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LM79MXX Series 3-Terminal Negative Regulators

General Description

The LM79MXX series of 3-terminal regulators is available with fixed output voltages of $-5V$, $-12V$, and $-15V$. These devices need only one external component—a compensation capacitor at the output. The LM79MXX series is packaged in the TO-220 power package, and is capable of supplying 0.5A of output current.

These regulators employ internal current limiting, safe area protection, and thermal shutdown for protection against virtually all overload conditions.

Low ground pin current of the LM79MXX series allows output voltage to be easily boosted above the preset value with

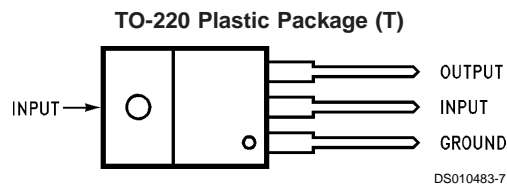
a resistor divider. The low quiescent current of these devices with a specified maximum change with line and load ensures good regulation in the voltage boosted mode.

For output voltage other than $-5V$, $-12V$, and $-15V$ the LM137 series provides an output voltage range from $-1.2V$ to $-57V$.

Features

- Thermal, short circuit and safe area protection
- High ripple rejection
- 0.5A output current
- 4% tolerance on preset output voltage

Connection Diagram



Front View

Order Number LM79M05CT, LM79M12CT or LM79M15CT
See NS Package Number T03B

Absolute Maximum Ratings (Note 1)

If Military/Aerospace specified devices are required, please contact the National Semiconductor Sales Office/Distributors for availability and specifications.

Input Voltage	
$V_O = -5V$	-25V
$V_O = -12V, -15V$	-35V
Input/Output Differential	
$V_O = -5V$	25V
$V_O = -12V, -15V$	30V

Power Dissipation (Note 2)

Internally Limited

Operating Junction Temperature Range

0°C to +125°C

Storage Temperature Range

-65°C to +150°C

Lead Temperature (Soldering, 10 sec.)

230°C

ESD Susceptibility

TBD

Electrical Characteristics LM79M05C

Conditions unless otherwise noted: $I_{OUT} = 350mA$, $C_{IN} = 2.2\mu F$, $C_{OUT} = 1\mu F$, $0^\circ C \leq T_J \leq +125^\circ C$

Part Number		LM79M05C			Units	
Output Voltage		-5V				
Input Voltage (Unless Otherwise Specified)		-10V				
Symbol	Parameter	Conditions	Min	Typ	Max	
V_O	Output Voltage	$T_J = 25^\circ C$	-4.8	-5.0	-5.2	V
		$5mA \leq I_{OUT} \leq 350mA$	-4.75		-5.25	V
ΔV_O	Line Regulation	$T_J = 25^\circ C$ (Note 3)				
				8	50	mV
				$(-25 \leq V_{IN} \leq -7)$		
ΔV_O	Load Regulation	$T_J = 25^\circ C$, (Note 3) $5mA \leq I_{OUT} \leq 0.5A$				
				2	30	mV
				$(-18 \leq V_{IN} \leq -8)$		
ΔV_O	Load Regulation	$T_J = 25^\circ C$, (Note 3) $5mA \leq I_{OUT} \leq 0.5A$		30	100	mV
I_Q	Quiescent Current	$T_J = 25^\circ C$		1	2	mA
ΔI_Q	Quiescent Current Change	With Input Voltage			0.4	mA
		With Load, $5mA \leq I_{OUT} \leq 350mA$			0.4	mA
V_n	Output Noise Voltage	$T_A = 25^\circ C$, $10Hz \leq f \leq 100Hz$		150		μV
	Ripple Rejection	$f = 120Hz$	54	66		dB
					$(-18 \leq V_{IN} \leq -8)$	
	Dropout Voltage	$T_J = 25^\circ C$, $I_{OUT} = 0.5A$		1.1		V
I_{OMAX}	Peak Output Current	$T_J = 25^\circ C$		800		mA
	Average Temperature Coefficient of Output Voltage	$I_{OUT} = 5mA$, $0^\circ C \leq T_J \leq 100^\circ C$		-0.4		mV/°C

