

generated fingerprints for *text* | *all* values of --output option.

This is only used for *Specify* value of --DataFieldsMode option.

Examples:

```
Extreg
MolID,CompoundName
```

-d, --DataFieldsMode *All* | *Common* | *Specify* | *CompoundID*

Specify how data fields in *SDF*file(s) are transferred to output CSV/TSV text file(s) along with generated fingerprints for *text* | *all* values of --output option: transfer all SD data field; transfer SD data files common to all compounds; extract specified data fields; generate a compound ID using molname line, a compound prefix, or a combination of both. Possible values: *All* | *Common* | *specify* | *CompoundID*. Default value: *CompoundID*.

-f, --Filter *Yes* | *No*

Specify whether to check and filter compound data in *SDF*file(s). Possible values: *Yes* or *No*. Default value: *Yes*.

By default, compound data is checked before calculating fingerprints and compounds containing atom data corresponding to non-element symbols or no atom data are ignored.

--FingerprintsLabel *text*

SD data label or text file column label to use for fingerprints string in output SD or CSV/TSV text file(s) specified by --output. Default value: *MACCSKeyFingerprints*.

-h, --help

Print this help message.

-k, --KeepLargestComponent *Yes* | *No*

Generate fingerprints for only the largest component in molecule. Possible values: *Yes* or *No*. Default value: *Yes*.

For molecules containing multiple connected components, fingerprints can be generated in two different ways: use all connected components or just the largest connected component. By default, all atoms except for the largest connected component are deleted before generation of fingerprints.

-m, --mode *MACCSKeyBits* | *MACCSKeyCount*

Specify type of MACCS keys [Ref 45-47] fingerprints to generate for molecules in *SDF*file(s). Possible values: *MACCSKeyBits*, *MACCSKeyCount*. Default value: *MACCSKeyBits*.

For *MACCSKeyBits* value of -m, --mode option, a fingerprint bit-vector string containing zeros and ones is generated and for *MACCSKeyCount* value, a fingerprint vector string corresponding to number of MACCS keys is generated.

MACCSKeyBits | *MACCSKeyCount* values for -m, --mode option along with two possible *166* | *322* values of -s, --size supports generation of four different types of MACCS keys fingerprint: *MACCS166KeyBits*, *MACCS166KeyCount*, *MACCS322KeyBits*, *MACCS322KeyCount*.

Definition of MACCS keys uses the following atom and bond symbols to define atom and bond environments:

Atom symbols for 166 keys [Ref 47]:

```
A : Any valid periodic table element symbol
Q : Hetro atoms; any non-C or non-H atom
X : Halogens; F, Cl, Br, I
Z : Others; other than H, C, N, O, Si, P, S, F, Cl, Br, I
```

Atom symbols for 322 keys [Ref 46]:

```
A : Any valid periodic table element symbol
Q : Hetro atoms; any non-C or non-H atom
X : Others; other than H, C, N, O, Si, P, S, F, Cl, Br, I
Z is neither defined nor used
```

Bond types:

```
- : Single
= : Double
T : Triple
```

: Triple
~ : Single or double query bond
% : An aromatic query bond

None : Any bond type; no explicit bond specified

\$: Ring bond; \$ before a bond type specifies ring bond
! : Chain or non-ring bond; ! before a bond type specifies chain bond

@ : A ring linkage and the number following it specifies the atoms position in the line, thus @1 means linked back to the first atom in the list.

Aromatic: Kekule or Arom5

Kekule: Bonds in 6-membered rings with alternate single/double bonds or perimeter bonds
Arom5: Bonds in 5-membered rings with two double bonds and a hetro atom at the apex of the ring.

