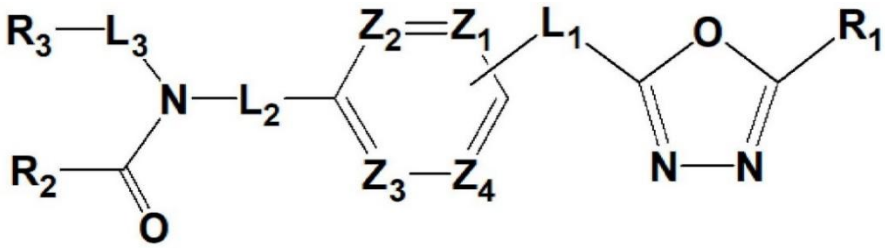
Claims

1. A pharmaceutical composition for preventing or treating heart failure, comprising a compound represented by formula I below, optical isomers thereof or pharmaceutically acceptable salts thereof as an active ingredient:

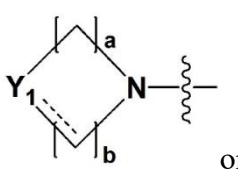
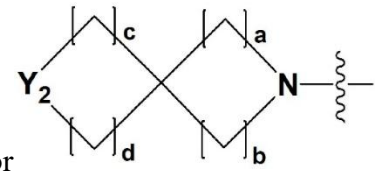
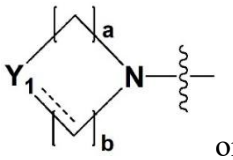
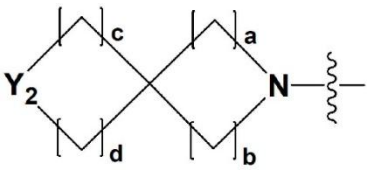
[Formula I]



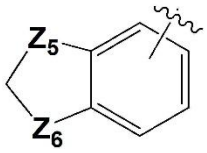
in formula I,

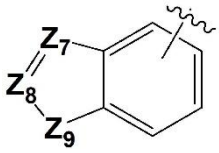
wherein L_1, L_2 or L_3 are each independently a bond or -(C_1-C_2 alkylene)-;

R_1 is -CX_2H or -CX_3;

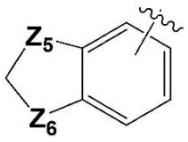
R_2 is -NR^AR^B, -OR^C,  or ,{wherein, at least one H of  or  may be substituted with -X, -OH, -O(C_1-C_4 alkyl), -NR^DR^E, -(C_1-C_4 alkyl), -CF_3, -CF_2H, -CN, -aryl, -heteroaryl, -(C_1-C_4 alkyl)-aryl or -(C_1-C_4 alkyl)-heteroaryl, [wherein at least one H of the -aryl, -heteroaryl, -(C_1-C_4 alkyl)-aryl or -(C_1-C_4 alkyl)-heteroaryl may be substituted with -X, -OH, -CF_3 or -CF_2H]};

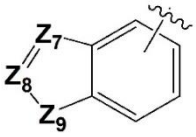
R_3 is -H, -(C_1-C_4 alkyl), -(C_1-C_4 alkyl)-O(C_1-C_4 alkyl), -(C_1-C_4 alkyl)-C(=O)-O(C_1-C_4 alkyl), -(C_3-C_7 cycloalkyl), -(C_2-C_6 cycloheteroalkyl), -aryl, -heteroaryl, -adamantyl,

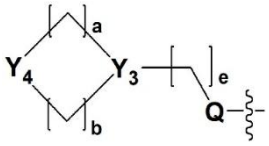


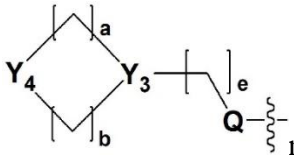
or 

{wherein, at least one H of -(C_1-C_4 alkyl) may be substituted with -X or -OH,

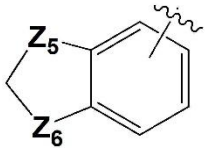
at least one H of -aryl or -heteroaryl each independently may be substituted with -X, -OH, -O(C_1-C_4 alkyl), -OCF_3, -O-aryl, -NR^DR^E, -(C_1-C_4 alkyl), -CF_3, -CF_2H, -C(=O)-(C_1-C_4 alkyl), -C(=O)-O(C_1-C_4 alkyl), -C(=O)-NR^DR^E, -$S(=O)_2$-(C_1-C_4 alkyl), aryl, heteroaryl, 

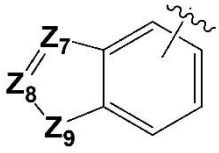
, 

or 

[wherein, at least one H of 

may be substituted with -X, -(C_1-C_4 alkyl), -NR^DR^E, -CF_3 or -CF_2H],

at least one H of -(C_3-C_7 cycloalkyl), -(C_2-C_6 cycloheteroalkyl), adamantyl, 

or 

may be each independently substituted with -X, -OH or -(C_1-C_4 alkyl)};

Y_1, Y_2 and Y_4 are each independently -CH_2-, -NR^F-, -O-, -C(=O)- or -$S(=O)_2$-;

Y_3 is -CH- or -N-;

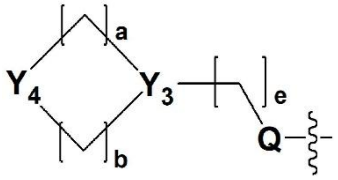
Z_1 to Z_4 are each independently N or CR^Z, {wherein at least three of Z_1 to Z_4 may not be simultaneously N, and R^Z is -H, -X or -O(C_1-C_4 alkyl)};

Z_5 and Z_6 are each independently -CH_2- or -O-;

Z_7 and Z_8 are each independently =CH- or =N-;

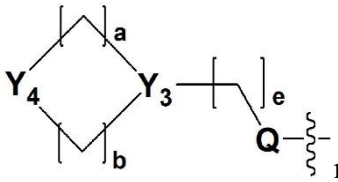
Z_9 is -NR^G- or -S-;

