LM567/LM567C Tone Decoder

FEATURES

- **20 to 1 Frequency Range with an External Resistor**
- **Logic Compatible Output with 100 mA Current Sinking Capability**
- **Bandwidth Adjustable from 0 to 14%**
- **High Rejection of Out of Band Signals and Noise**
- **Immunity to False Signals**
- **Highly Stable Center Frequency**
- **Center Frequency Adjustable from 0.01 Hz to 500 kHz**

APPLICATIONS

- **Touch Tone Decoding**
- **Precision Oscillator**
- **Frequency Monitoring and Control**
- **Wide Band FSK Demodulation**
- **Ultrasonic Controls**
- **Carrier Current Remote Controls**
- **Communications Paging Decoders**

DESCRIPTION

The LM567 and LM567C are general purpose tone decoders designed to provide a saturated transistor switch to ground when an input signal is present within the passband. The circuit consists of an I and Q detector driven by a voltage controlled oscillator which determines the center frequency of the decoder. External components are used to independently set center frequency, bandwidth and output delay.

CONNECTION DIAGRAM

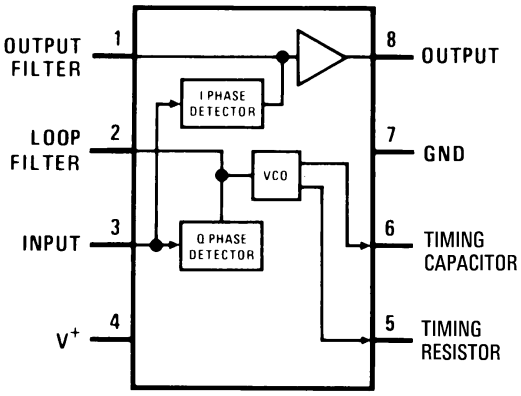


Figure 2. PDIP and SOIC Packages
Top View

ABSOLUTE MAXIMUM RATINGS(1)(2)(3)

Supply Voltage Pin	9V
Power Dissipation (4)	1100 mW
V_8	15V
V_3	−10V
V_3	V_4 + 0.5V
Storage Temperature Range	−65°C to +150°C
Operating Temperature Range	
LM567H	−55°C to +125°C
LM567CH, LM567CM, LM567CN	0°C to +70°C
Soldering Information	
PDIP Package	
Soldering (10 sec.)	260°C
SOIC Package	
Vapor Phase (60 sec.)	215°C
Infrared (15 sec.)	220°C

(1) Absolute Maximum Ratings indicate limits beyond which damage to the device may occur. Operating Ratings indicate conditions for which the device is functional, but do not ensure specific performance limits. Electrical Characteristics state DC and AC electrical specifications under particular test conditions which ensure specific performance limits. This assumes that the device is within the Operating Ratings. Specifications are not ensured for parameters where no limit is given, however, the typical value is a good indication of device performance.
(2) If Military/Aerospace specified devices are required, please contact the Texas Instruments Sales Office/Distributors for availability and specifications.
(3) Refer to RETS567X drawing for specifications of military LM567H version.
(4) The maximum junction temperature of the LM567 and LM567C is 150°C. For operating at elevated temperatures, devices in the TO-5 package must be derated based on a thermal resistance of 150°C/W, junction to ambient or 45°C/W, junction to case. For the DIP the device must be derated based on a thermal resistance of 110°C/W, junction to ambient. For the SOIC package, the device must be derated based on a thermal resistance of 160°C/W, junction to ambient.

