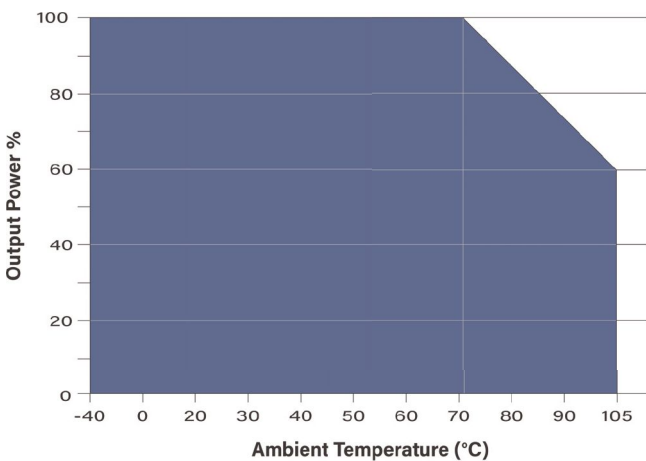
Notes:

- Reverse polarity on the input should be avoided. The unit is not protected internally for this.
- Specified at full load over the full input voltage range specified for the model being tested.
- Specified with the output filter components shown in the typical application circuit on page 4.
- Transient recovery is measured to within a 1% error band for a load step change of 25%.
- If the remote On/Offpin is left open, the unit is on. If it is grounded, the unit shuts off.
- The recommended reflow settings are a peak temperature of 245 °C for a maximum period (TPK) of 10S and a time above liquidous (TL) of \leq 60 seconds at 217 °C. For more information, please contact the factory.
- Any units that are not packaged in a vacuum sealed container should be stored in a controlled environment. Contact the factory for more information.
- This regulator is not designed to be used in parallel with another unit to increase output power.
- The input should not exceed the range given in the model selection chart. Exceeding this limit could damage the unit.
- It is recommended that an external fuse be used. The fuse should be selected based upon the actual input current of the application. For more information please call the factory.

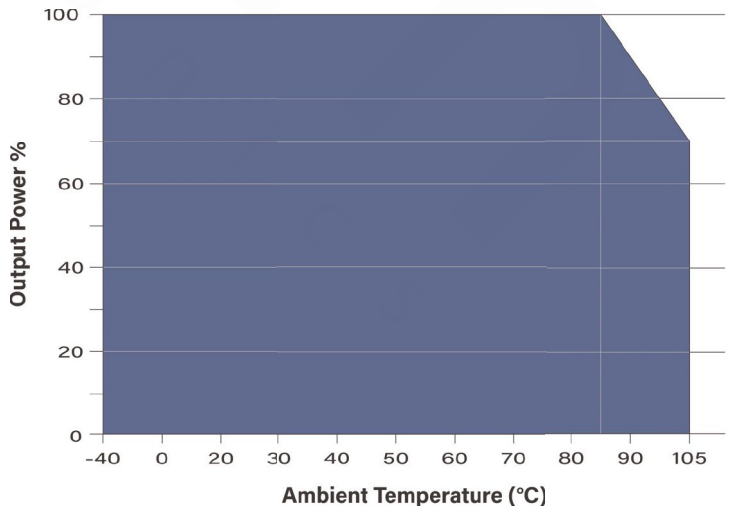
Temperature Derating: 3.3, 5.0 & 6.5 Vout



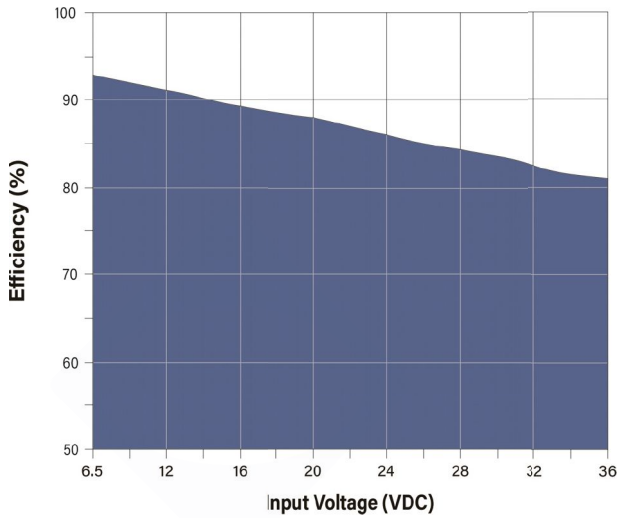
Temperature Derating: 9, 12, 15 Vout, VIN ≤ 26V