Electrical Characteristics LM79M12C, LM79M15C

Conditions unless otherwise noted: $I_{OUT} = 350\text{mA}$, $C_{IN} = 2.2\mu\text{F}$, $C_{OUT} = 1\mu\text{F}$, $0^\circ\text{C} \leq T_J \leq +125^\circ\text{C}$

Part Number			LM79M12C			LM79M15C			Units
Output Voltage			-12V			-15V			
Input Voltage (Unless Otherwise Specified)			-19V			-23V			
Symbol	Parameter	Conditions	Min	Typ	Max	Min	Typ	Max	
V_O	Output Voltage	$T_J = 25^\circ\text{C}$	-11.5	-12.0	-12.5	-14.4	-15.0	-15.6	V
		$5\text{mA} \leq I_{OUT} \leq 350\text{mA}$	-11.4		-12.6	-14.25		-15.75	V
ΔV_O	Line Regulation	$T_J = 25^\circ\text{C}$ (Note 3)		5	80		5	80	mV
				$(-30 \leq V_{IN} \leq -14.5)$		$(-30 \leq V_{IN} \leq -17.5)$			
				3	50		3	50	mV
			$(-25 \leq V_{IN} \leq -15)$		$(-28 \leq V_{IN} \leq -18)$				
ΔV_O	Load Regulation	$T_J = 25^\circ\text{C}$, (Note 3) $5\text{mA} \leq I_{OUT} \leq 0.5\text{A}$		30	240		30	240	mV
I_Q	Quiescent Current	$T_J = 25^\circ\text{C}$		1.5	3		1.5	3	mA
ΔI_Q	Quiescent Current Change	With Input Voltage			0.4			0.4	mA
			$(-30 \leq V_{IN} \leq -14.5)$		$(-30 \leq V_{IN} \leq -27)$				
		With Load, $5\text{mA} \leq I_{OUT} \leq 350\text{mA}$			0.4			0.4	mA
V_n	Output Noise Voltage	$T_A = 25^\circ\text{C}$, $10\text{Hz} \leq f \leq 100\text{Hz}$		400			400		μV
	Ripple Rejection	$f = 120\text{Hz}$	54	70		54	70		dB
			$(-25 \leq V_{IN} \leq -15)$		$(-30 \leq V_{IN} \leq -17.5)$				
	Dropout Voltage	$T_J = 25^\circ\text{C}$, $I_{OUT} = 0.5\text{A}$		1.1			1.1		V
I_{OMAX}	Peak Output Current	$T_J = 25^\circ\text{C}$		800			800		mA
	Average Temperature Coefficient of Output Voltage	$I_{OUT} = 5\text{mA}$, $0^\circ\text{C} \leq T_J \leq 100^\circ\text{C}$		-0.8			-1.0		$\text{mV}/^\circ\text{C}$

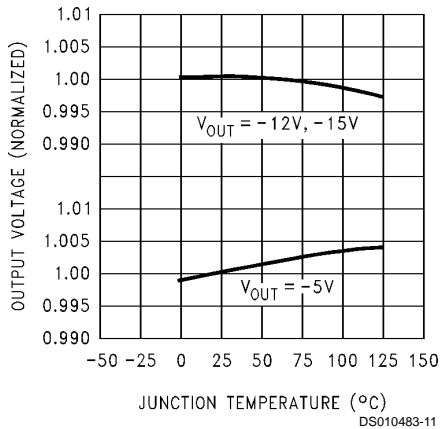
Note 1: Absolute Maximum Ratings indicate limits beyond which damage to the device may occur. Operating Ratings indicate conditions for which the device is intended to be functional, but do not guarantee specific performance limits. For guaranteed specifications and test conditions, see the Electrical Characteristics.

Note 2: Refer to Typical Performance Characteristics and Design Considerations for details.

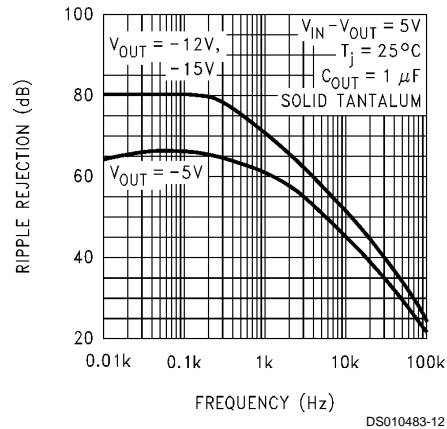
Note 3: Regulation is measured at a constant junction temperature by pulse testing with a low duty cycle. Changes in output voltage due to heating effects must be taken into account.

