Precision Rail-to-Rail Input and Output Operational Amplifiers

OP184/OP284/OP484

FEATURES

Single-supply operation
Wide bandwidth: 4 MHz
Low offset voltage: 65 µV
Unity-gain stable
High slew rate: 4.0 V/µs
Low noise: 3.9 nV/√Hz

APPLICATIONS

Battery-powered instrumentation
Power supply control and protection
Telecommunications
DAC output amplifier
ADC input buffer

GENERAL DESCRIPTION

The OP184/OP284/OP484 are single, dual, and quad single-supply, 4 MHz bandwidth amplifiers featuring rail-to-rail inputs and outputs. They are guaranteed to operate from 3 V to 36 V (or ±1.5 V to ±18 V).

These amplifiers are superb for single-supply applications requiring both ac and precision dc performance. The combination of wide bandwidth, low noise, and precision makes the OP184/OP284/OP484 useful in a wide variety of applications, including filters and instrumentation.

Other applications for these amplifiers include portable telecommunications equipment, power supply control and protection, and use as amplifiers or buffers for transducers with wide output ranges. Sensors requiring a rail-to-rail input amplifier include Hall effect, piezoelectric, and resistive transducers.

The ability to swing rail-to-rail at both the input and output enables designers to build multistage filters in single-supply systems and to maintain high signal-to-noise ratios.

The OP184/OP284/OP484 are specified over the hot extended industrial temperature range of −40°C to +125°C. The single OP184 is available in 8-lead SOIC surface mount packages. The dual OP284 is available in 8-lead PDIP and SOIC surface mount packages. The quad OP484 is available in 14-lead PDIP and 14-lead, narrow-body SOIC packages.

PIN CONFIGURATIONS

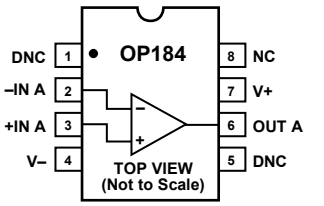


Figure 1. 8-Lead SOIC (S-Suffix)

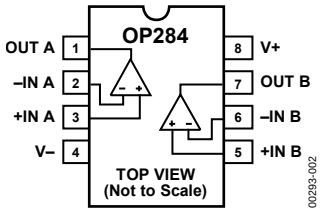


Figure 2. 8-Lead PDIP (P-Suffix)
8-Lead SOIC (S-Suffix)

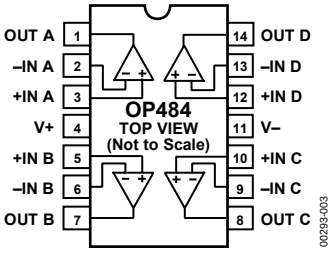


Figure 3. 14-Lead PDIP (P-Suffix)
14-Lead Narrow-Body SOIC (S-Suffix)

SPECIFICATIONS

ELECTRICAL CHARACTERISTICS

V_S = 5.0 V, V_{CM} = 2.5 V, T_A = 25°C, unless otherwise noted.

Table 1.