R^A and R^B are each independently -H, -(C_1-C_4 alkyl), -(C_1-C_4 alkyl)-OH, -(C_1-C_4

alkyl)-NR^DR^E, -aryl, -(C_1-C_4 alkyl)-aryl, -heteroaryl, -(C_1-C_4 aryl)-heteroaryl, -(C_3-C_7 cycloalkyl), -(C_2-C_6 heterocycloalkyl) or 

{wherein, at least one H of the -(C_1-C_4 alkyl), -(C_1-C_4 alkyl)-OH or -(C_1-C_4 alkyl)-NR^DR^E may be substituted with -X,

at least one H of the -aryl, -(C_1-C_4 alkyl)-aryl, -heteroaryl, -(C_1-C_4 alkyl)-heteroaryl, -(C_3-C_7 cycloalkyl) or -(C_2-C_6 heterocycloalkyl) may be substituted with -X, -OH, -O(C_1-C_4 alkyl), -(C_1-C_4 alkyl), -CF_3, -CF_2H or -CN,

at least one H of 

may be substituted with -X, -OH, -O(C_1-C_4 alkyl), -(C_1-C_4 alkyl), -CF_3, -CF_2H, -CN, -(C_2-C_6 heterocycloalkyl), -aryl, -(C_1-C_4 alkyl)-aryl, -heteroaryl or -heteroaryl-(C_1-C_4 alkyl)};

R^C is -(C_1-C_4 alkyl), -aryl, -(C_1-C_4 alkyl)-aryl, -heteroaryl or -(C_1-C_4 alkyl)-heteroaryl, {wherein, at least one H of -(C_1-C_4 alkyl) may be substituted with -X or -OH, at least one H of -aryl, -(C_1-C_4 alkyl)-aryl, -heteroaryl or -(C_1-C_4 alkyl)-heteroaryl may be substituted with -X, -OH, -CF_3 or -CF_2H};

R^D and R^E are each independently -H, -(C_1-C_4 alkyl), -aryl or -(C_1-C_4 alkyl)-aryl, {wherein, at least one H of -(C_1-C_4 alkyl) may be substituted with -X or -OH, at least one H of -aryl or -(C_1-C_4 alkyl)-aryl may be substituted with -X, -OH, -CF_3 or -CF_2H};

R^F is -H, -(C_1-C_6 alkyl), -(C_1-C_4 alkyl)-OH, -(C_1-C_4 alkyl)-O-(C_1-C_4 alkyl), -C(=O)-(C_1-C_4 alkyl), -C(=O)-0(C_1-C_4 alkyl), -(C_1-C_4 alkyl)-C(=O)-O(C_1-C_4 alkyl), -(C_1-C_4 alkyl)-NR^DR^E, -$S(=O)_2$-(C_1-C_4 alkyl), -aryl, -(C_1-C_4 alkyl)-aryl, -(C_2-C_4 alkenyl)-aryl, -heteroaryl, -(C_1-C_4 alkyl)-heteroaryl, -C(=O)-(C_3-C_7 cycloalkyl), -(C_2-C_6 heterocycloalkyl) or -(C_1-C_4

alkyl)-C(=O)-(C_2-C_6 heterocycloalkyl)

{wherein at least one H of -(C_1-C_4 alkyl), -(C_1-C_4 alkyl)-OH, -(C_1-C_4 alkyl)-O-(C_1-C_4 alkyl), -C(=O)-(C_1-C_4 alkyl), -C(=O)-O(C_1-C_4 alkyl), -(C_1-C_4 alkyl)-C(=O)-O(C_1-C_4 alkyl), -(C_1-C_4 alkyl)-NR^DR^E or -S(=O)$_2$-(C_1-C_4 alkyl) may be substituted with -X,

at least one H of -aryl, -(C_1-C_4alkyl)-aryl, -(C_2-C_4 alkenyl)-aryl, -heteroaryl, -(C_1-C_4 alkyl)-heteroaryl, -C(=O)-(C_3-C_7 cycloalkyl), -C_2-C_6 heterocycloalkyl or -(C_1-C_4alkyl)-C(=O)-(C_2-C_6heterocycloalkyl) may be substituted with -X, -OH, -CF_3 or -CF_2H};

R^G is -H or -(C_1-C_4 alkyl);

Q is -O- or a bond;

 is a single bond or double bond, {provided that,  is a double bond, Y_1 is =CH-};

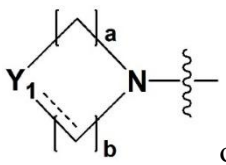
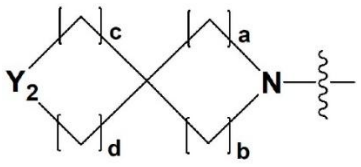
a to e are each independently an integer of 0, 1, 2, 3 or 4 {provided that, a and b may not be simultaneously 0, and c and d may not be simultaneously 0};

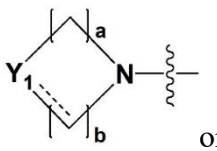
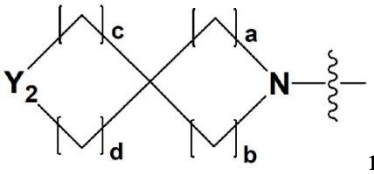
X is each independently F, Cl, Br or I.

2. The pharmaceutical composition of claim 1, wherein in the compound represented by formula I,

L_1, L_2 or L_3 are each independently a bond or -(C_1-C_2alkylene)-;

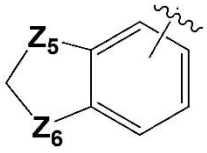
R_1 is -CX_2H or -CX_3;

R_2 is -NR^AR^B, -OR^C,  or 

{wherein at least one of H of  or  may be

substituted with -X, -OH, -NR^DR^E, -(C_1-C_4 alkyl)};

R_3 is -(C_1-C_4 alkyl), -(C_3-C_7 cycloalkyl), -aryl, -heteroaryl, -adamantyl,



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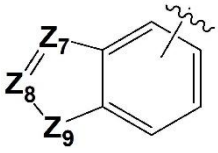
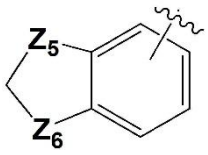
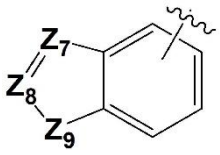