Typical Performance Characteristics

Output Voltage vs. Temperature

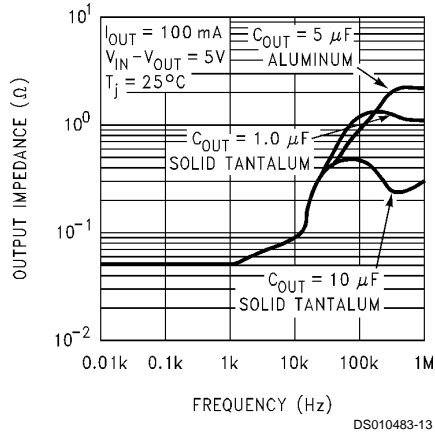


Ripple Rejection

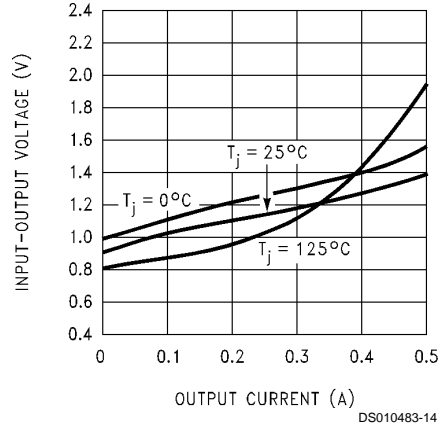


Typical Performance Characteristics (Continued)