ELECTRICAL CHARACTERISTICS

AC Test Circuit, T_A = 25°C, V^+ = 5V

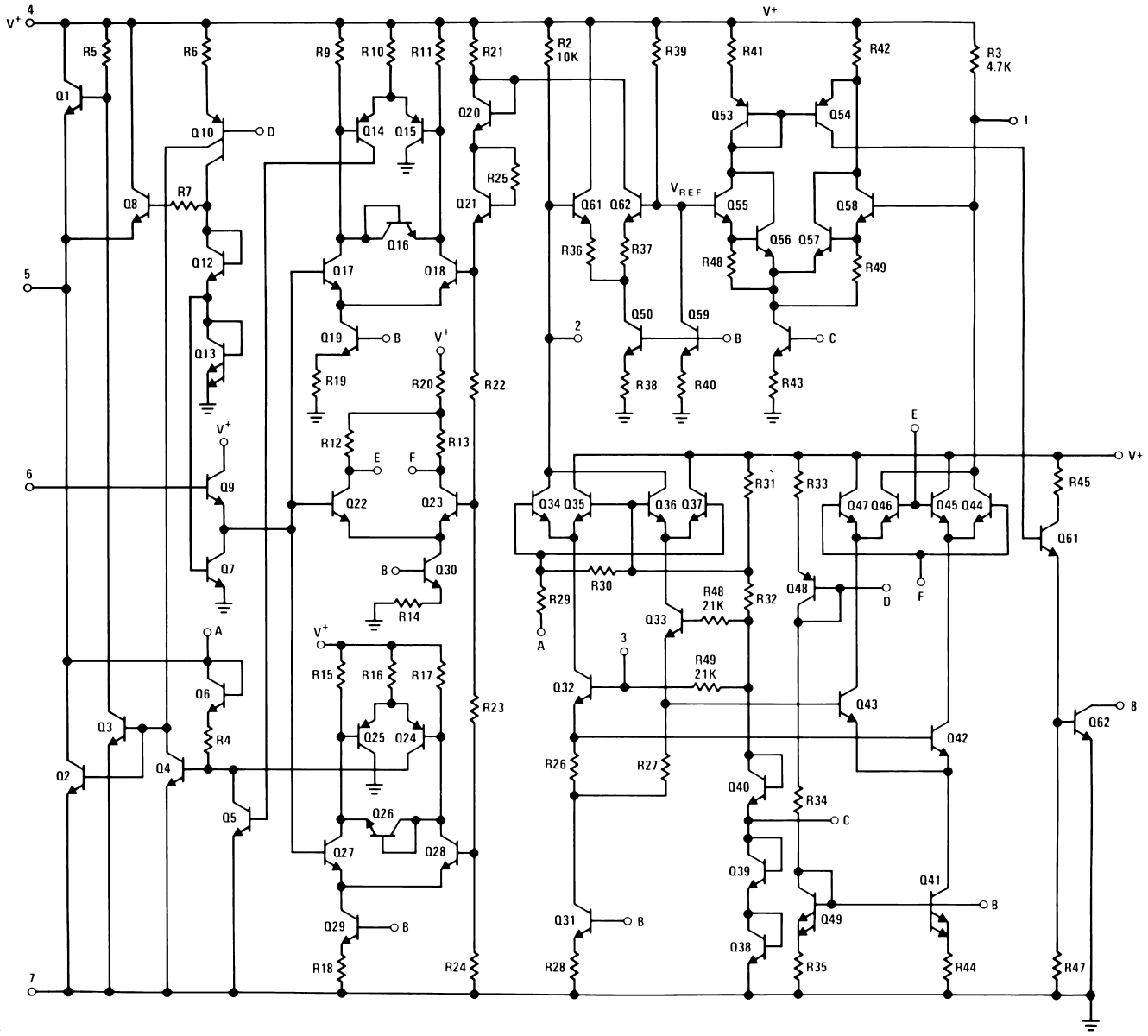
Parameters	Conditions	LM567			LM567C/LM567CM			Units
		Min	Typ	Max	Min	Typ	Max	
Power Supply Voltage Range		4.75	5.0	9.0	4.75	5.0	9.0	V
Power Supply Current Quiescent	R_L = 20k		6	8		7	10	mA
Power Supply Current Activated	R_L = 20k		11	13		12	15	mA
Input Resistance		18	20		15	20		kΩ
Smallest Detectable Input Voltage	I_L = 100 mA, $f_i = f_o$		20	25		20	25	mVrms
Largest No Output Input Voltage	I_C = 100 mA, $f_i = f_o$	10	15		10	15		mVrms
Largest Simultaneous Outband Signal to Inband Signal Ratio			6			6		dB
Minimum Input Signal to Wideband Noise Ratio	B_n = 140 kHz		−6			−6		dB
Largest Detection Bandwidth		12	14	16	10	14	18	% of f_o
Largest Detection Bandwidth Skew			1	2		2	3	% of f_o
Largest Detection Bandwidth Variation with Temperature			±0.1			±0.1		%/°C
Largest Detection Bandwidth Variation with Supply Voltage	4.75–6.75V		±1	±2		±1	±5	%V
Highest Center Frequency		100	500		100	500		kHz