{wherein at least one H of -aryl or -heteroaryl may be each independently substituted with -X, -O(C_1-C_4alkyl), -OCF_3, -O-aryl, -NR^DR^E, -(C_1-C_4 alkyl), -CF_3, -$S(=O)_2$-(C_1-C_4alkyl), -aryl, -heteroaryl,


,


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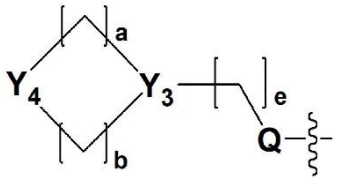
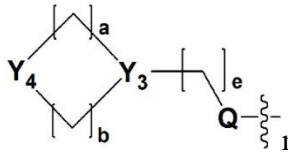
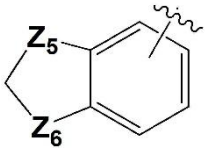
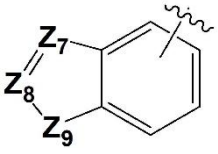


[wherein, at least one H of


may be substituted with -NR^DR^E or -(C_1-C_4 alkyl)], at least one H of


or


maybe each independently substituted with -(C_1-C_4 alkyl)};

Y_1, Y_2 and Y_4 are each independently -CH_2-, -NR^F-, -O-, -C(=O)- or -$S(=O)_2$-;

Y_3 is -CH- or -N-;

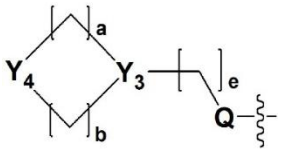
Z_1 to Z_4 is each independently N or CR^Z {wherein at least three of Z_1 to Z_4 may not be simultaneously N, and R^Z is -H, -X or -O(C_1-C_4 alkyl)};

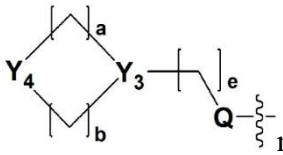
Z_5 and Z_6 are each independently -CH_2- or -O-;

Z_7 and Z_8 are each independently =CH- or =N-;

Z_9 is -NR^G- or -S-;

R^A and R^B are each independently -H, -(C_1-C_4 alkyl), -(C_1-C_4 alkyl)-OH, -(C_1-C_4

alkyl)-NR^DR^E, -aryl, -(C_1-C_4 alkyl)-aryl, -(C_3-C_7 cycloalkyl) or 

{wherein, at least one H of 

may be substituted with -X, -(C_1-C_4alkyl), -CF_3, -(C_2-C_6 heterocycloalkyl), -(C_1-C_4 alkyl)-aryl, -heteroaryl or heteroaryl-(C_1-C_4 alkyl)};

R^C is -(C_1-C_4 alkyl) or -aryl;

R^D and R^E are each independently -H, -(C_1-C_4alkyl) or -(C_1-C_4 alkyl)-aryl;

R^F is -H, -(C_1-C_6alkyl), -(C_1-C_4alkyl)-OH, -(C_1-C_4 alkyl)-O-(C_1-C_4 alkyl), -C(=O)-(C_1-C_4alkyl), -C(=O)-O(C_1-C_4 alkyl), -(C_1-C_4 alkyl)-C(=O)-O(C_1-C_4alkyl), -(C_1-C_4alkyl)-NR^DR^E, -$S(=O)_2$-(C_1-C_4 alkyl), -aryl, -(C_1-C_4 alkyl)-aryl, -(C_2-C_4 alkenyl)-aryl, -heteroaryl, -(C_1-C_4 alkyl)-heteroaryl, -C(=O)-(C_3-C_7 cycloalkyl), -(C_2-C_6 heterocycloalkyl) or -(C_1-C_4 alkyl)-C(=O)-(C_2-C_6 heterocycloalkyl)

{wherein at least one H of -(C_1-C_4alkyl) or -C(=O)-O(C_1-C_4alkyl) may be substituted with -X,

at least one H of -aryl may be substituted with -X};

R^G is -(C_1-C_4 alkyl);

Q is -O- or a bond;

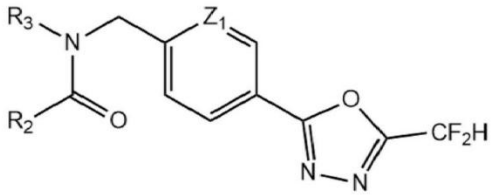

is a single bond or a double bond {provided that 
is a double bond, Y_1 is -CH-};

a to e are each independently an integer of 0, 1, 2, 3 or 4 {provided that a and b may not be simultaneously 0, and c and d may not be simultaneously 0};

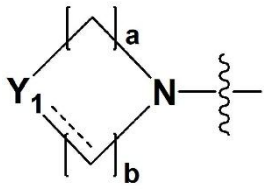
X is each independently F, Cl, Br or I.

3. The pharmaceutical composition of claim 1, wherein the compound represented by formula I is the compound represented by formula Ia:

[Formula Ia]



in formula Ia, wherein,

R_2 is  ;

R_3 is -aryl {wherein, at least one H of -aryl may be each independently substituted with -X};

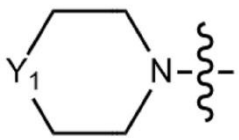
Y_1 is -O- or -S(=O)$_2$-;

Z_1 is N or CR^Z {wherein, R^Z is -X};

a and b are each independently an integer of 0, 1, 2, 3 or 4 {wherein, a and b may not be simultaneously 0};

X is each independently F, Cl, Br or I.