Parameter	Symbol	Conditions	Min	Typ	Max	Unit
INPUT CHARACTERISTICS						
Offset Voltage, OP184/OP284E Grade[1]	V_{OS}				65	µV
		−40°C ≤ T_A ≤ +125°C			165	µV
Offset Voltage, OP184/OP284F Grade[1]	V_{OS}				125	µV
		−40°C ≤ T_A ≤ +125°C			350	µV
Offset Voltage, OP484E Grade[1]	V_{OS}				75	µV
		−40°C ≤ T_A ≤ +125°C			175	µV
Offset Voltage, OP484F Grade[1]	V_{OS}				150	µV
		−40°C ≤ T_A ≤ +125°C			450	µV
Input Bias Current	I_B			60	450	nA
		−40°C ≤ T_A ≤ +125°C			600	nA
Input Offset Current	I_{OS}			2	50	nA
		−40°C ≤ T_A ≤ +125°C			50	nA
Input Voltage Range			0		5	V
Common-Mode Rejection Ratio	CMRR	V_{CM} = 0 V to 5 V	60			dB
		V_{CM} = 1.0 V to 4.0 V, −40°C ≤ T_A ≤ +125°C	86			dB
Large Signal Voltage Gain	A_{VO}	R_L = 2 kΩ, 1 V ≤ V_O ≤ 4 V	50	240		V/mV
		R_L = 2 kΩ, −40°C ≤ T_A ≤ +125°C	25			V/mV
Bias Current Drift	$\Delta I_B/\Delta T$			150		pA/°C
OUTPUT CHARACTERISTICS						
Output Voltage High	V_{OH}	I_L = 1.0 mA	4.85			V
Output Voltage Low	V_{OL}	I_L = 1.0 mA			125	mV
Output Current	I_{OUT}		±6.5			mA
POWER SUPPLY						
Power Supply Rejection Ratio	PSRR	V_S = 2.0 V to 10 V, −40°C ≤ T_A ≤ +125°C	76			dB
Supply Current/Amplifier	I_{SY}	V_O = 2.5 V, −40°C ≤ T_A ≤ +125°C			1.45	mA
Supply Voltage Range	V_S		3		36	V
DYNAMIC PERFORMANCE						
Slew Rate	SR	R_L = 2 kΩ	1.65	2.4		V/µs
Settling Time	t_S	To 0.01%, 1.0 V step		2.5		µs
Gain Bandwidth Product	GBP			3.25		MHz
Phase Margin	Φ_M			45		Degrees
NOISE PERFORMANCE						
Voltage Noise	e_n p-p	0.1 Hz to 10 Hz		0.3		µV p-p
Voltage Noise Density	e_n	f = 1 kHz		3.9		nV/√Hz
Current Noise Density	i_n			0.4		pA/√Hz

[1] Input offset voltage measurements are performed by automated test equipment approximately 0.5 seconds after application of power.

V_S = 3.0 V, V_{CM} = 1.5 V, T_A = 25°C, unless otherwise noted.

Table 2.

Parameter	Symbol	Conditions	Min	Typ	Max	Unit
INPUT CHARACTERISTICS						
Offset Voltage, OP184/OP284E Grade[1]	V_{OS}				65	µV
		−40°C ≤ T_A ≤ +125°C			165	µV
Offset Voltage, OP184/OP284F Grade[1]	V_{OS}				125	µV
		−40°C ≤ T_A ≤ +125°C			350	µV
Offset Voltage, OP484E Grade[1]	V_{OS}				100	µV
		−40°C ≤ T_A ≤ +125°C			200	µV
Offset Voltage, OP484F Grade[1]	V_{OS}				150	µV
		−40°C ≤ T_A ≤ +125°C			450	µV
Input Bias Current	I_B			60	450	nA
		−40°C ≤ T_A ≤ +125°C			600	nA
Input Offset Current	I_{OS}	−40°C ≤ T_A ≤ +125°C			50	nA
Input Voltage Range			0		3	V
Common-Mode Rejection Ratio	CMRR	V_{CM} = 0 V to 3 V	60			dB
		V_{CM} = 0 V to 3 V, −40°C ≤ T_A ≤ +125°C	56			dB
OUTPUT CHARACTERISTICS						
Output Voltage High	V_{OH}	I_L = 1.0 mA	2.85			V
Output Voltage Low	V_{OL}	I_L = 1.0 mA			125	mV
POWER SUPPLY						
Power Supply Rejection Ratio	PSRR	V_S = ±1.25 V to ±1.75 V	76			dB
Supply Current/Amplifier	I_{SY}	V_O = 1.5 V, −40°C ≤ T_A ≤ +125°C			1.35	mA
DYNAMIC PERFORMANCE						
Gain Bandwidth Product	GBP			3		MHz
NOISE PERFORMANCE						
Voltage Noise Density	e_n	f = 1 kHz		3.9		nV/√Hz

[1] Input offset voltage measurements are performed by automated test equipment approximately 0.5 seconds after application of power.

V_S = ±15.0 V, V_{CM} = 0 V, T_A = 25°C, unless otherwise noted.

Table 3.