ELECTRICAL CHARACTERISTICS (continued)

AC Test Circuit, T_A = 25°C, V^+ = 5V

Parameters	Conditions	LM567			LM567C/LM567CM			Units
		Min	Typ	Max	Min	Typ	Max	
Center Frequency Stability (4.75–5.75V)	0 < T_A < 70 −55 < T_A < +125		35 ± 60 35 ± 140			35 ± 60 35 ± 140		ppm/°C ppm/°C
Center Frequency Shift with Supply Voltage	4.75V–6.75V 4.75V–9V		0.5	1.0 2.0		0.4	2.0 2.0	%/V %/V
Fastest ON-OFF Cycling Rate			f_o/20			f_o/20		
Output Leakage Current	V_8 = 15V		0.01	25		0.01	25	μA
Output Saturation Voltage	e_i = 25 mV, I_8 = 30 mA e_i = 25 mV, I_8 = 100 mA		0.2 0.6	0.4 1.0		0.2 0.6	0.4 1.0	V
Output Fall Time			30			30		ns
Output Rise Time			150			150		ns

SCHEMATIC DIAGRAM



TYPICAL PERFORMANCE CHARACTERISTICS

Typical Frequency Drift

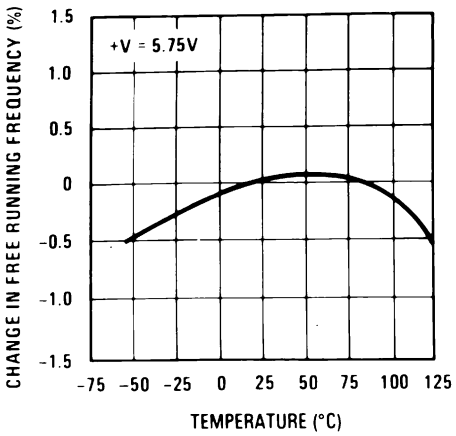


Figure 3.

Typical Bandwidth Variation

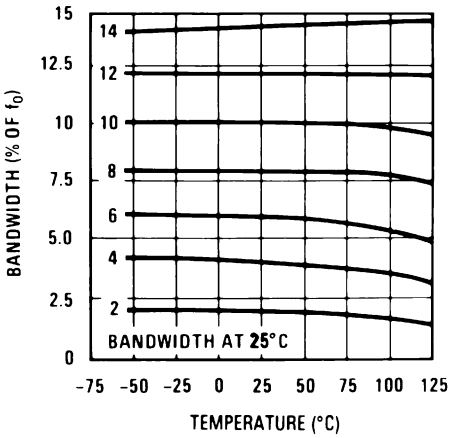


Figure 4.

Typical Frequency Drift

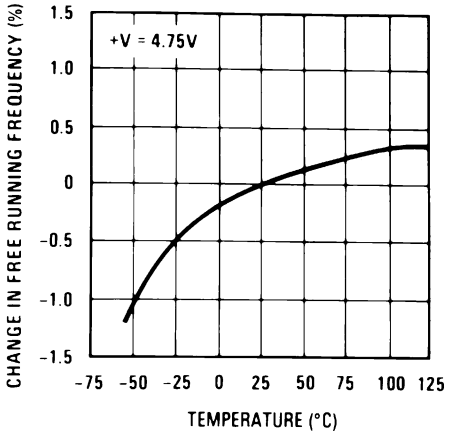


Figure 5.