MACCS 166 keys [Ref 45-47] are defined as follows:

Key Description

1 ISOTOPE
2 103 < ATOMIC NO. < 256
3 GROUP IVA,VA,VIA PERIODS 4-6 (Ge...)
4 ACTINIDE
5 GROUP IIIB,IVB (Sc...)
6 LANTHANIDE
7 GROUP VB,VIB,VIIB (V...)
8 QAAA@1
9 GROUP VIII (Fe...)
10 GROUP IIA (ALKALINE EARTH)
11 4M RING
12 GROUP IB,IIB (Cu...)
13 ON(C)C
14 S-S
15 OC(O)O
16 QAA@1
17 CTC
18 GROUP IIIA (B...)
19 7M RING
20 SI
21 C=C(Q)Q
22 3M RING
23 NC(O)O
24 N-O
25 NC(N)N
26 C\$=C(\$A)\$A
27 I
28 QCH2Q
29 P
30 CQ(C)(C)A
31 QX
32 CSN
33 NS
34 CH2=A
35 GROUP IA (ALKALI METAL)
36 S HETEROCYCLE
37 NC(O)N
38 NC(C)N
39 OS(O)O
40 S-O
41 CTN
42 F
43 QHAQH
44 OTHER
45 C=CN

46 BR
47 SAN
48 OQ(O)O
49 CHARGE
50 C=C(C)C
51 CSO
52 NN
53 QHAAQHQH
54 QHAAQH
55 OSO
56 ON(O)C
57 O HETEROCYCLE
58 QSQ
59 Snot%A%A
60 S=O
61 AS(A)A
62 A\$A!A\$A
63 N=O
64 A\$A!S
65 C%N
66 CC(C)(C)A
67 QS
68 QHQH (&...)
69 QQH
70 QNQ
71 NO
72 OAAO
73 S=A
74 CH3ACH3
75 A!N\$A
76 C=C(A)A
77 NAN
78 C=N
79 NAAN
80 NAAAN
81 SA(A)A
82 ACH2QH
83 QAAAA@1
84 NH2
85 CN(C)C
86 CH2QCH2
87 X!A\$A
88 S
89 OAAAO
90 QHAAACH2A
91 QHAAACH2A
92 OC(N)C
93 QCH3
94 QN
95 NAAO
96 5M RING
97 NAAAO
98 QAAAAA@1
99 C=C
100 ACH2N
101 8M RING
102 QO
103 CL
104 QHACH2A
105 A\$A(\$A)\$A
106 QA(Q)Q
107 XA(A)A
108 CH3AAACH2A
109 ACH2O
110 NCO
111 NACH2A
112 AA(A)(A)A
113 Onot%A%A
114 CH3CH2A

```
115 CH3ACH2A
116 CH3AACH2A
117 NAO
118 ACH2CH2A > 1
119 N=A
120 HETEROCYCLIC ATOM > 1 (&...)
121 N HETEROCYCLE
122 AN(A)A
123 OCO
124 QQ
125 AROMATIC RING > 1
126 A!O!A
127 A$A!O > 1 (&...)
128 ACH2AAACH2A
129 ACH2AACH2A
130 QQ > 1 (&...)
131 QH > 1
132 OACH2A
133 A$A!N
134 X (HALOGEN)
135 Nnot%A%A
136 O=A > 1
137 HETEROCYCLE
138 QCH2A > 1 (&...)
139 OH
140 O > 3 (&...)
141 CH3 > 2 (&...)
142 N > 1
143 A$A!O
144 Anot%A%Anot%A
145 6M RING > 1
146 O > 2
147 ACH2CH2A
148 AQ(A)A
149 CH3 > 1
150 A!A$A!A
151 NH
152 OC(C)C
153 QCH2A
154 C=O
155 A!CH2!A
156 NA(A)A
157 C-O
158 C-N
159 O > 1
160 CH3
161 N
162 AROMATIC
163 6M RING
164 O
165 RING
166 FRAGMENTS
```

MACCS 322 keys set as defined in tables 1, 2 and 3 [Ref 46] include:

- . 26 atom properties of type P, as listed in Table 1
- . 32 one-atom environments, as listed in Table 3
- . 264 atom-bond-atom combinations listed in Table 4

Total number of keys in three tables is : 322

Atom symbol, X, used for 322 keys [Ref 46] doesn't refer to Halogens as it does for 166 keys. In order to keep the definition of 322 keys consistent with the published definitions, the symbol X is used to imply "others" atoms, but it's internally mapped to symbol X as defined for 166 keys during the generation of key values.