Parameter	Symbol	Conditions	Min	Typ	Max	Unit
INPUT CHARACTERISTICS						
Offset Voltage, OP184/OP284E Grade[1]	V_{OS}				100	µV
		−40°C ≤ T_A ≤ +125°C			200	µV
Offset Voltage, OP184/OP284F Grade[1]	V_{OS}				175	µV
		−40°C ≤ T_A ≤ +125°C			375	µV
Offset Voltage, OP484E Grade[1]	V_{OS}				150	µV
		−40°C ≤ T_A ≤ +125°C			300	µV
Offset Voltage, OP484F Grade[1]	V_{OS}				250	µV
		−40°C ≤ T_A ≤ +125°C			500	µV
Input Bias Current	I_B			80	450	nA
		−40°C ≤ T_A ≤ +125°C			575	nA
Input Offset Current	I_{OS}	−40°C ≤ T_A ≤ +125°C			50	nA
Input Voltage Range			−15		+15	V
Common-Mode Rejection Ratio	CMRR	V_{CM} = −14.0 V to +14.0 V, −40°C ≤ T_A ≤ +125°C	86	90		dB
		V_{CM} = −15.0 V to +15.0 V	80			dB
Large Signal Voltage Gain	A_{VO}	R_L = 2 kΩ, −10 V ≤ V_O ≤ 10 V	150	1000		V/mV
		R_L = 2 kΩ, −40 V ≤ T_A ≤ +125°C	75			V/mV
Offset Voltage Drift E Grade	$\Delta V_{OS}/\Delta T$			0.2	2.00	µV/°C
Bias Current Drift	$\Delta V_B/\Delta T$			150		pA/°C
OUTPUT CHARACTERISTICS						
Output Voltage High	V_{OH}	I_L = 1.0 mA	14.8			V
Output Voltage Low	V_{OL}	I_L = 1.0 mA			−14.875	V
Output Current	I_{OUT}		±10			mA
POWER SUPPLY						
Power Supply Rejection Ratio	PSRR	V_S = ±2.0 V to ±18 V, −40°C ≤ T_A ≤ +125°C	90			dB
Supply Current/Amplifier	I_{SY}	V_O = 0 V, −40°C ≤ T_A ≤ +125°C			2.0	mA
Supply Current/Amplifier	I_{SY}	V_S = ±18 V, −40°C ≤ T_A ≤ +125°C			2.25	mA
DYNAMIC PERFORMANCE						
Slew Rate	SR	R_L = 2 kΩ	2.4	4.0		V/µs
Full-Power Bandwidth	BW_p	1% distortion, R_L = 2 kΩ, V_O = 29 V p-p		35		kHz
Settling Time	t_S	To 0.01%, 10 V step		4		µs
Gain Bandwidth Product	GBP			4.25		MHz
Phase Margin	Φ_M			50		Degrees
NOISE PERFORMANCE						
Voltage Noise	e_n p-p	0.1 Hz to 10 Hz		0.3		µV p-p
Voltage Noise Density	e_n	f = 1 kHz		3.9		nV/√Hz
Current Noise Density	i_n			0.4		pA/√Hz

[1] Input offset voltage measurements are performed by automated test equipment approximately 0.5 seconds after application of power.

ABSOLUTE MAXIMUM RATINGS

Table 4.

Parameter	Rating
Supply Voltage	±18 V
Input Voltage	±18 V
Differential Input Voltage[1]	±0.6 V
Output Short-Circuit Duration to GND	Indefinite
Storage Temperature Range	
P-Suffix, S-Suffix Packages	−65°C to +150°C
Operating Temperature Range	
OP184/OP284/OP484E/OP484F	−40°C to +125°C
Junction Temperature Range	
P-Suffix, S-Suffix Packages	−65°C to +150°C
Lead Temperature (Soldering 60 sec)	300°C

[1] For input voltages greater than 0.6 V, the input current should be limited to less than 5 mA to prevent degradation or destruction of the input devices.

Stresses above those listed under Absolute Maximum Ratings may cause permanent damage to the device. This is a stress rating only; functional operation of the device at these or any other conditions above those indicated in the operational section of this specification is not implied. Exposure to absolute maximum rating conditions for extended periods may affect device reliability.

Absolute maximum ratings apply to both DICE and packaged parts, unless otherwise noted.

THERMAL RESISTANCE

θ_{JA} is specified for the worst-case conditions; that is, θ_{JA} is specified for a device in socket for PDIP. θ_{JA} is specified for a device soldered in the circuit board for SOIC packages.