Typical Frequency Drift

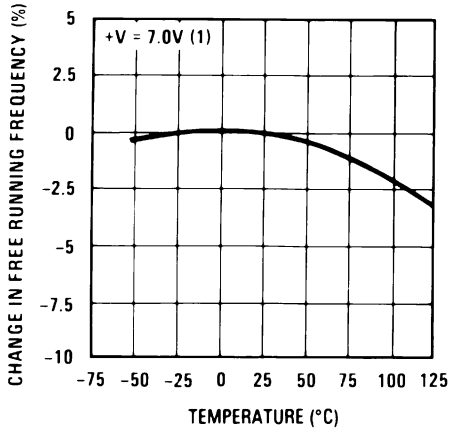


Figure 6.

Bandwidth vs Input SignalAmplitude

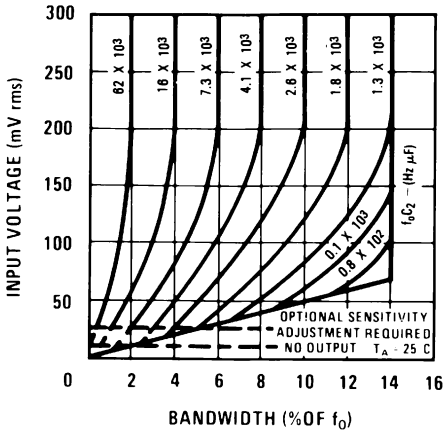


Figure 7.

Largest Detection Bandwidth

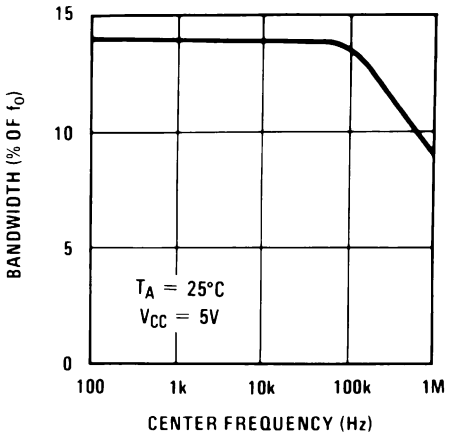


Figure 8.

TYPICAL PERFORMANCE CHARACTERISTICS (continued)

Detection Bandwidth as a Function of C_2 and C_3

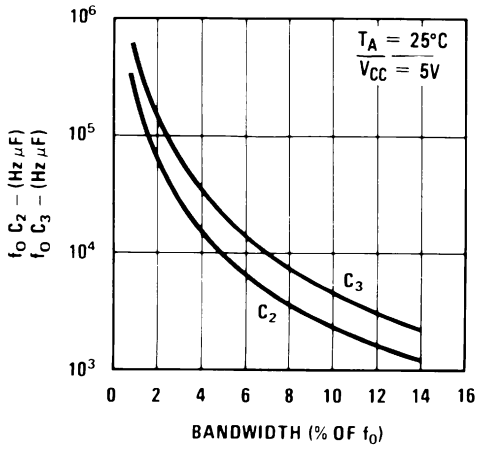


Figure 9.

Typical Supply Current vs Supply Voltage

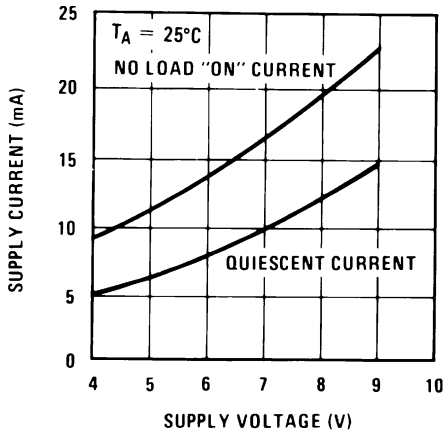


Figure 10.