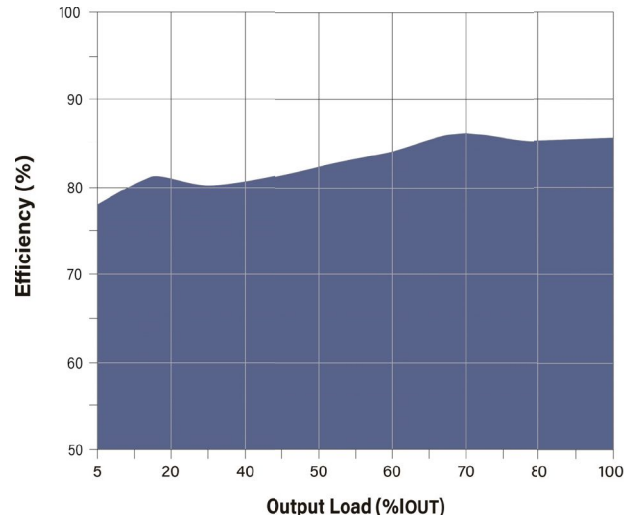
Temperature Derating: 9, 12, 15 Vout, VIN = 26V ≤ 36V



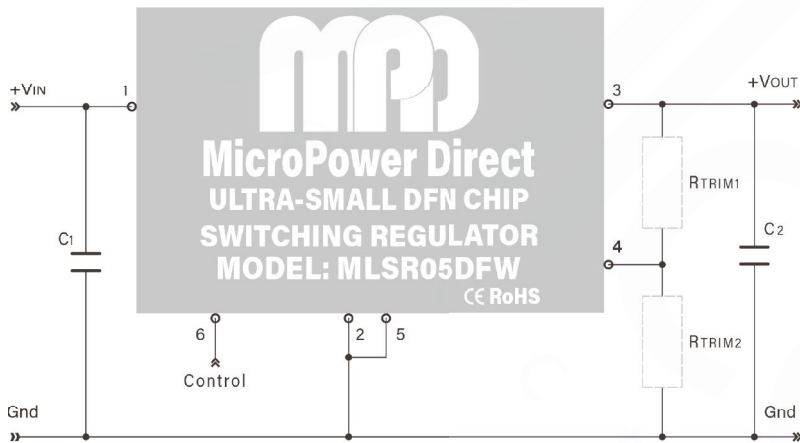
Efficiency vs Input Voltage: MLSR05-05DFW



Efficiency vs Output Load: MLSR05-05DFW



Simple Connection: Pos Output



Component Values

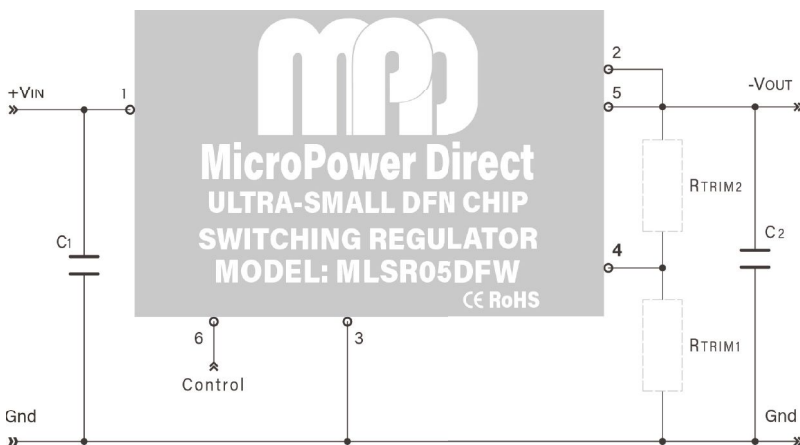
Model Number	C1	C2	R1/R2
MLSR05-03DFW	10 μ F/50V	22 μ F/10V	The resistors RTRIM1 and RTRIM2 are used to adjust the output voltage of the unit. See page 5.
MLSR05-05DFW	10 μ F/50V	22 μ F/10V	
MLSR05-06DFW	10 μ F/50V	22 μ F/16V	
MLSR05-09DFW	10 μ F/50V	22 μ F/16V	
MLSR05-12DFW	10 μ F/50V	22 μ F/25V	
MLSR05-15DFW	10 μ F/50V	22 μ F/25V	