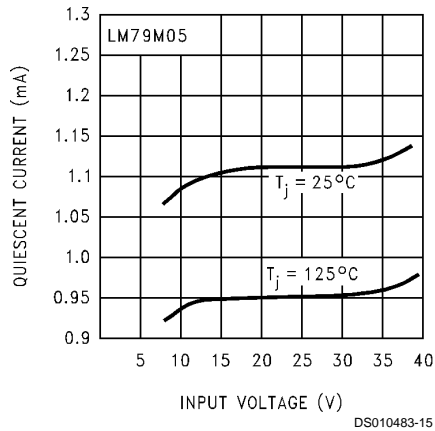
Output Impedance



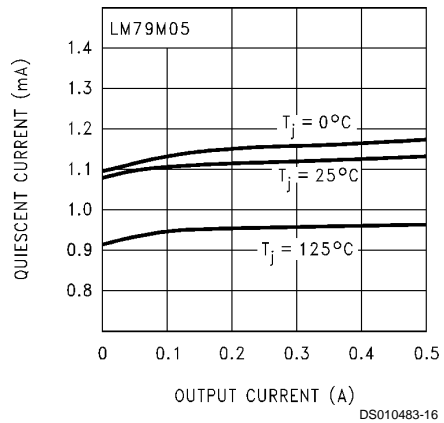
Minimum Input-Output Differential



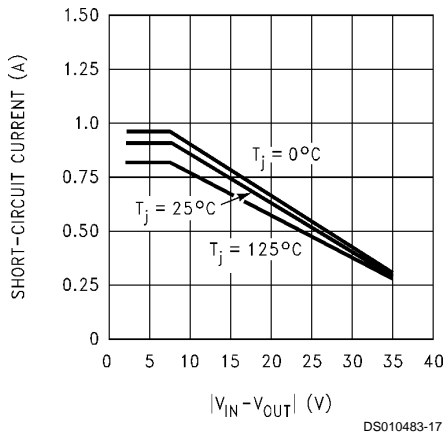
Quiescent Current vs. Input Voltage



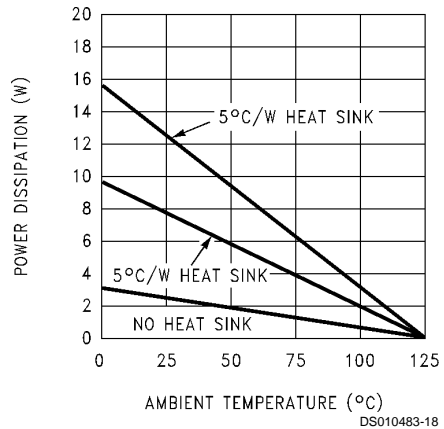
Quiescent Current vs. Load Current



Short-Circuit Current

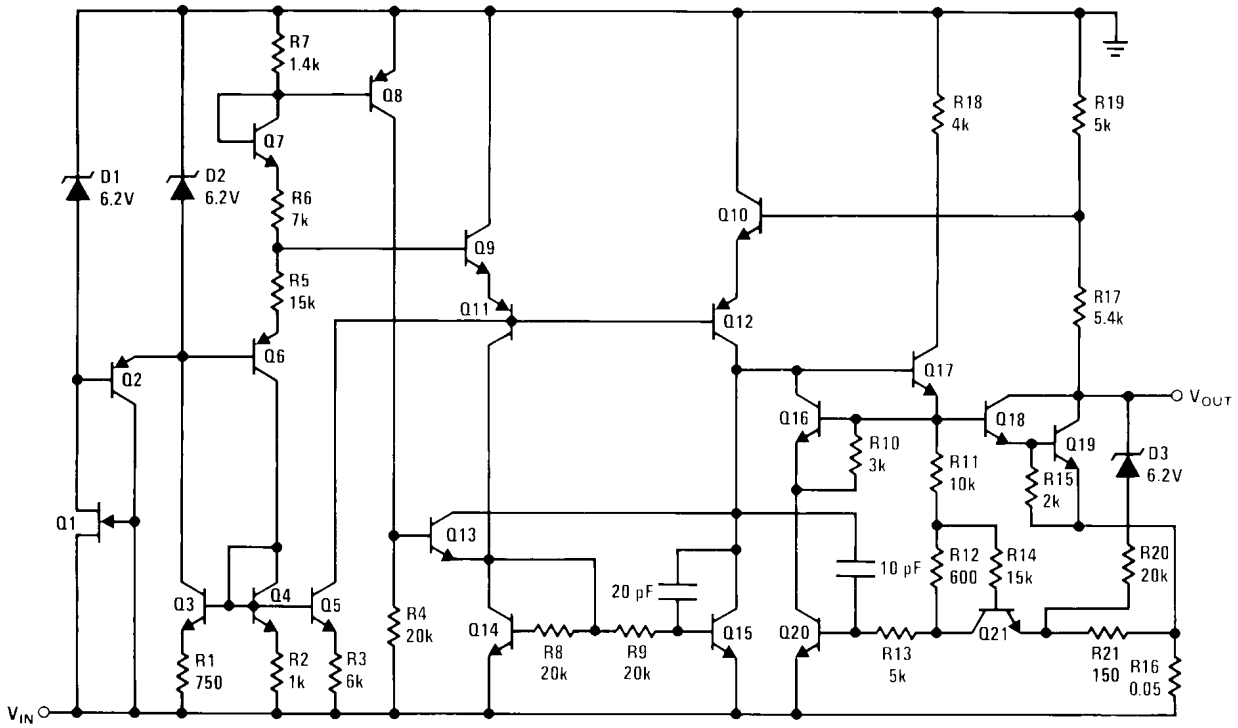


Maximum Average Power Dissipation (TO-220)