Greatest Number of Cycles Before Output

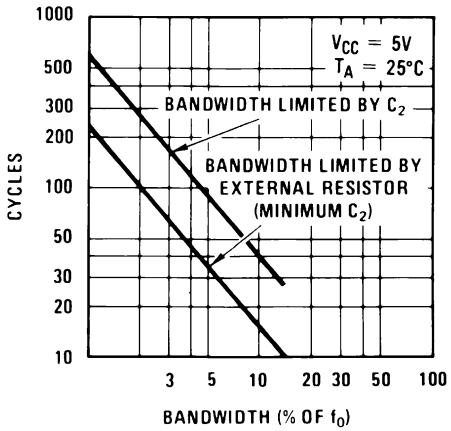


Figure 11.

Typical Output Voltage vs Temperature

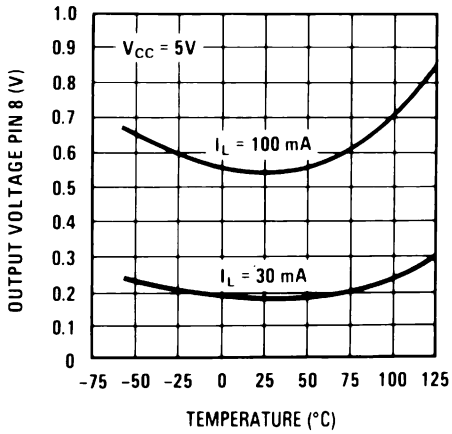
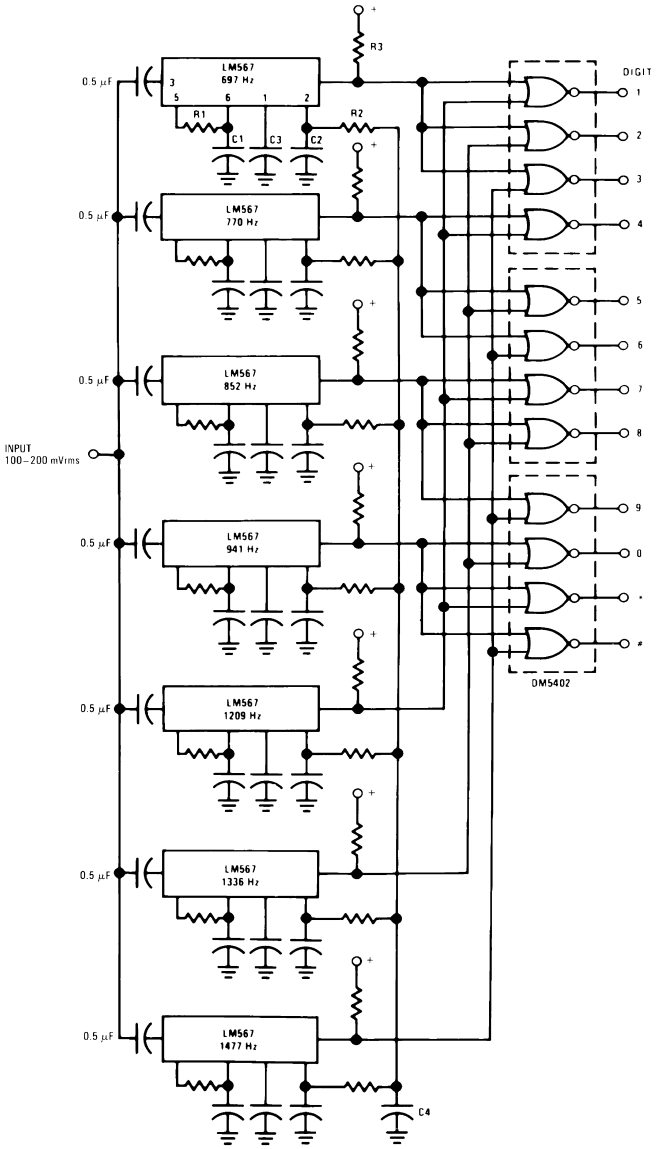


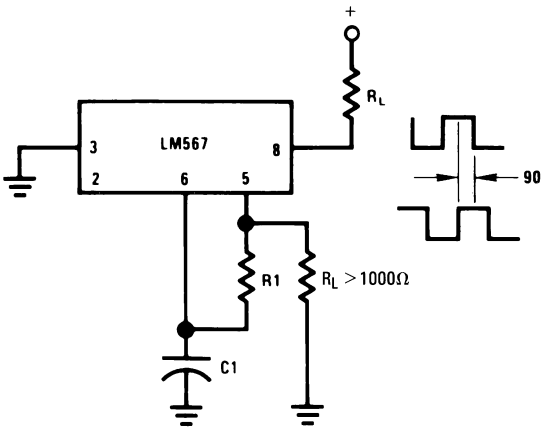
Figure 12.

