15 MHz Rail-to-Rail Operational Amplifiers

OP162/OP262/OP462

FEATURES

Wide bandwidth: 15 MHz
Low offset voltage: 325 µV max
Low noise: 9.5 nV/√Hz @ 1 kHz
Single-supply operation: 2.7 V to 12 V
Rail-to-rail output swing
Low TCV_{OS}: 1 µV/°C typ
High slew rate: 13 V/µs
No phase inversion
Unity-gain stable

APPLICATIONS

Portable instrumentation
Sampling ADC amplifier
Wireless LANs
Direct access arrangement
Office automation

GENERAL DESCRIPTION

The OP162 (single), OP262 (dual), and OP462 (quad) rail-to-rail 15 MHz amplifiers feature the extra speed new designs require, with the benefits of precision and low power operation. With their incredibly low offset voltage of 45 µV (typical) and low noise, they are perfectly suited for precision filter applications and instrumentation. The low supply current of 500 µA (typical) is critical for portable or densely packed designs. In addition, the rail-to-rail output swing provides greater dynamic range and control than standard video amplifiers.

These products operate from single supplies as low as 2.7 V to dual supplies of ±6 V. The fast settling times and wide output swings recommend them for buffers to sampling A/D converters. The output drive of 30 mA (sink and source) is needed for many audio and display applications; more output current can be supplied for limited durations. The OPx62 family is specified over the extended industrial temperature range (–40°C to +125°C). The single OP162 amplifiers are available in 8-lead SOIC, MSOP, and TSSOP packages. The dual OP262 amplifiers are available in 8-lead SOIC and TSSOP packages. The quad OP462 amplifiers are available in 14-lead, narrow-body SOIC and TSSOP packages.

PIN CONFIGURATIONS

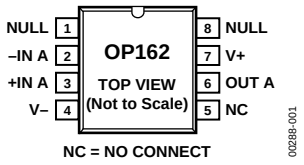


Figure 1. 8-Lead Narrow-Body SOIC (S Suffix)

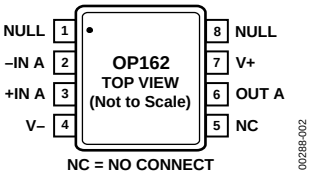


Figure 2. 8-Lead TSSOP (RU Suffix)
8-Lead MSOP (RM Suffix)

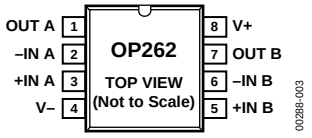


Figure 3. 8-Lead Narrow-Body SOIC (S Suffix)

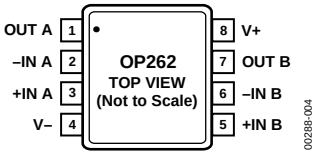


Figure 4. 8-Lead TSSOP (RU Suffix)

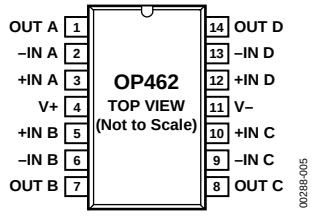


Figure 5. 14-Lead Narrow-Body SOIC (S Suffix)

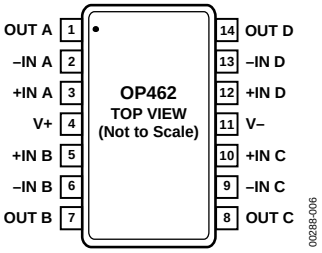


Figure 6. 14-Lead TSSOP (RU Suffix)

SPECIFICATIONS

@ V_S = 5.0 V, V_{CM} = 0 V, T_A = 25°C, unless otherwise noted.