Table 5. Thermal Resistance

Package Type	θ_{JA}	θ_{JC}	Unit
8-Lead PDIP (P-Suffix)	103	43	°C/W
8-Lead SOIC (S-Suffix)	158	43	°C/W
14-Lead PDIP (P-Suffix)	83	39	°C/W
14-Lead SOIC (S-Suffix)	92	27	°C/W

ESD CAUTION

ESD (electrostatic discharge) sensitive device. Charged devices and circuit boards can discharge without detection. Although this product features patented or proprietary protection circuitry, damage may occur on devices subjected to high energy ESD. Therefore, proper ESD precautions should be taken to avoid performance degradation or loss of functionality.

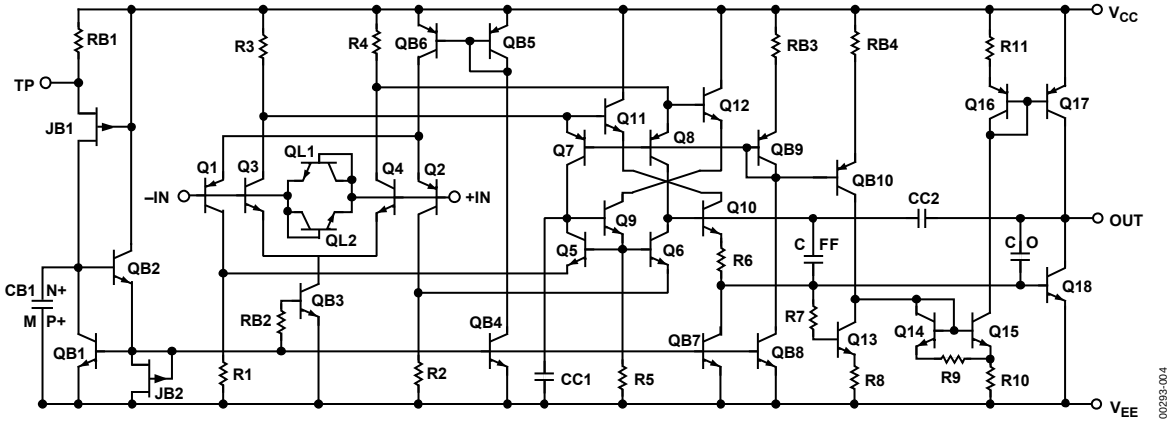
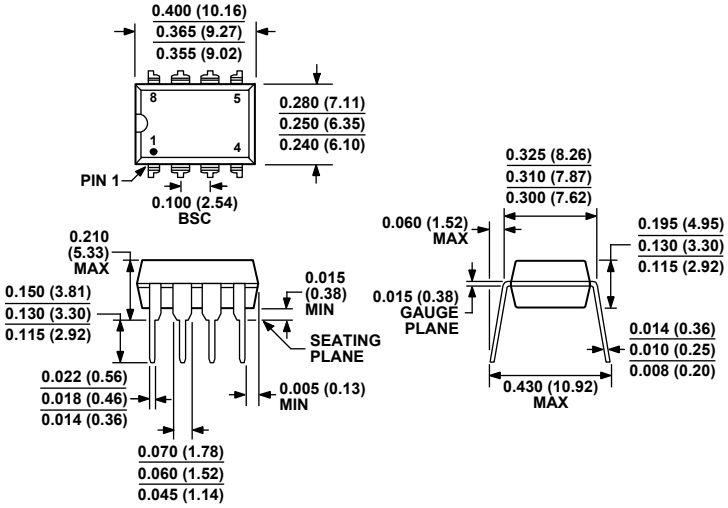