Atom properties-based keys (26):

Key	Description
1	A(AAA) or AA(A)A - atom with at least three neighbors
2	Q - heteroatom

3 Anot%not-A - atom involved in one or more multiple bonds, not aromatic
 4 A(AAAA) or AA(A)(A)A - atom with at least four neighbors
 5 A(QQ) or QA(Q) - atom with at least two heteroatom neighbors
 6 A(QQQ) or QA(Q)Q - atom with at least three heteroatom neighbors
 7 QH - heteroatom with at least one hydrogen attached
 8 CH2(AA) or ACH2A - carbon with at least two single bonds and at least
 two hydrogens attached
 9 CH3(A) or ACH3 - carbon with at least one single bond and at least three
 hydrogens attached
 10 Halogen
 11 A(-A-A-A) or A-A(-A)-A - atom has at least three single bonds
 12 AAAAA@1 > 2 - atom is in at least two different six-membered rings
 13 A(\$A\$A\$A) or A\$A(\$A)\$A - atom has more than two ring bonds
 14 A\$A!A\$A - atom is at a ring/chain boundary. When a comparison is done
 with another atom the path passes through the chain bond.
 15 Anot%A%Anot%A - atom is at an aromatic/nonaromatic boundary. When a
 comparison is done with another atom the path
 passes through the aromatic bond.
 16 A!A!A - atom with more than one chain bond
 17 A!A\$A!A - atom is at a ring/chain boundary. When a comparison is done
 with another atom the path passes through the ring bond.
 18 A%Anot%A%A - atom is at an aromatic/nonaromatic boundary. When a
 comparison is done with another atom the
 path passes through the nonaromatic bond.
 19 HETEROCYCLE - atom is a heteroatom in a ring.
 20 rare properties: atom with five or more neighbors, atom in
 four or more rings, or atom types other than
 H, C, N, O, S, F, Cl, Br, or I
 21 rare properties: atom has a charge, is an isotope, has two or
 more multiple bonds, or has a triple bond.
 22 N - nitrogen
 23 S - sulfur
 24 O - oxygen
 25 A(AA)A(A)A(AA) - atom has two neighbors, each with three or
 more neighbors (including the central atom).
 26 CHACH2 - atom has two hydrocarbon (CH2) neighbors

Atomic environments properties-based keys (32):

Key	Description
27	C(CC)
28	C(CCC)
29	C(CN)
30	C(CCN)
31	C(NN)
32	C(NNC)
33	C(NNN)
34	C(CO)
35	C(CCO)
36	C(NO)
37	C(NCO)
38	C(NNO)
39	C(OO)
40	C(COO)
41	C(NOO)
42	C(OOO)
43	Q(CC)
44	Q(CCC)
45	Q(CN)
46	Q(CCN)
47	Q(NN)
48	Q(CNN)
49	Q(NNN)
50	Q(CO)
51	Q(CCO)
52	Q(NO)
53	Q(CNO)
54	Q(NNO)
55	Q(OO)

56 Q(COO)
57 Q(NOO)
58 Q(OOO)

Note: The first symbol is the central atom, with atoms bonded to the central atom listed in parentheses. Q is any non-C, non-H atom. If only two atoms are in parentheses, there is no implication concerning the other atoms bonded to the central atom.

Atom-Bond-Atom properties-based keys: (264)

Key	Description
59	C-C
60	C-N
61	C-O
62	C-S
63	C-Cl
64	C-P
65	C-F
66	C-Br
67	C-Si
68	C-I
69	C-X
70	N-N
71	N-O
72	N-S
73	N-Cl
74	N-P
75	N-F
76	N-Br
77	N-Si
78	N-I
79	N-X
80	O-O
81	O-S
82	O-Cl
83	O-P
84	O-F
85	O-Br
86	O-Si
87	O-I
88	O-X
89	S-S
90	S-Cl
91	S-P
92	S-F
93	S-Br
94	S-Si
95	S-I
96	S-X
97	Cl-Cl
98	Cl-P
99	Cl-F
100	Cl-Br
101	Cl-Si
102	Cl-I
103	Cl-X
104	P-P
105	P-F
106	P-Br
107	P-Si
108	P-I
109	P-X
110	F-F
111	F-Br
112	F-Si
113	F-I
114	F-X
115	Br-Br
116	Br-Si
117	Br-I