Table 1. Electrical Characteristics

Parameter	Symbol	Conditions	Min	Typ	Max	Unit
INPUT CHARACTERISTICS						
Offset Voltage	V_{OS}	OP162G, OP262G, OP462G		45	325	µV
		−40°C ≤ T_A ≤ +125°C			800	µV
		H grade, −40°C ≤ T_A ≤ +125°C			1	mV
		D grade		0.8	3	mV
		−40°C ≤ T_A ≤ +125°C			5	mV
Input Bias Current	I_B			360	600	nA
		−40°C ≤ T_A ≤ +125°C			650	nA
Input Offset Current	I_{OS}			±2.5	±25	nA
		−40°C ≤ T_A ≤ +125°C			±40	nA
Input Voltage Range	V_{CM}		0		4	V
Common-Mode Rejection	CMRR	0 V ≤ V_{CM} ≤ 4.0 V, −40°C ≤ T_A ≤ +125°C	70	110		dB
Large Signal Voltage Gain	A_{VO}	R_L = 2 kΩ, 0.5 ≤ V_{OUT} ≤ 4.5 V		30		V/mV
		R_L = 10 kΩ, 0.5 ≤ V_{OUT} ≤ 4.5 V	65	88		V/mV
		R_L = 10 kΩ, −40°C ≤ T_A ≤ +125°C	40			V/mV
Long-Term Offset Voltage[1]	V_{OS}	G grade			600	µV
Offset Voltage Drift[2]	$\Delta V_{OS}/\Delta T$			1		µV/°C
Bias Current Drift	$\Delta I_B/\Delta T$			250		pA/°C
OUTPUT CHARACTERISTICS						
Output Voltage Swing High	V_{OH}	I_L = 250 µA, −40°C ≤ T_A ≤ +125°C	4.95	4.99		V
		I_L = 5 mA	4.85	4.94		V
Output Voltage Swing Low	V_{OL}	I_L = 250 µA, −40°C ≤T_A ≤ +125°C		14	50	mV
		I_L = 5 mA		65	150	mV
Short-Circuit Current	I_{SC}	Short to ground		±80		mA
Maximum Output Current	I_{OUT}			±30		mA
POWER SUPPLY						
Power Supply Rejection Ratio	PSRR	V_S = 2.7 V to 7 V		120		dB
		−40°C ≤ T_A ≤ +125°C	90			dB
Supply Current/Amplifier	I_{SY}	OP162, V_{OUT} = 2.5 V		600	750	µA
		−40°C ≤ T_A ≤ +125°C			1	mA
		OP262, OP462, V_{OUT} = 2.5 V		500	700	µA
		−40°C ≤ T_A ≤ +125°C			850	µA
DYNAMIC PERFORMANCE						
Slew Rate	SR	1 V < V_{OUT} < 4 V, R_L = 10 kΩ		10		V/µs
Settling Time	t_S	To 0.1%, A_V = −1, V_O = 2 V step		540		ns
Gain Bandwidth Product	GBP			15		MHz
Phase Margin	φ_m			61		Degrees
NOISE PERFORMANCE						
Voltage Noise	e_n p-p	0.1 Hz to 10 Hz		0.5		µV p-p
Voltage Noise Density	e_n	f = 1 kHz		9.5		nV/√Hz
Current Noise Density	i_n	f = 1 kHz		0.4		pA/√Hz

[1] Long-term offset voltage is guaranteed by a 1000 hour life test performed on three independent lots at 125°C, with an LTPD of 1.3.
[2] Offset voltage drift is the average of the −40°C to +25°C delta and the +25°C to +125°C delta.

@ V_S = 3.0 V, V_{CM} = 0 V, T_A = 25°C, unless otherwise noted.