Notes (for positive & negative output connections):

1. C1 & C2 are low ESR ceramic capacitors used to minimize noise at the regulator. A tantalum or low ESR electrolytic capacitor may also be used.
2. C1 & C2 are required and should be mounted as close to the regulator pins as possible.

If meeting EN 55032 EMI specifications is required see the circuit diagrams on page 4.

Simple Connection: Neg Output



Component Values

Model Number	C1	C2	R1/R2
MLSR05-03DFW	10 μ F/50V	22 μ F/10V	The resistors RTRIM1 and RTRIM2 are used to adjust the output voltage of the unit. See page 5.
MLSR05-05DFW	10 μ F/50V	22 μ F/10V	
MLSR05-06DFW	10 μ F/50V	22 μ F/16V	
MLSR05-09DFW	10 μ F/50V	22 μ F/16V	
MLSR05-12DFW	10 μ F/50V	22 μ F/25V	
MLSR05-15DFW	10 μ F/50V	22 μ F/25V	

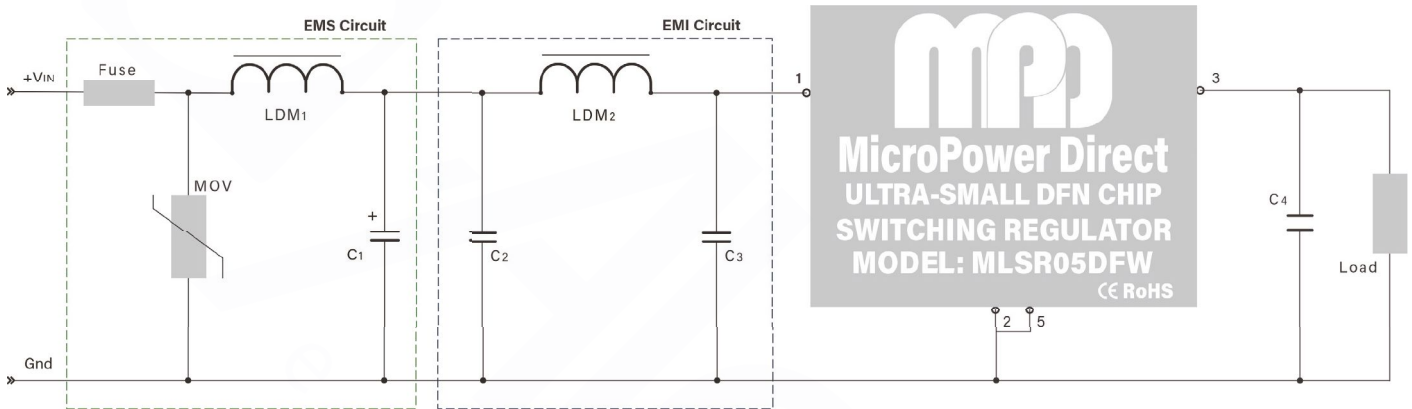
EMI Characteristics

Parameter	Standard	Criteria	Level
Radiated Emissions, See Note 1	EN 55032		Class B
Conducted Emissions, See note 2	EN 55032		Class B
ESD	EN 61000-4-2	B	±6 kV Contact
RS	EN 61000-4-3	A	10V/m
EFT, See Note 3	EN 61000-4-4	B	±1kV
Surge, See Note 3	EN 61000-4-5	B	±1kV (L-L)
CS	EN61000-4-6	A	3V rms