118	Br-X
119	Si-Si
120	Si-I
121	Si-X
122	I-I
123	I-X
124	X-X
125	C=C
126	C=N
127	C=O
128	C=S
129	C=Cl
130	C=P
131	C=F
132	C=Br
133	C=Si
134	C=I
135	C=X
136	N=N
137	N=O
138	N=S
139	N=Cl
140	N=P
141	N=F
142	N=Br
143	N=Si
144	N=I
145	N=X
146	O=O
147	O=S
148	O=Cl
149	O=P
150	O=F
151	O=Br
152	O=Si
153	O=I
154	O=X
155	S=S
156	S=Cl
157	S=P
158	S=F
159	S=Br
160	S=Si
161	S=I
162	S=X
163	Cl=Cl
164	Cl=P
165	Cl=F
166	Cl=Br
167	Cl=Si
168	Cl=I
169	Cl=X
170	P=P
171	P=F
172	P=Br
173	P=Si
174	P=I
175	P=X
176	F=F
177	F=Br
178	F=Si
179	F=I
180	F=X
181	Br=Br
182	Br=Si
183	Br=I
184	Br=X
185	Si=Si
186	Si=I

187	Si=X
188	I=I
189	I=X
190	X=X
191	C#C
192	C#N
193	C#O
194	C#S
195	C#Cl
196	C#P
197	C#F
198	C#Br
199	C#Si
200	C#I
201	C#X
202	N#N
203	N#O
204	N#S
205	N#Cl
206	N#P
207	N#F
208	N#Br
209	N#Si
210	N#I
211	N#X
212	O#O
213	O#S
214	O#Cl
215	O#P
216	O#F
217	O#Br
218	O#Si
219	O#I
220	O#X
221	S#S
222	S#Cl
223	S#P
224	S#F
225	S#Br
226	S#Si
227	S#I
228	S#X
229	Cl#Cl
230	Cl#P
231	Cl#F
232	Cl#Br
233	Cl#Si
234	Cl#I
235	Cl#X
236	P#P
237	P#F
238	P#Br
239	P#Si
240	P#I
241	P#X
242	F#F
243	F#Br
244	F#Si
245	F#I
246	F#X
247	Br#Br
248	Br#Si
249	Br#I
250	Br#X
251	Si#Si
252	Si#I
253	Si#X
254	I#I
255	I#X

256	X#X
257	C\$C
258	C\$N
259	C\$O
260	C\$S
261	C\$Cl
262	C\$P
263	C\$F
264	C\$Br
265	C\$Si
266	C\$I
267	C\$X
268	N\$N
269	N\$O
270	N\$S
271	N\$Cl
272	N\$P
273	N\$F
274	N\$Br
275	N\$Si
276	N\$I
277	N\$X
278	O\$O
279	O\$S
280	O\$Cl
281	O\$P
282	O\$F
283	O\$Br
284	O\$Si
285	O\$I
286	O\$X
287	S\$S
288	S\$Cl
289	S\$P
290	S\$F
291	S\$Br
292	S\$Si
293	S\$I
294	S\$X
295	Cl\$Cl
296	Cl\$P
297	Cl\$F
298	Cl\$Br
299	Cl\$Si
300	Cl\$I
301	Cl\$X
302	P\$P
303	P\$F
304	P\$Br
305	P\$Si
306	P\$I
307	P\$X
308	F\$F
309	F\$Br
310	F\$Si
311	F\$I
312	F\$X
313	Br\$Br
314	Br\$Si
315	Br\$I
316	Br\$X
317	Si\$Si
318	Si\$I
319	Si\$X
320	I\$I
321	I\$X
322	X\$X

```
% MACCSKeysFingerprints.pl -size 322 -r SampleMACCS322FPBin -o Sample.sdf
```

To generate MACCS keys fingerprints of size 166 corresponding to count of keys in ValuesString format and create a SampleMACCS166FPCount.csv file containing sequential compound IDs along with fingerprints vector strings data, type:

```
% MACCSKeysFingerprints.pl -m MACCSKeyCount -r SampleMACCS166FPCount
-o Sample.sdf
```

To generate MACCS keys fingerprints of size 322 corresponding to count of keys in ValuesString format and create a SampleMACCS322FPCount.csv file containing sequential compound IDs along with fingerprints vector strings data, type:

```
% MACCSKeysFingerprints.pl -m MACCSKeyCount -size 322
-r SampleMACCS322FPCount -o Sample.sdf
```