Table 2. Electrical Characteristics

Parameter	Symbol	Conditions	Min	Typ	Max	Unit
INPUT CHARACTERISTICS						
Offset Voltage	V_{OS}	OP162G, OP262G, OP462G		50	325	µV
		G, H grades, –40°C ≤ T_A ≤ +125°C			1	mV
		D grade		0.8	3	mV
		–40°C ≤ T_A ≤ +125°C			5	mV
Input Bias Current	I_B			360	600	nA
Input Offset Current	I_{OS}			±2.5	±25	nA
Input Voltage Range	V_{CM}		0		2	V
Common-Mode Rejection	CMRR	0 V ≤ V_{CM} ≤ 2.0 V, –40°C ≤ T_A ≤ +125°C	70	110		dB
Large Signal Voltage Gain	A_{VO}	R_L = 2 kΩ, 0.5 V ≤ V_{OUT} ≤ 2.5 V		20		V/mV
		R_L = 10 kΩ, 0.5 V ≤ V_{OUT} ≤ 2.5 V	20	30		V/mV
Long-Term Offset Voltage[1]	V_{OS}	G grade			600	µV
OUTPUT CHARACTERISTICS						
Output Voltage Swing High	V_{OH}	I_L = 250 µA	2.95	2.99		V
		I_L= 5 mA	2.85	2.93		V
Output Voltage Swing Low	V_{OL}	I_L = 250 µA		14	50	mV
		I_L= 5 mA		66	150	mV
POWER SUPPLY						
Power Supply Rejection Ratio	PSRR	V_S = 2.7 V to 7 V,				
		–40°C ≤ T_A ≤ +125°C	60	110		dB
Supply Current/Amplifier	I_{SY}	OP162, V_{OUT} = 1.5 V		600	700	µA
		–40°C ≤ T_A ≤ +125°C			1	mA
		OP262, OP462, V_{OUT} = 1.5 V		500	650	µA
		–40°C ≤ T_A ≤ +125°C			850	µA
DYNAMIC PERFORMANCE						
Slew Rate	SR	R_L = 10 kΩ		10		V/µs
Settling Time	t_S	To 0.1%, A_V = –1, V_O = 2 V step		575		ns
Gain Bandwidth Product	GBP			15		MHz
Phase Margin	φ_m			59		Degrees
NOISE PERFORMANCE						
Voltage Noise	e_n p-p	0.1 Hz to 10 Hz		0.5		µV p-p
Voltage Noise Density	e_n	f = 1 kHz		9.5		nV/√Hz
Current Noise Density	i_n	f = 1 kHz		0.4		pA/√Hz

[1] Long-term offset voltage is guaranteed by a 1000 hour life test performed on three independent lots at 125°C, with an LTPD of 1.3.

@ V_S = ±5.0 V, V_{CM} = 0 V, T_A = 25°C, unless otherwise noted.

Table 3. Electrical Characteristics

Parameter	Symbol	Conditions	Min	Typ	Max	Unit
INPUT CHARACTERISTICS						
Offset Voltage	V_{OS}	OP162G, OP262G, OP462G		25	325	µV
		−40°C ≤ T_A ≤ +125°C			800	µV
		H grade, −40°C ≤ T_A ≤ +125°C			1	mV
		D grade		0.8	3	mV
		−40°C ≤ T_A ≤ +125°C			5	mV
Input Bias Current	I_B			260	500	nA
		−40°C ≤ T_A ≤ +125°C			650	nA
Input Offset Current	I_{OS}			±2.5	±25	nA
		−40°C ≤ T_A ≤ +125°C			±40	nA
Input Voltage Range	V_{CM}		−5		+4	V
Common-Mode Rejection	CMRR	−4.9 V ≤ V_{CM} ≤ +4.0 V, −40°C ≤ T_A ≤ +125°C	70	110		dB
Large Signal Voltage Gain	A_{VO}	R_L = 2 kΩ, −4.5 V ≤ V_{OUT} ≤ +4.5 V		35		V/mV
		R_L = 10 kΩ, −4.5 V ≤ V_{OUT} ≤ +4.5 V	75	120		V/mV
		−40°C ≤ T_A ≤ +125°C	25			V/mV
Long-Term Offset Voltage[1]	V_{OS}	G grade			600	µV
Offset Voltage Drift[2]	$\Delta V_{OS}/\Delta T$			1		µV/°C
Bias Current Drift	$\Delta I_B/\Delta T$			250		pA/°C
OUTPUT CHARACTERISTICS						
Output Voltage Swing High	V_{OH}	I_L = 250 µA, −40°C ≤ T_A ≤ +125°C	4.95	4.99		V
		I_L= 5 mA	4.85	4.94		V
Output Voltage Swing Low	V_{OL}	I_L = 250 µA, −40°C ≤ T_A ≤ +125°C		−4.99	−4.95	V
		I_L= 5 mA		−4.94	−4.85	V
Short-Circuit Current	I_{SC}	Short to ground		±80		mA
Maximum Output Current	I_{OUT}			±30		mA
POWER SUPPLY						
Power Supply Rejection Ratio	PSRR	V_S = ±1.35 V to ±6 V,				
		−40°C ≤ T_A ≤ +125°C	60	110		dB
Supply Current/Amplifier	I_{SY}	OP162, V_{OUT} = 0 V		650	800	µA
		−40°C ≤ T_A ≤ +125°C			1.15	mA
		OP262, OP462, V_{OUT} = 0 V		550	775	µA
		−40°C ≤ T_A ≤ +125°C			1	mA
Supply Voltage Range	V_S		3.0 (±1.5)		12 (±6)	V
DYNAMIC PERFORMANCE						
Slew Rate	SR	−4 V < V_{OUT} < 4 V, R_L = 10 kΩ		13		V/µs
Settling Time	t_S	To 0.1%, A_V = −1, V_O = 2 V step		475		ns
Gain Bandwidth Product	GBP			15		MHz
Phase Margin	φ_m			64		Degrees
NOISE PERFORMANCE						
Voltage Noise	e_n p-p	0.1 Hz to 10 Hz		0.5		µV p-p
Voltage Noise Density	e_n	f = 1 kHz		9.5		nV/√Hz
Current Noise Density	i_n	f = 1 kHz		0.4		pA/√Hz