4. The pharmaceutical composition of claim 3, wherein in the compound represented by formula Ia,

R_2 is  ;

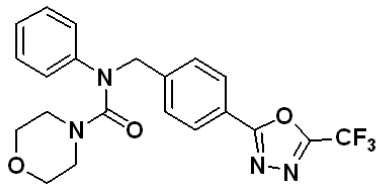
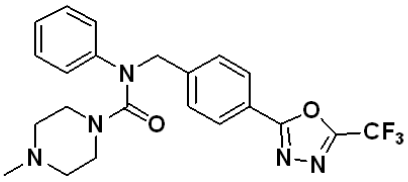
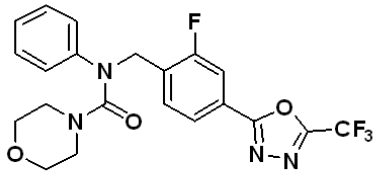
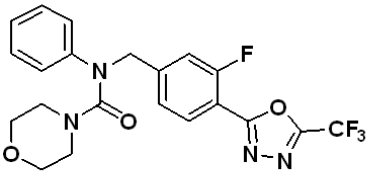
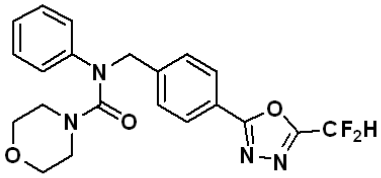
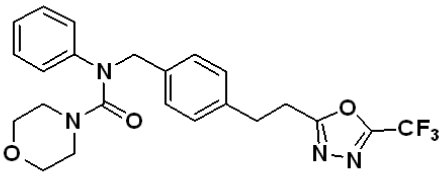
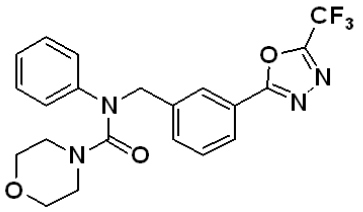
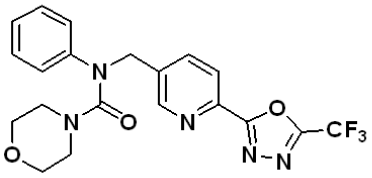
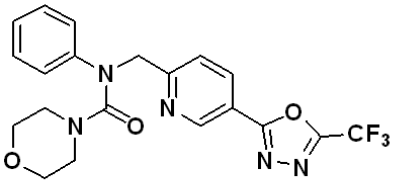
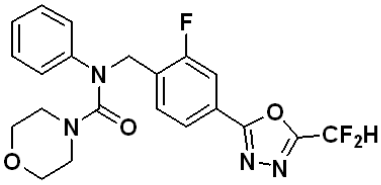
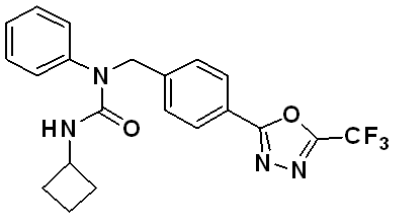
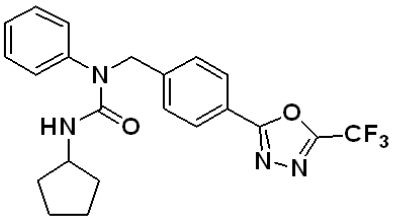
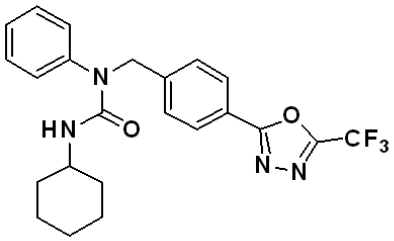
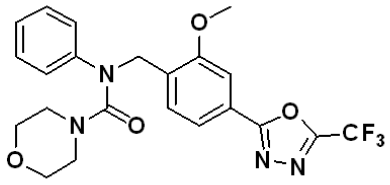
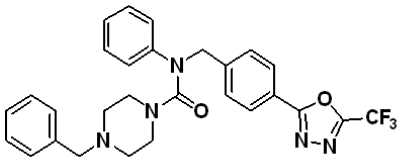
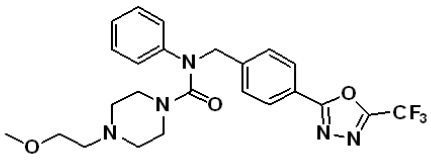
R_3 is -phenyl {wherein, at least one H of -phenyl each independently is substituted