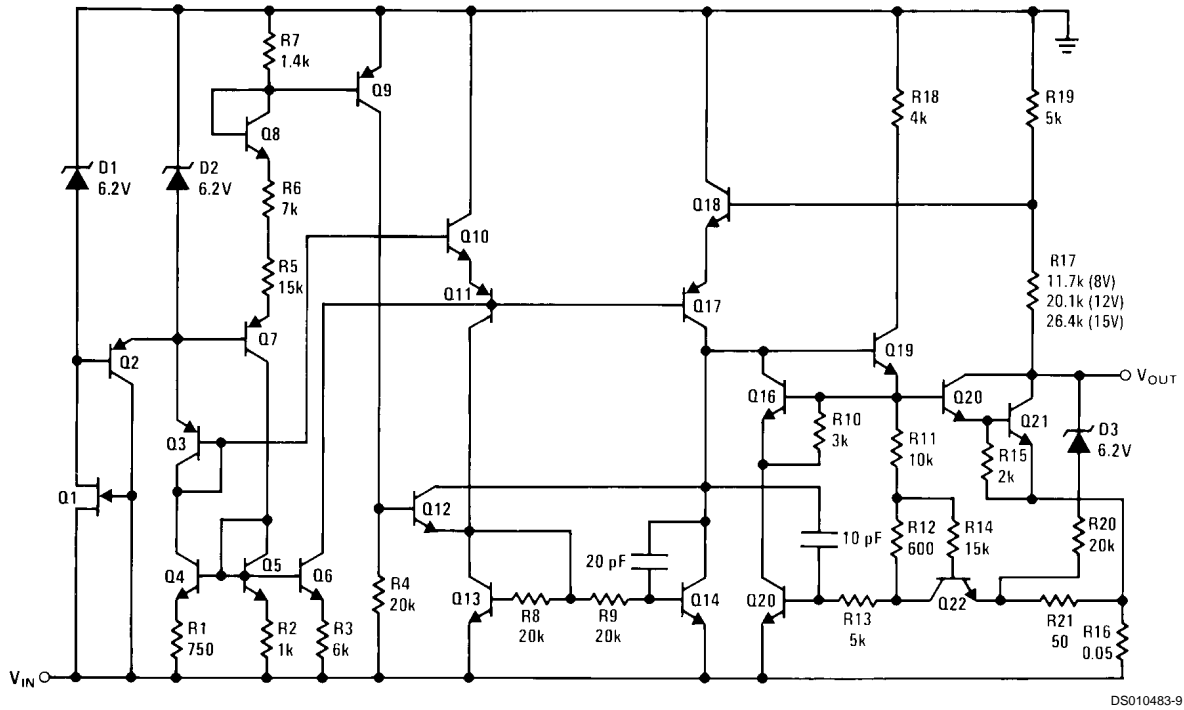


Schematic Diagrams

-5V



-12V and -15V



Design Considerations

The LM79MXX fixed voltage regulator series have thermal-overload protection from excessive power, internal short-circuit protection which limits the circuit's maximum current, and output transistor safe-area compensation for reducing the output current as the voltage across the pass transistor is increased.

Although the internal power dissipation is limited, the junction temperature must be kept below the maximum specified temperature in order to meet data sheet specifications. To calculate the maximum junction temperature or heat sink required, the following thermal resistance values should be used:

Package	θ_{JC} (°C/W)	θ_{JA} (°C/W)
TO-220	3	40

$$P_{D\text{MAX}} = \frac{T_{J\text{MAX}} - T_A}{\theta_{JC} + \theta_{CA}} \text{ or}$$

$$= \frac{T_{J\text{MAX}} - T_A}{\theta_{JA}} \text{ (Without a Heat Sink)} \quad (1)$$

$$\theta_{CA} = \theta_{CS} + \theta_{SA}$$

Solving for T_J :

$$T_J = T_A + P_D (\theta_{JC} + \theta_{CA}) \text{ or}$$

$$= T_A + P_D \theta_{JA} \text{ (Without a Heat Sink)}$$

Where

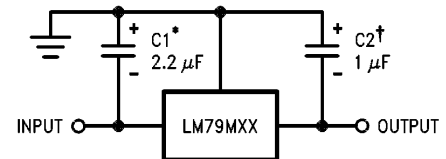
- T_J = Junction Temperature
- T_A = Ambient Temperature
- P_D = Power Dissipation
- θ_{JC} = Junction-to-Case Thermal Resistance
- θ_{CA} = Case-to-Ambient Thermal Resistance
- θ_{CS} = Case-to-Heat Sink Thermal Resistance
- θ_{SA} = Heat Sink-to-Ambient Thermal Resistance
- θ_{JA} = Junction-to-Ambient Thermal Resistance

Typical Applications

Bypass capacitors are necessary for stable operation of the LM79MXX series of regulators over the input voltage and output current ranges. Output bypass capacitors will improve the transient response of the regulator.

The bypass capacitors (2.2 μ F on the input, 1.0 μ F on the output), should be ceramic or solid tantalum which have good high frequency characteristics. If aluminum electrolytics are used, their values should be 10 μ F or larger. The bypass capacitors should be mounted with the shortest leads, and if possible, directly across the regulator terminals.