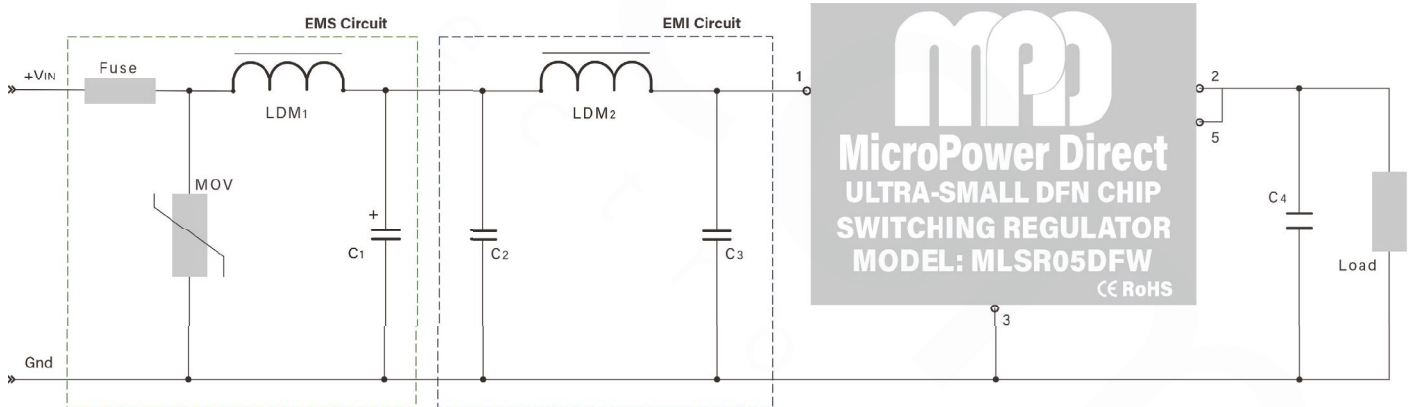
Notes:

1. The unit meets radiated emissions to class B with the addition of external components as shown in the typical connection with external EMC components below.
2. The unit meets conducted emissions to class B with the addition of external components as shown in the typical connection with external EMC components below.
3. The unit meets EFT & surge EMS specifications with the addition of external components as shown in the typical connection with external EMC components below.

Typical Pos Output Connection: With External EMC Components



Typical Neg Output Connection: With External EMC Components



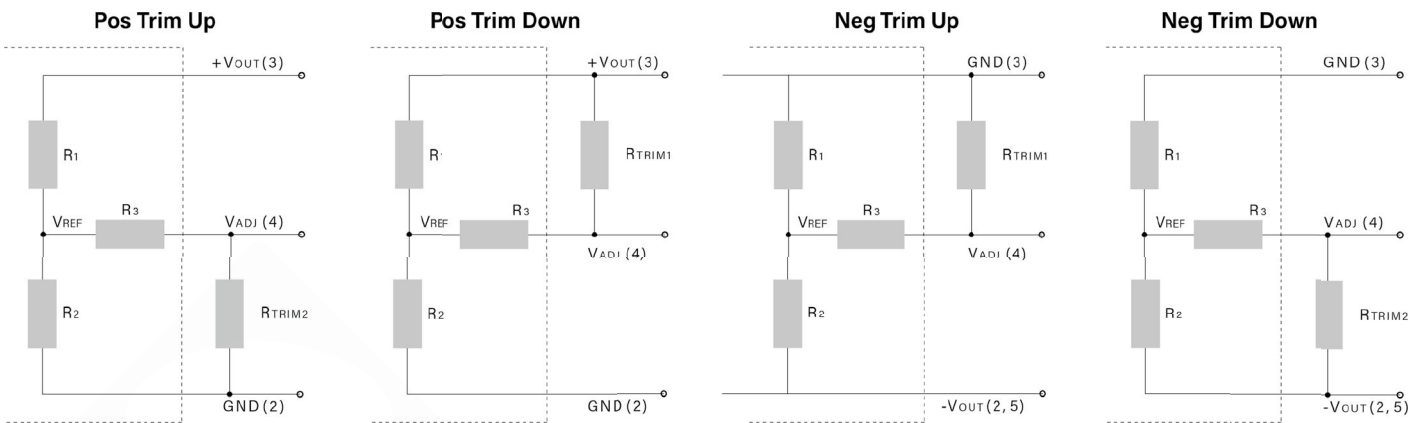
The diagram above illustrates a typical connection of the MLSR05DFW series for applications that require meeting EMC standards. This circuit will typically meet the requirements of EN 55032 class B. Some notes on this diagram (starting with the input circuit) are:

1. It is recommended that an external fuse be used. The fuse should be selected based upon the actual input current of the application. For more information please call the factory.
2. An external MOV is recommended on the input to protect the unit in the event of a surge. A recommended value is given in the table at right.
3. In many applications simply adding input/output capacitors will enhance the input surge protection and reduce output ripple sufficiently. The input capacitor C1 and output capacitors C2 and C3 shown in the typical connection diagrams above.

4. Recommended values for components are:

Model	Component Value						
	MOV	LDM1	C1	C2	LDM2	C3	C4
MLSR05-03DFW (Positive Output)	S20K30	82 μH (CODACA-S P53-820k)	680 μF/50V	10 μF/50V	10 μH (CODACA-S P53-100k)	0.47 μF/50V	22 μF/10V
MLSR05-03DFW (Negative Output)					10 μH (CODACA-S P53-220k)	---	22 μF/10V
MLSR05-05DFW					10 μH (CODACA-S P53-100k)	---	22 μF/10V
MLSR05-06DFW					10 μH (CODACA-S P53-100k)	1.0 μF/50V	22 μF/16V
MLSR05-09DFW					10 μH (CODACA-S P53-100k)	1.0 μF/50V	22 μF/16V
MLSR05-12DFW					22 μH (CODACA-S P53-220k)	0.47 μF/50V	22 μF/25V
MLSR05-15DFW					22 μH (CODACA-S P53-220k)	0.47 μF/50V	22 μF/25V

Output Adjustment



The output of the MLSR05DFW series may be adjusted by connecting either resistor R1 or R2 to the VADJ pin as shown above. Approximate resistor values are given in the table at right. If the output adjust is not required, pin (4) should be left open.

If the output is adjusted, it is important to stay within the specified adjustment range, or the unit could be damaged. The required resistor value is calculated by the formulas:

$$\text{Trim Down} = R_{TRIM1} = \frac{A \times R_1}{R_1 - A} - R_3 \quad \text{Where } A = \frac{V_{OUT} - V_{REF}}{V_{REF}} \times R_2$$

$$\text{Trim Up} = R_{TRIM2} = \frac{A \times R_2}{R_2 - A} - R_3 \quad \text{Where } A = \frac{V_{REF}}{V_{OUT} - V_{REF}} \times R_1$$

Where $R_{TRIM1}, R_{TRIM2} =$ The value of the external trim resistor
 $A =$ A is defined as shown above

The values of R1, R2, R3 and VREF are given in the table below.

Output Trim Resistor Values

Output Voltage	Resistor Value			
	R1 (kΩ)	R2 (kΩ)	R3 (kΩ)	VREF (V)
3.3 VDC	47.00	15.00	82.00	0.80
5.0 VDC	36.00	6.875	36.00	0.80
6.5 VDC	47.00	6.596	36.00	0.80
9.0 VDC	75.00	7.318	47.00	0.80
12.0 VDC	120.0	8.571	51.00	0.80
15.0 VDC	100.0	5.634	36.00	0.80