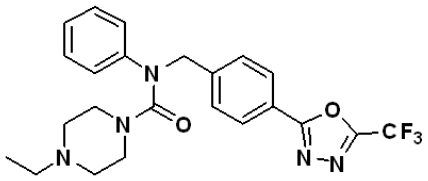
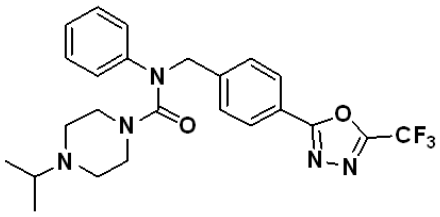
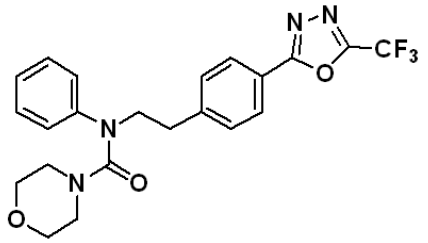
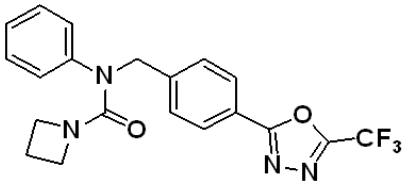
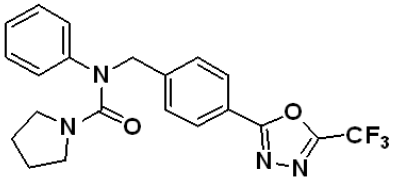
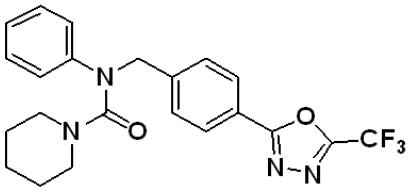
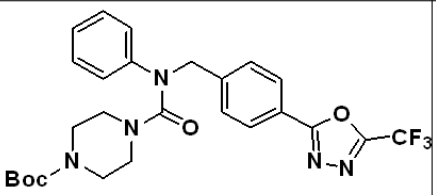
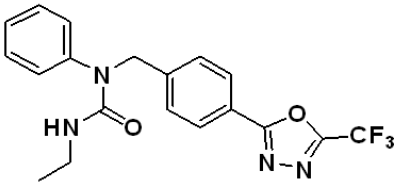
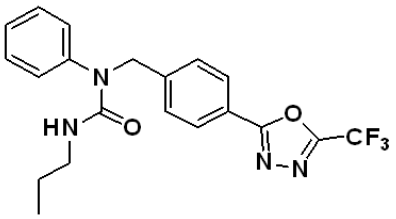
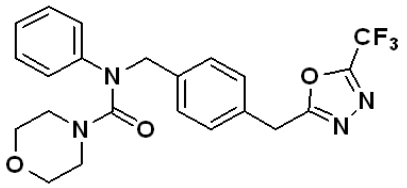
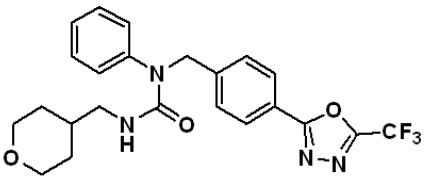
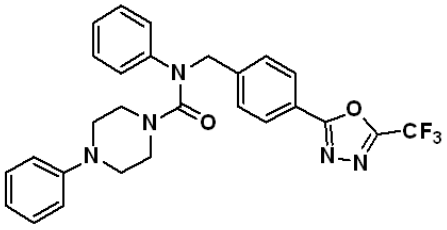
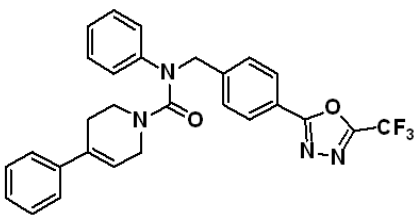
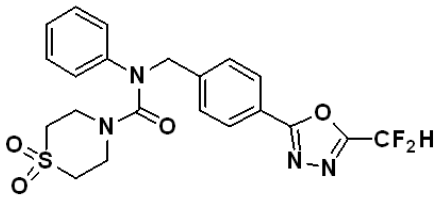
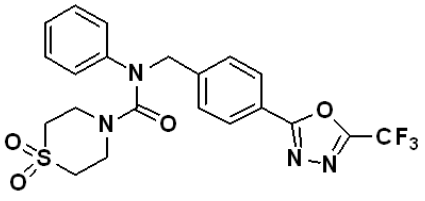
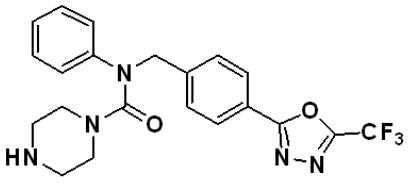
with -F or -Cl};

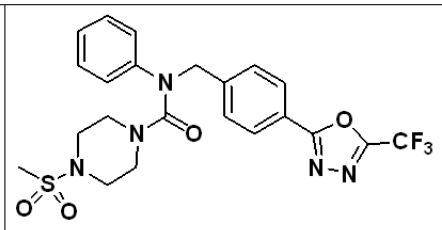
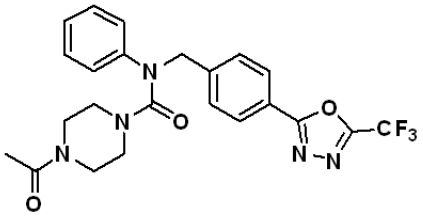
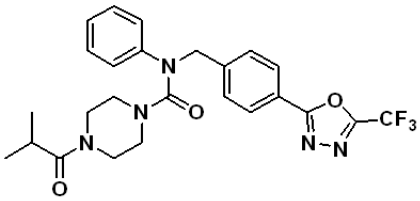
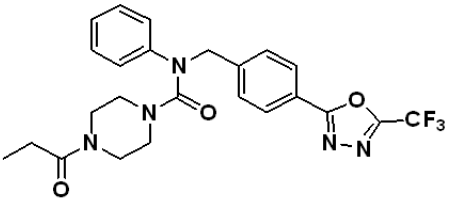
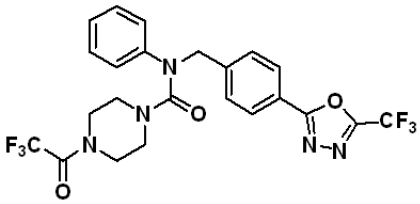
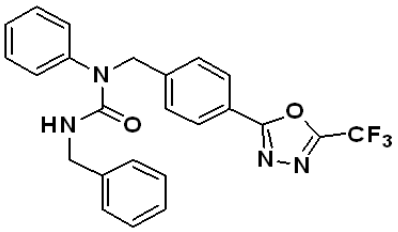
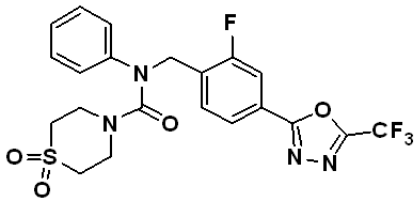
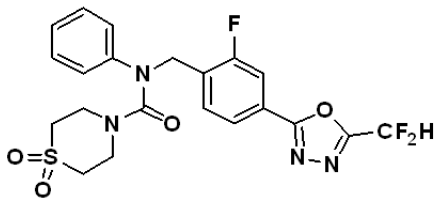
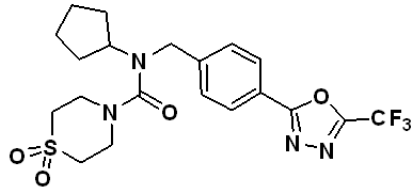
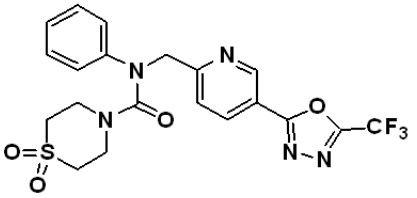
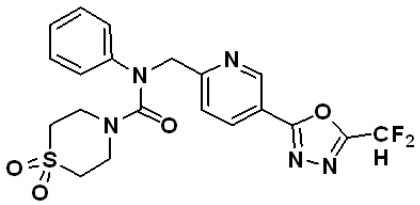
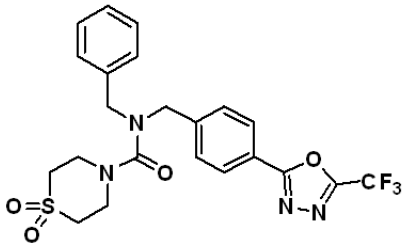
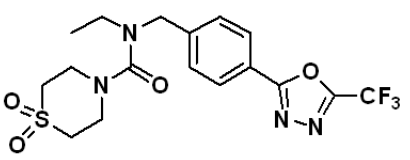
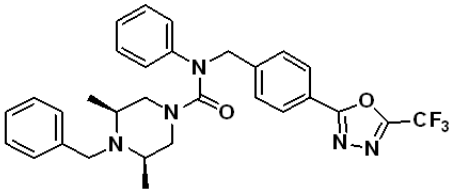
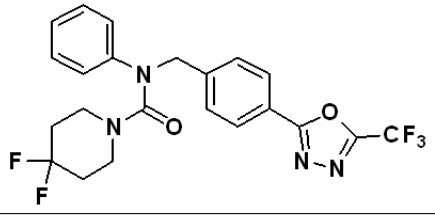
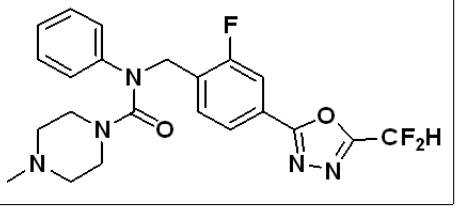
Y_1 is -O- or -S(=O)$_2$-;