Fixed Regulator



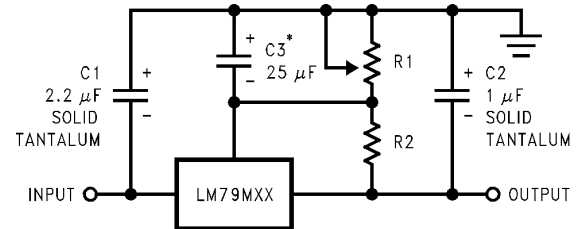
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*Required if regulator is separated from filter capacitor by more than 3". For value given, capacitor must be solid tantalum. 25 μ F aluminum electrolytic may be substituted.

†Required for stability. For value given, capacitor must be solid tantalum. 25 μ F aluminum electrolytic may be substituted. Values given may be increased without limit.

For output capacitance in excess of 100 μ F, a high current diode from input to output (1N4001, etc.) will protect the regulator from momentary input shorts.

Variable Output



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*Improves transient response and ripple rejection. Do not increase beyond 50 μ F.

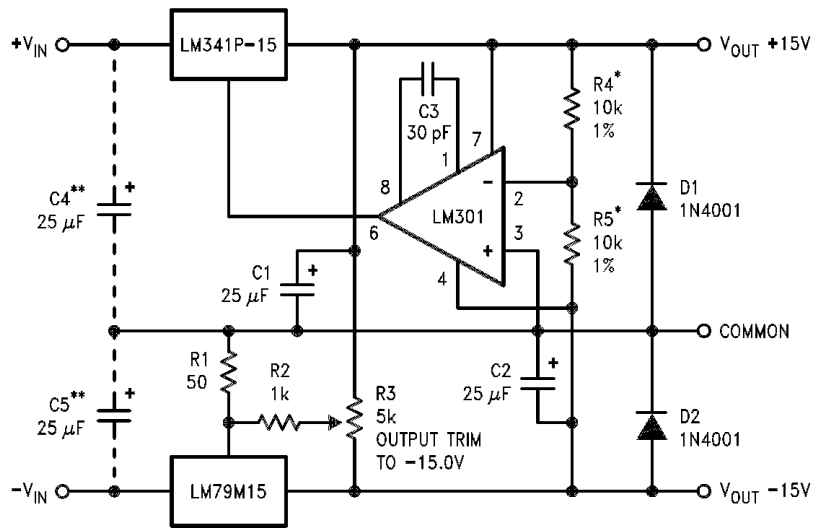
$$V_{\text{OUT}} = V_{\text{SET}} \left(\frac{R1 + R2}{R2} \right)$$

Select R2 as follows:

LM79M05C	300 Ω
LM79M12C	750 Ω
LM79M15C	1k

Typical Applications (Continued)

±15V, 1 Amp Tracking Regulators



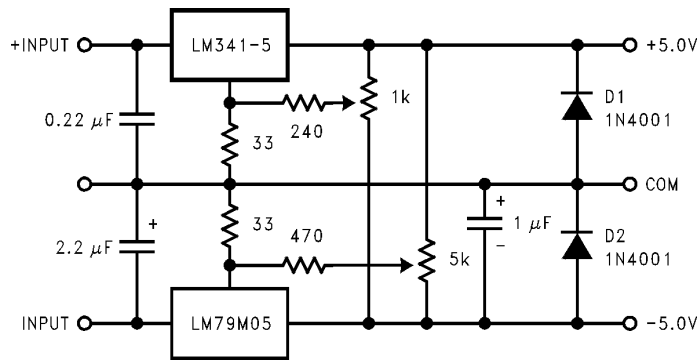
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*Resistor tolerance of R4 and R5 determine matching of (+) and (-) outputs.
 **Necessary only if raw supply filter capacitors are more than 3" from regulators.

Performance (Typical)

	(-15)	(+15)
Load Regulation at 0.5A	40mV	2 mV
Output Ripple, $C_{IN} = 3000\mu F$, $I_L = 0.5A$	100 μV_{rms}	100 μV_{rms}
Temperature Stability	50mV	50mV
Output Noise $10Hz \leq f \leq 10kHz$	150 μV_{rms}	150 μV_{rms}

Dual Trimmed Supply



DS010483-4