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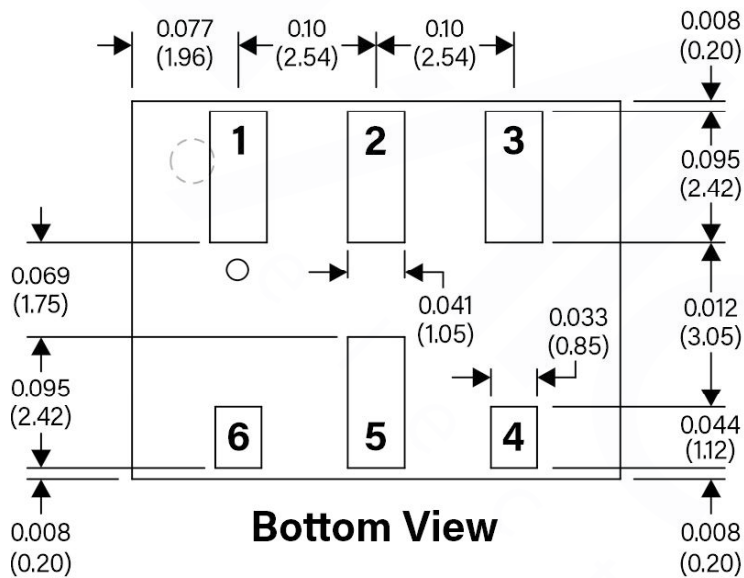
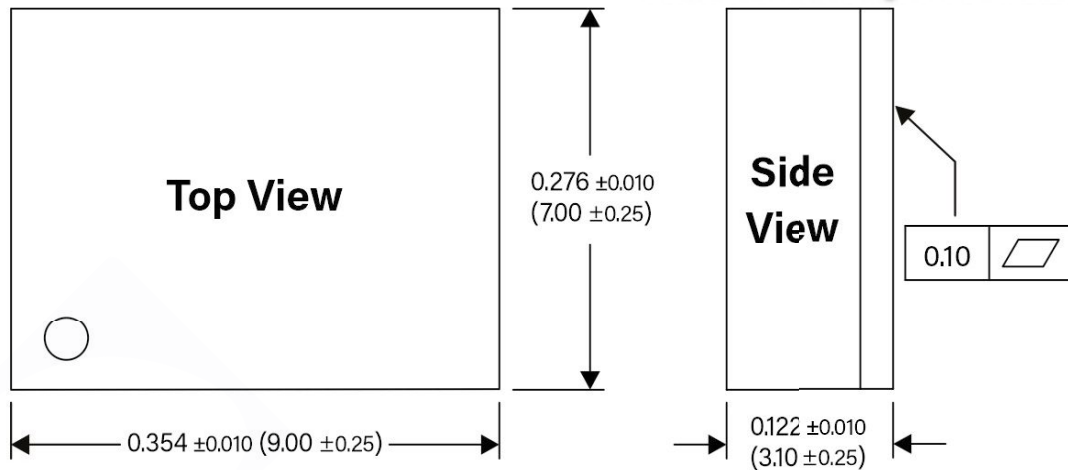
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External Trim Resistor Values

Vout Nom	±3.3 VDC		±5.0 VDC		±6.5 VDC		±9.0 VDC		±12.0 VDC		±15.0 VDC	
Vout Adj	RTRIM1	RTRIM2	RTRIM1	RTRIM2	RTRIM1	RTRIM2	RTRIM1	RTRIM2	RTRIM1	RTRIM2	RTRIM1	RTRIM2
2.97	221 kΩ											
3.63		34 kΩ										
4.50			236 kΩ									
5.50				20 kΩ								
5.85					392 kΩ							
7.15						22 kΩ						
8.10							562 kΩ					
9.90								19 kΩ				
10.80									948 kΩ			
13.20										29 kΩ		
13.50											1,048 kΩ	
16.50												17 kΩ