TYPICAL APPLICATIONS



Component values (typ)
R1 6.8 to 15k
R2 4.7k
R3 20k
C1 0.10 mfd
C2 1.0 mfd 6V
C3 2.2 mfd 6V
C4 250 mfd 6V

Figure 13. Touch-Tone Decoder



Connect Pin 3 to 2.8V to Invert Output

Figure 14. Oscillator with Quadrature Output

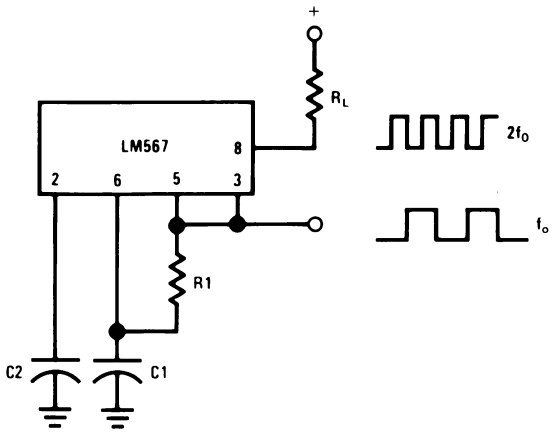


Figure 15. Oscillator with Double Frequency Output

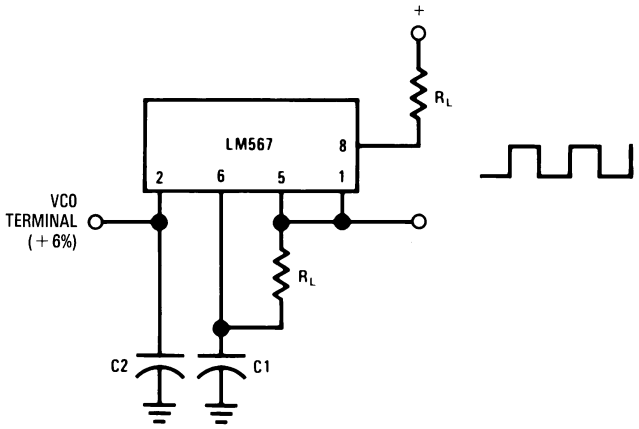
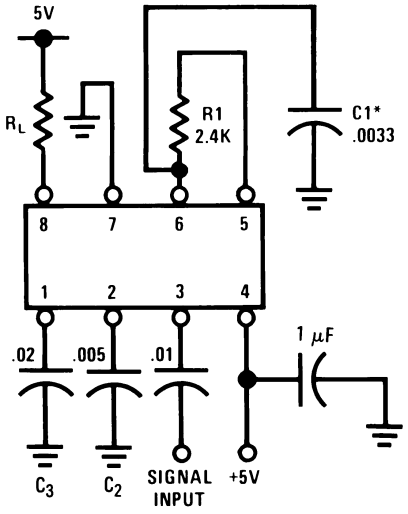


Figure 16. Precision Oscillator Drive 100 mA Loads

AC TEST CIRCUIT



f_i = 100 kHz + 5V
***Note:** Adjust for f_o = 100 kHz.

APPLICATIONS INFORMATION

The center frequency of the tone decoder is equal to the free running frequency of the VCO. This is given by

$$f_o \cong \frac{1}{1.1\ R_1\ C_1}$$

The bandwidth of the filter may be found from the approximation

$$BW = 1070\sqrt{\frac{V_i}{f_o C_2}}\ \text{in \% of } f_o$$

where

- V_i = Input voltage (volts rms), $V_i \leq 200mV$
- C_2 = Capacitance at Pin 2(μF)

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