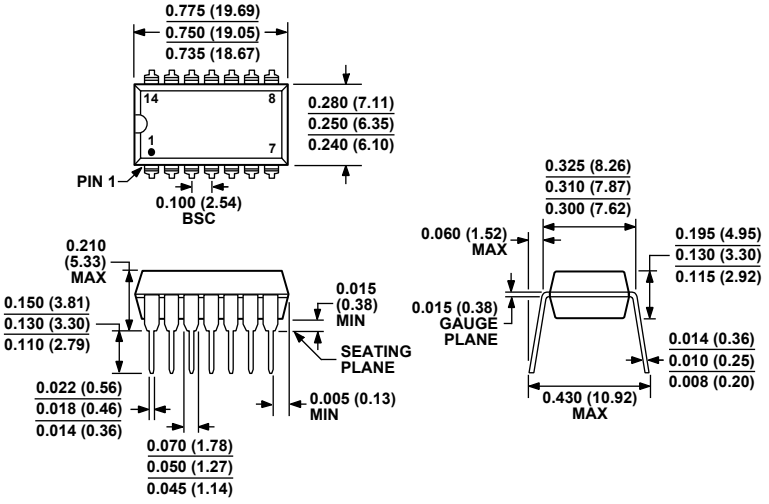
Figure 4. Simplified Schematic

OUTLINE DIMENSIONS



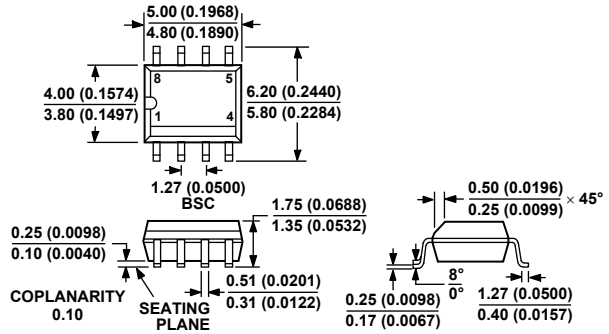
COMPLIANT TO JEDEC STANDARDS MS-001-BA
CONTROLLING DIMENSIONS ARE IN INCHES; MILLIMETER DIMENSIONS (IN PARENTHESES) ARE ROUNDED-OFF INCH EQUIVALENTS FOR REFERENCE ONLY AND ARE NOT APPROPRIATE FOR USE IN DESIGN. CORNER LEADS MAY BE CONFIGURED AS WHOLE OR HALF LEADS.

Figure 60. 8-Lead Plastic Dual In-Line Package [PDIP]
(N-8)
P-Suffix
Dimensions shown in inches and (millimeters)



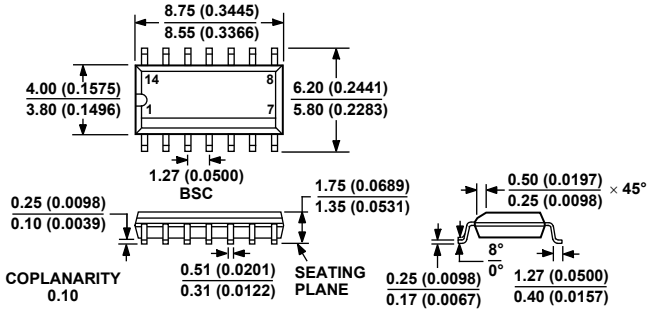
COMPLIANT TO JEDEC STANDARDS MS-001-AA
CONTROLLING DIMENSIONS ARE IN INCHES; MILLIMETER DIMENSIONS (IN PARENTHESES) ARE ROUNDED-OFF INCH EQUIVALENTS FOR REFERENCE ONLY AND ARE NOT APPROPRIATE FOR USE IN DESIGN. CORNER LEADS MAY BE CONFIGURED AS WHOLE OR HALF LEADS.

Figure 61. 14-Lead Plastic Dual In-Line Package [PDIP]
(N-14)
P-Suffix
Dimensions shown in inches and (millimeters)



COMPLIANT TO JEDEC STANDARDS MS-012-AA
CONTROLLING DIMENSIONS ARE IN MILLIMETERS; INCH DIMENSIONS (IN PARENTHESES) ARE ROUNDED-OFF MILLIMETER EQUIVALENTS FOR REFERENCE ONLY AND ARE NOT APPROPRIATE FOR USE IN DESIGN.

Figure 62. 8-Lead Standard Small Outline Package [SOIC_N]
Narrow Body
(R-8)
S-Suffix
Dimensions shown in millimeters and (inches)



COMPLIANT TO JEDEC STANDARDS MS-012-AB
CONTROLLING DIMENSIONS ARE IN MILLIMETERS; INCH DIMENSIONS (IN PARENTHESES) ARE ROUNDED-OFF MILLIMETER EQUIVALENTS FOR REFERENCE ONLY AND ARE NOT APPROPRIATE FOR USE IN DESIGN.