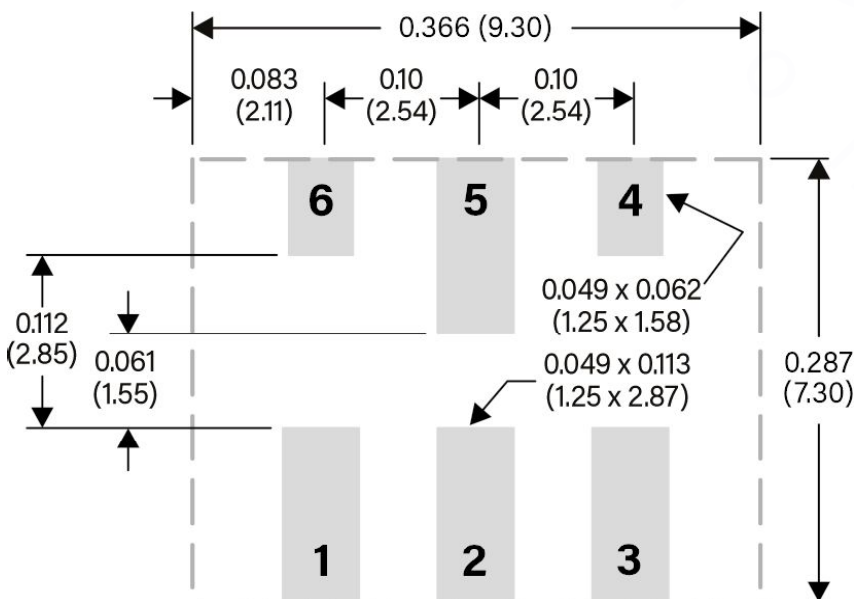
Mechanical Dimensions



Pin Connection

Pin	Positive Output	Negative Output
1	+VIN	+VIN
2	GND	-VOUT
3	+VOUT	GND
4	Trim	Trim
5	+VOUT	-VOUT
6	Control	Control

Board Layout



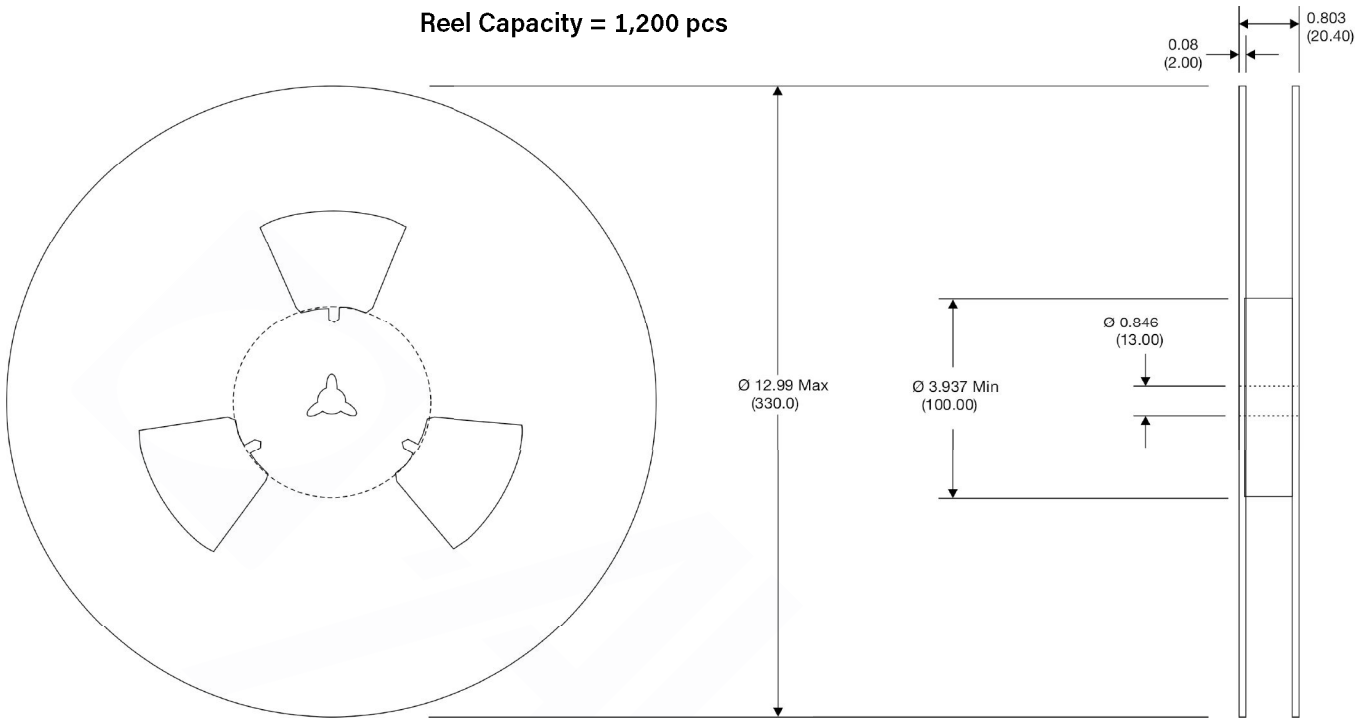
Notes:

- All dimensions are typical in inches (mm)
- General Tolerance = ± 0.02 (± 0.50) unless otherwise noted.
- Weight (Typ) = 0.020 Oz (25g)

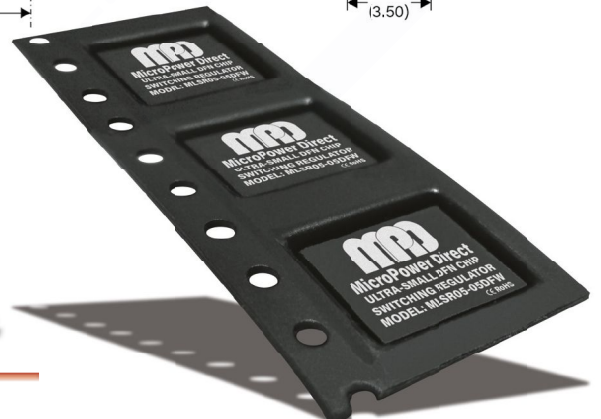
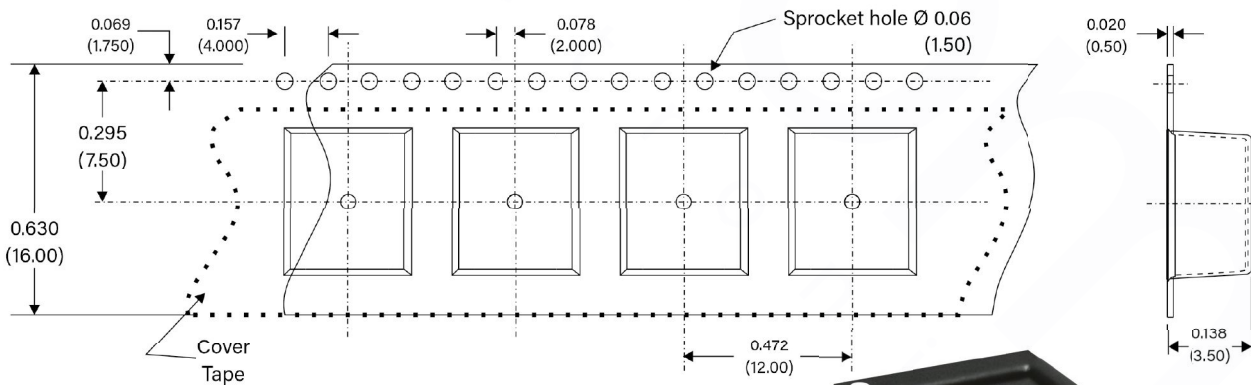
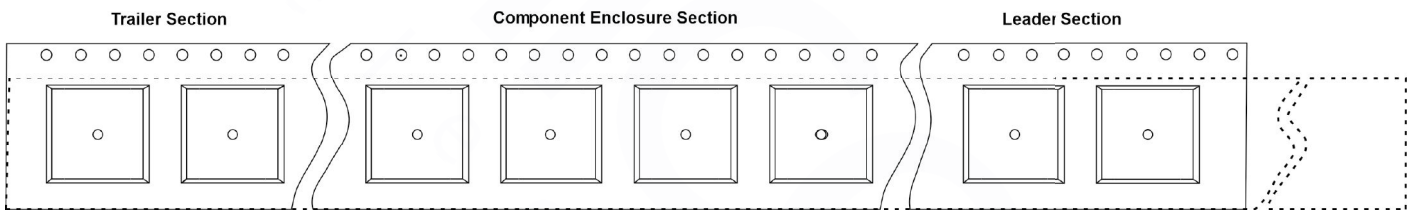
The MLSR05DFW series is available on Tape/Reel. Contact the factory for more information on smaller qty shipments.

Reel Dimensions

Reel Capacity = 1,200 pcs



Tape Dimensions



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