To generate MACCS keys fingerprints of size 166 in hexadecimal bit-vector string format with ascending bits order and create a SampleMACCS166FPHex.csv file containing compound IDs from MolName along with fingerprints bit-vector strings data, type:

```
% MACCSKeysFingerprints.pl -m MACCSKeyBits --size 166 --BitStringFormat
HexadecimalString --BitsOrder Ascending --DataFieldsMode CompoundID
--CompoundIDMode MolName -r SampleMACCS166FPBin -o Sample.sdf
```

To generate MACCS keys fingerprints of size 166 corresponding to count of keys in IDsAndValuesString format and create a SampleMACCS166FPCount.csv file containing compound IDs from MolName line along with fingerprints vector strings data, type:

```
% MACCSKeysFingerprints.pl -m MACCSKeyCount --size 166
--VectorStringFormat IDsAndValuesString --DataFieldsMode CompoundID
--CompoundIDMode MolName -r SampleMACCS166FPCount -o Sample.sdf
```

To generate MACCS keys fingerprints of size 166 corresponding to count of keys in IDsAndValuesString format and create a SampleMACCS166FPCount.csv file containing compound IDs using specified data field along with fingerprints vector strings data, type:

```
% MACCSKeysFingerprints.pl -m MACCSKeyCount --size 166
--VectorStringFormat IDsAndValuesString --DataFieldsMode CompoundID
--CompoundIDMode DataField --CompoundID Mol_ID -r
SampleMACCS166FPCount -o Sample.sdf
```

To generate MACCS keys fingerprints of size 322 corresponding to count of keys in ValuesString format and create a SampleMACCS322FPCount.tsv file containing compound IDs derived from combination of molecule name line and an explicit compound prefix along with fingerprints vector strings data in a column labels MACCSKeyCountFP, type:

```
% MACCSKeysFingerprints.pl -m MACCSKeyCount -size 322 --DataFieldsMode
CompoundID --CompoundIDMode MolnameOrLabelPrefix --CompoundID Cmpd
--CompoundIDLabel MolID --FingerprintsLabel MACCSKeyCountFP --OutDelim
Tab -r SampleMACCS322FPCount -o Sample.sdf
```

To generate MACCS keys fingerprints of size 166 corresponding to count of keys in ValuesString format and create a SampleMACCS166FPCount.csv file containing specific data fields columns along with fingerprints vector strings data, type:

```
% MACCSKeysFingerprints.pl -m MACCSKeyCount --size 166
--VectorStringFormat ValuesString --DataFieldsMode Specify --DataFields
Mol_ID -r SampleMACCS166FPCount -o Sample.sdf
```

To generate MACCS keys fingerprints of size 322 corresponding to count of keys in ValuesString format and create a SampleMACCS322FPCount.csv file containing common data fields columns along with fingerprints vector strings data, type:

```
% MACCSKeysFingerprints.pl -m MACCSKeyCount --size 322
--VectorStringFormat ValuesString --DataFieldsMode Common -r
SampleMACCS322FPCount -o Sample.sdf
```

To generate MACCS keys fingerprints of size 166 corresponding to count of keys in ValuesString format and create SampleMACCS166FPCount.sdf, SampleMACCS166FPCount.fpf and SampleMACCS166FPCount.csv files containing all data fields columns in CSV file along with fingerprints vector strings data, type:

```
% MACCSKeysFingerprints.pl -m MACCSKeyCount --size 166 --output all
--VectorStringFormat ValuesString --DataFieldsMode All -r
SampleMACCS166FPCount -o Sample.sdf
```

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SEE ALSO

InfoFingerprintsFiles.pl, SimilarityMatricesFingerprints.pl, AtomNeighborhoodsFingerprints.pl, ExtendedConnectivityFingerprints.pl, PathLengthFingerprints.pl, TopologicalAtomPairsFingerprints.pl, TopologicalAtomTorsionsFingerprints.pl, TopologicalPharmacophoreAtomPairsFingerprints.pl, TopologicalPharmacophoreAtomTripletsFingerprints.pl

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