[1] Long-term offset voltage is guaranteed by a 1000 hour life test performed on three independent lots at +125°C, with an LTPD of 1.3.
[2] Offset voltage drift is the average of the −40°C to +25°C delta and the +25°C to +125°C delta.

ABSOLUTE MAXIMUM RATINGS

Table 4.

Parameter	Min
Supply Voltage	±6 V
Input Voltage[1]	±6 V
Differential Input Voltage[2]	±0.6 V
Internal Power Dissipation	
SOIC (S)	Observe Derating Curves
MSOP (RM)	Observe Derating Curves
TSSOP (RU)	Observe Derating Curves
Output Short-Circuit Duration	Observe Derating Curves
Storage Temperature Range	–65°C to +150°C
Operating Temperature Range	–40°C to +125°C
Junction Temperature Range	–65°C to +150°C
Lead Temperature Range (Soldering, 10 sec)	300°C

[1] For supply voltages greater than 6 V, the input voltage is limited to less than or equal to the supply voltage.
[2] For differential 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 operation section of this specification is not implied. Exposure to absolute maximum rating conditions for extended periods may affect device reliability.

Table 5.

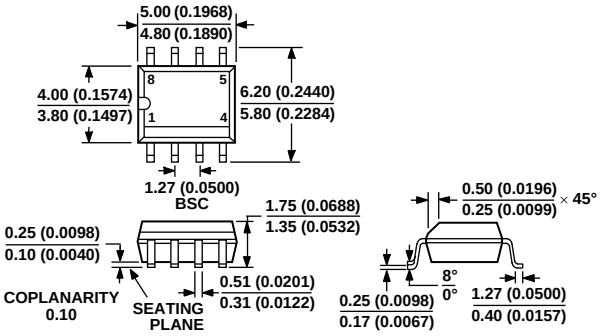
Package Type	θ_{JA}[1]	θ_{JC}	Unit
8-Lead SOIC (S)	157	56	°C/W
8-Lead TSSOP (RU)	208		°C/W
8-Lead MSOP (RM)	190	44	°C/W
14-Lead SOIC (S)	105		°C/W
14-Lead TSSOP (RU)	148		°C/W

[1] θ_{JA} is specified for the worst-case conditions, that is, θ_{JA} is specified for a device soldered in circuit board for SOIC, MSOP, and TSSOP packages.

ESD CAUTION

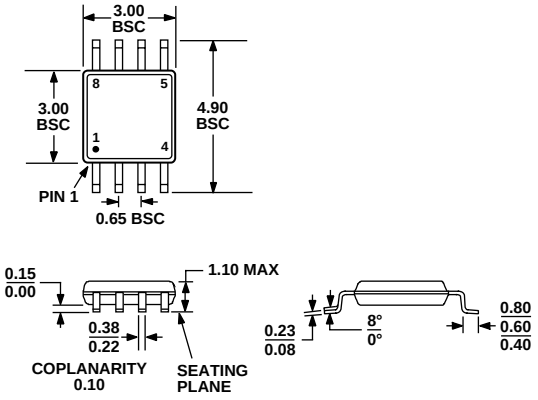
ESD (electrostatic discharge) sensitive device. Electrostatic charges as high as 4000 V readily accumulate on the human body and test equipment and can discharge without detection. Although this product features proprietary ESD protection circuitry, permanent damage may occur on devices subjected to high energy electrostatic discharges. Therefore, proper ESD precautions are recommended to avoid performance degradation or loss of functionality.