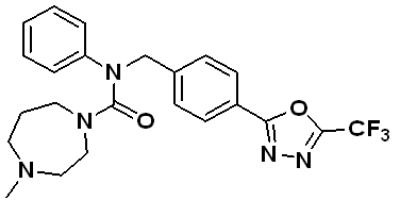
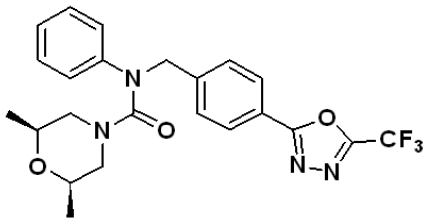
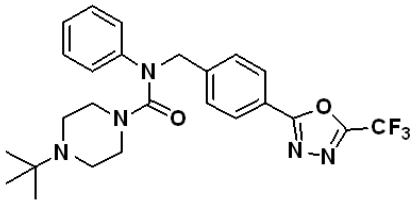
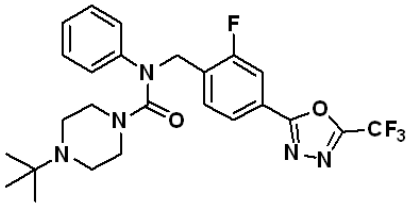
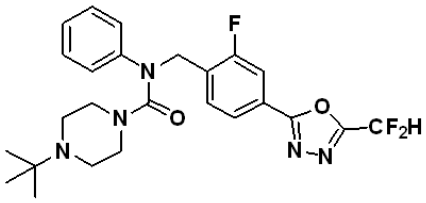
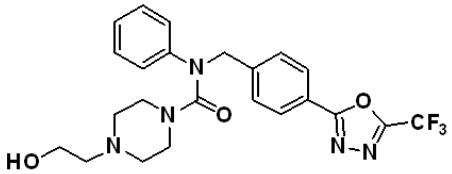
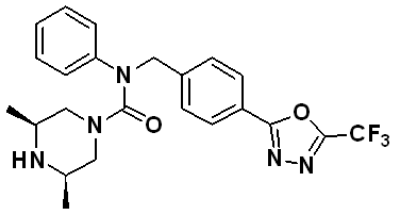
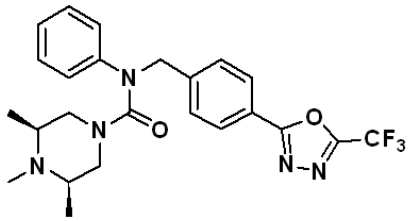
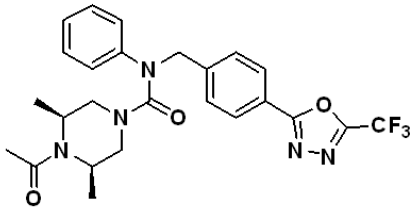
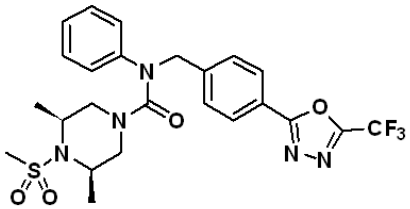
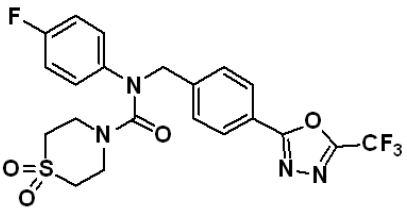
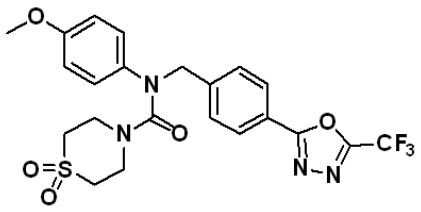
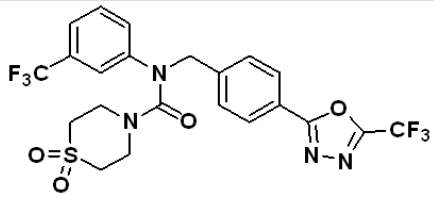
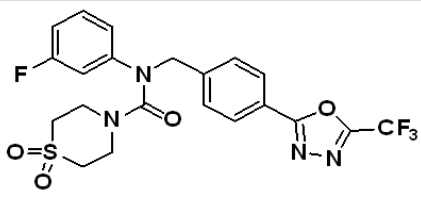
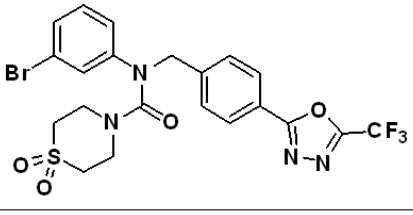
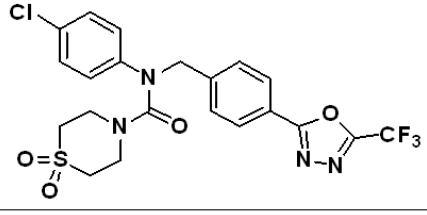
Z_1 is N or CF.