Figure 63. 14-Lead Standard Small Outline Package [SOIC_N]
Narrow Body
(R-14)
S-Suffix
Dimensions shown in millimeters and (inches)

ORDERING GUIDE

Model	Temperature Range	Package Description	Package Option
OP184ES	−40°C to +125°C	8-Lead SOIC_N	S-Suffix (R-8)
OP184ES-REEL	−40°C to +125°C	8-Lead SOIC_N	S-Suffix (R-8)
OP184ES-REEL7	−40°C to +125°C	8-Lead SOIC_N	S-Suffix (R-8)
OP184ESZ[1]	−40°C to +125°C	8-Lead SOIC_N	S-Suffix (R-8)
OP184ESZ-REEL[1]	−40°C to +125°C	8-Lead SOIC_N	S-Suffix (R-8)
OP184ESZ-REEL7[1]	−40°C to +125°C	8-Lead SOIC_N	S-Suffix (R-8)
OP184FS	−40°C to +125°C	8-Lead SOIC_N	S-Suffix (R-8)
OP184FS-REEL	−40°C to +125°C	8-Lead SOIC_N	S-Suffix (R-8)
OP184FS–REEL7	−40°C to +125°C	8-Lead SOIC_N	S-Suffix (R-8)
OP184FSZ[1]	−40°C to +125°C	8-Lead SOIC_N	S-Suffix (R-8)
OP184FSZ-REEL[1]	−40°C to +125°C	8-Lead SOIC_N	S-Suffix (R-8)
OP184FSZ-REEL7[1]	−40°C to +125°C	8-Lead SOIC_N	S-Suffix (R-8)
OP284EP	−40°C to +125°C	8-Lead PDIP	P-Suffix (N-8)
OP284EPZ[1]	−40°C to +125°C	8-Lead PDIP	P-Suffix (N-8)
OP284ES	−40°C to +125°C	8-Lead SOIC_N	S-Suffix (R-8)
OP284ES-REEL	−40°C to +125°C	8-Lead SOIC_N	S-Suffix (R-8)
OP284ES-REEL7	−40°C to +125°C	8-Lead SOIC_N	S-Suffix (R-8)
OP284ESZ[1]	−40°C to +125°C	8-Lead SOIC_N	S-Suffix (R-8)
OP284ESZ-REEL[1]	−40°C to +125°C	8-Lead SOIC_N	S-Suffix (R-8)
OP284ESZ-REEL7[1]	−40°C to +125°C	8-Lead SOIC_N	S-Suffix (R-8)
OP284FS	−40°C to +125°C	8-Lead SOIC_N	S-Suffix (R-8)
OP284FS-REEL	−40°C to +125°C	8-Lead SOIC_N	S-Suffix (R-8)
OP284FS-REEL7	−40°C to +125°C	8-Lead SOIC_N	S-Suffix (R-8)
OP284FSZ[1]	−40°C to +125°C	8-Lead SOIC_N	S-Suffix (R-8)
OP284FSZ-REEL[1]	−40°C to +125°C	8-Lead SOIC_N	S-Suffix (R-8)
OP284FSZ-REEL7[1]	−40°C to +125°C	8-Lead SOIC_N	S-Suffix (R-8)
OP284GBC		Die	
OP484ES	−40°C to +125°C	14-Lead SOIC_N	S-Suffix (R-14)
OP484ES-REEL	−40°C to +125°C	14-Lead SOIC_N	S-Suffix (R-14)
OP484ESZ[1]	−40°C to +125°C	14-Lead SOIC_N	S-Suffix (R-14)
OP484ESZ-REEL[1]	−40°C to +125°C	14-Lead SOIC_N	S-Suffix (R-14)
OP484FP	−40°C to +125°C	14-Lead PDIP	P-Suffix (N-14)
OP484FPZ[1]	−40°C to +125°C	14-Lead PDIP	P-Suffix (N-14)
OP484FS	−40°C to +125°C	14-Lead SOIC_N	S-Suffix (R-14)
OP484FS-REEL	−40°C to +125°C	14-Lead SOIC_N	S-Suffix (R-14)
OP484FS-REEL7	−40°C to +125°C	14-Lead SOIC_N	S-Suffix (R-14)
OP484FSZ[1]	−40°C to +125°C	14-Lead SOIC_N	S-Suffix (R-14)
OP484FSZ-REEL[1]	−40°C to +125°C	14-Lead SOIC_N	S-Suffix (R-14)
OP484FSZ-REEL7[1]	−40°C to +125°C	14-Lead SOIC_N	S-Suffix (R-14)

[1] Z = RoHS Compliant part.