OUTLINE DIMENSIONS



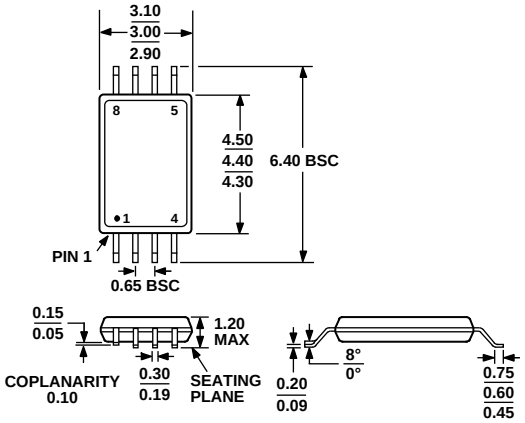
COMPLIANT TO JEDEC STANDARDS MS-012AA
CONTROLLING DIMENSIONS ARE IN MILLIMETERS; INCH DIMENSIONS (IN PARENTHESES) ARE ROUNDED-OFF MILLIMETER EQUIVALENTS FOR REFERENCE ONLY AND ARE NOT APPROPRIATE FOR USE IN DESIGN

Figure 51. 8-Lead Standard Small Outline Package [SOIC] Narrow Body S-Suffix (R-8)
Dimensions shown in millimeters and (inches)



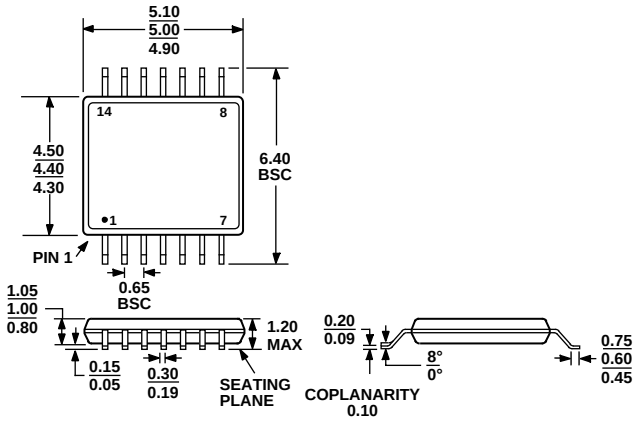
COMPLIANT TO JEDEC STANDARDS MO-187AA

Figure 52. 8-Lead Mini Small Outline Package [MSOP] (RM-8)
Dimensions shown in millimeters



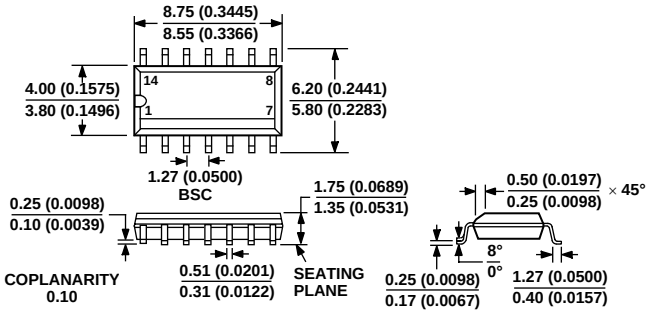
COMPLIANT TO JEDEC STANDARDS MO-153AA

Figure 53. 8-Lead Thin Shrink Small Outline Package [TSSOP] (RU-8)
Dimensions shown in millimeters



COMPLIANT TO JEDEC STANDARDS MO-153AB-1

Figure 54. 14-Lead Thin Shrink Small Outline Package [TSSOP] (RU-14)
Dimensions shown in millimeters



COMPLIANT TO JEDEC STANDARDS MS-012AB
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 55. 14-Lead Standard Small Outline Package [SOIC] Narrow Body S-Suffix (R-14)
Dimensions shown in millimeters and (inches)

ORDERING GUIDE

Model	Temperature Range	Package Description	Package Option	Branding
OP162GS	−40°C to +125°C	8-Lead SOIC	S-Suffix (R-8)	
OP162GS-REEL	−40°C to +125°C	8-Lead SOIC	S-Suffix (R-8)	
OP162GS-REEL7	−40°C to +125°C	8-Lead SOIC	S-Suffix (R-8)	
OP162GSZ[1]	−40°C to +125°C	8-Lead SOIC	S-Suffix (R-8)	
OP162GSZ-REEL[1]	−40°C to +125°C	8-Lead SOIC	S-Suffix (R-8)	
OP162GSZ-REEL7[1]	−40°C to +125°C	8-Lead SOIC	S-Suffix (R-8)	
OP162DRU-REEL	−40°C to +125°C	8-Lead TSSOP	RU-8	
OP162DRUZ-REEL[1]	−40°C to +125°C	8-Lead TSSOP	RU-8	
OP162HRU-REEL	−40°C to +125°C	8-Lead TSSOP	RU-8	
OP162HRUZ-REEL[1]	−40°C to +125°C	8-Lead TSSOP	RU-8	
OP162DRM-REEL	−40°C to +125°C	8-Lead MSOP	RM-8	AND
OP162DRMZ-REEL[1]	−40°C to +125°C	8-Lead MSOP	RM-8	AOJ
OP262DRU-REEL	−40°C to +125°C	8-Lead TSSOP	RU-8	
OP262DRUZ-REEL[1]	−40°C to +125°C	8-Lead TSSOP	RU-8	
OP262GS	−40°C to +125°C	8-Lead SOIC	S-Suffix (R-8)	
OP262GS-REEL	−40°C to +125°C	8-Lead SOIC	S-Suffix (R-8)	
OP262GS-REEL7	−40°C to +125°C	8-Lead SOIC	S-Suffix (R-8)	
OP262GSZ[1]	−40°C to +125°C	8-Lead SOIC	S-Suffix (R-8)	
OP262GSZ-REEL[1]	−40°C to +125°C	8-Lead SOIC	S-Suffix (R-8)	
OP262GSZ-REEL7[1]	−40°C to +125°C	8-Lead SOIC	S-Suffix (R-8)	
OP262HRU-REEL	−40°C to +125°C	8-Lead TSSOP	RU-8	
OP262HRUZ-REEL[1]	−40°C to +125°C	8-Lead TSSOP	RU-8	
OP462DRU-REEL	−40°C to +125°C	14-Lead TSSOP	RU-14	
OP462DRUZ-REEL[1]	−40°C to +125°C	14-Lead TSSOP	RU-14	
OP462DS	−40°C to +125°C	14-Lead SOIC	S-Suffix (R-14)	
OP462DS-REEL	−40°C to +125°C	14-Lead SOIC	S-Suffix (R-14)	
OP462DS-REEL7	−40°C to +125°C	14-Lead SOIC	S-Suffix (R-14)	
OP462DSZ[1]	−40°C to +125°C	14-Lead SOIC	S-Suffix (R-14)	
OP462DSZ-REEL[1]	−40°C to +125°C	14-Lead SOIC	S-Suffix (R-14)	
OP462DSZ-REEL7[1]	−40°C to +125°C	14-Lead SOIC	S-Suffix (R-14)	
OP462GS	−40°C to +125°C	14-Lead SOIC	S-Suffix (R-14)	
OP462GS-REEL	−40°C to +125°C	14-Lead SOIC	S-Suffix (R-14)	
OP462GS-REEL7	−40°C to +125°C	14-Lead SOIC	S-Suffix (R-14)	
OP462GSZ[1]	−40°C to +125°C	14-Lead SOIC	S-Suffix (R-14)	
OP462GSZ-REEL[1]	−40°C to +125°C	14-Lead SOIC	S-Suffix (R-14)	
OP462GSZ-REEL7[1]	−40°C to +125°C	14-Lead SOIC	S-Suffix (R-14)	
OP462HRU-REEL	−40°C to +125°C	14-Lead TSSOP	RU-14	
OP462HRUZ-REEL[1]	−40°C to +125°C	14-Lead TSSOP	RU-14	

[1] Z = Pb-free part.