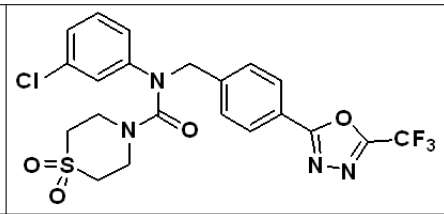
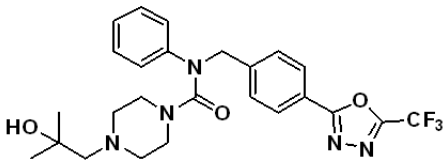
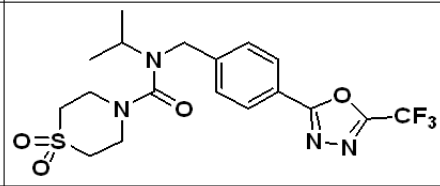
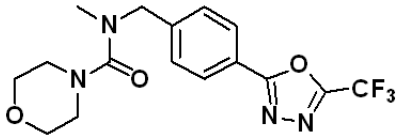
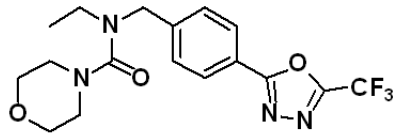
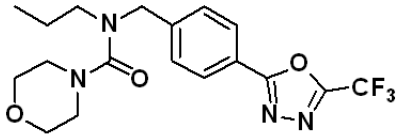
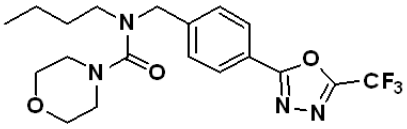
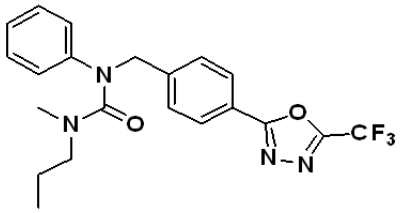
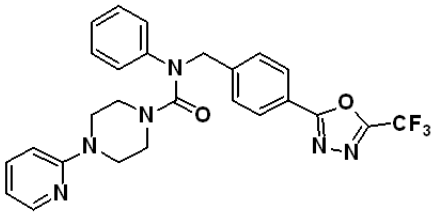
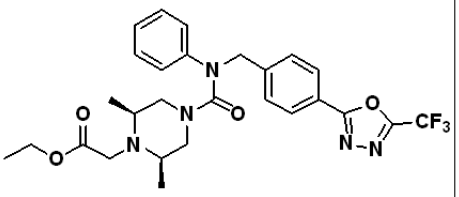
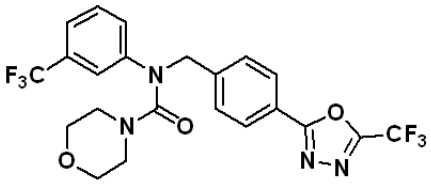
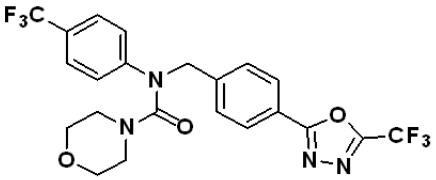
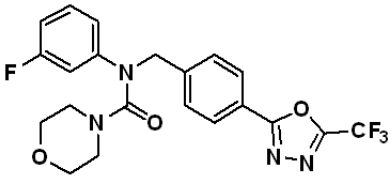
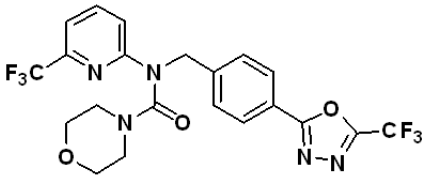
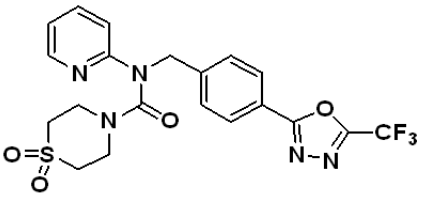
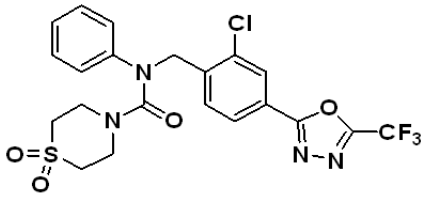
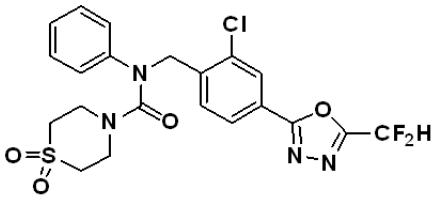
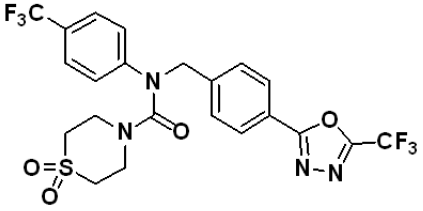
5. A pharmaceutical composition for preventing or treating heart failure, comprising a compound, optical isomers thereof or pharmaceutically acceptable salts thereof as an active ingredient, wherein the compound has the following structure:

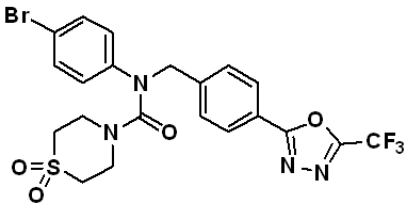
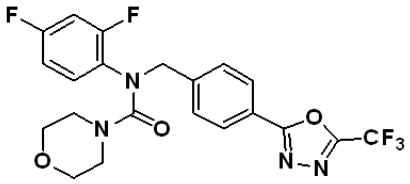
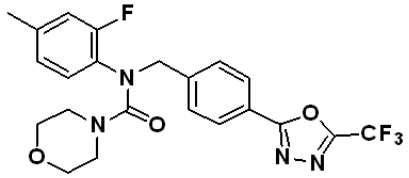
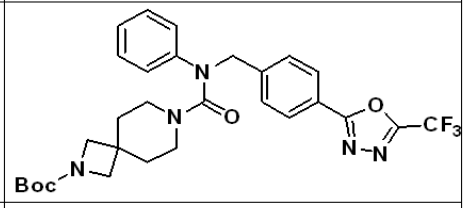
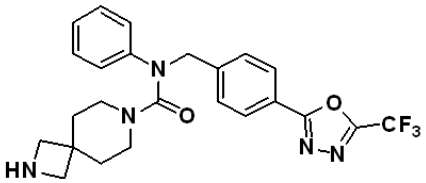
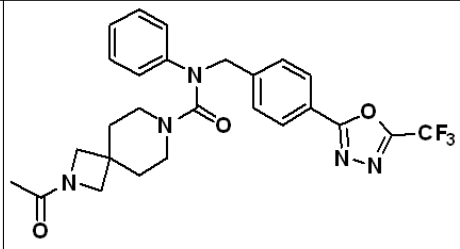
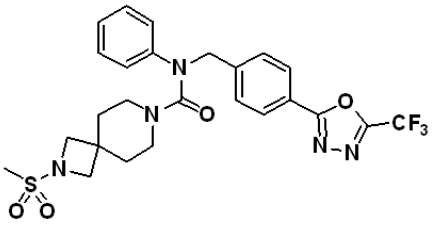
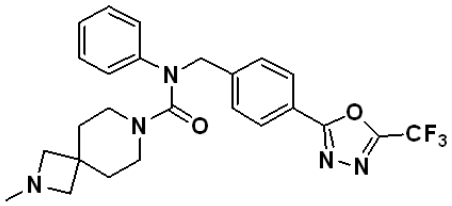
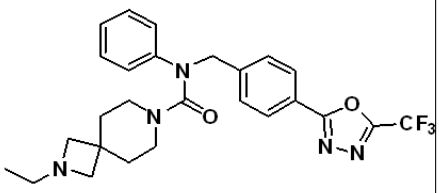
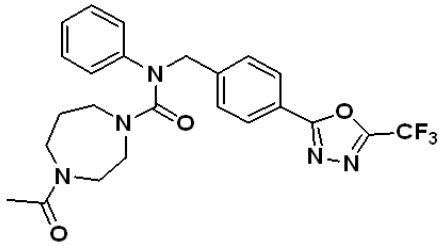
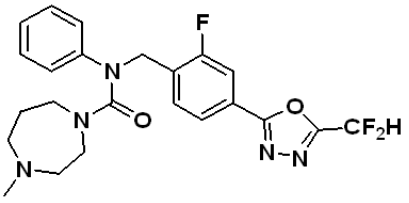
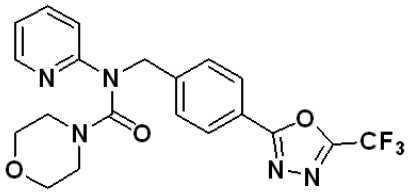
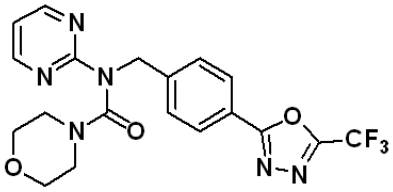
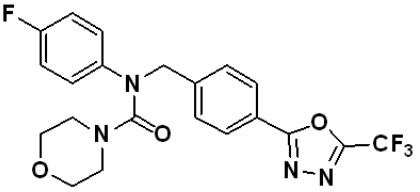
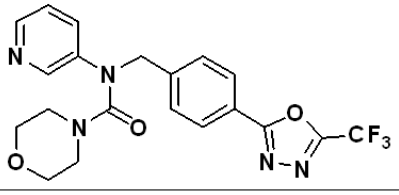
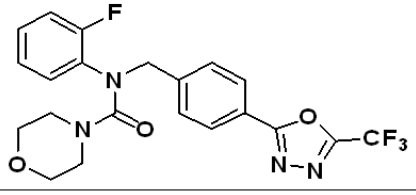
Compound	Structure	Compound	Structure
1		2	
3		4	
5		6	
7		8	
9		10	
11		12	
13		14	
15		16	

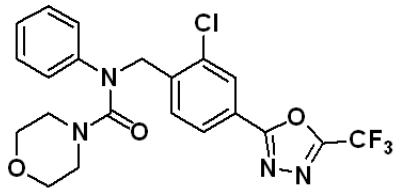
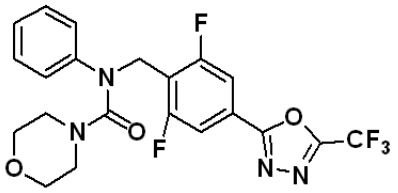
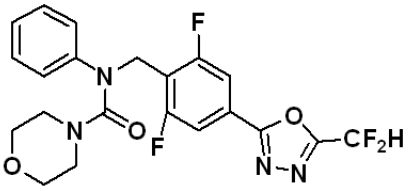
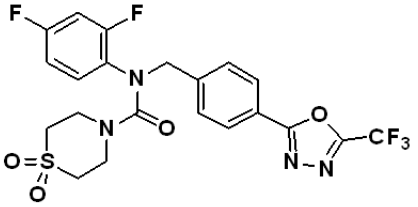
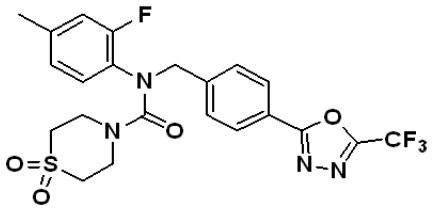
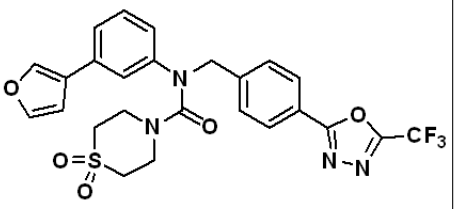
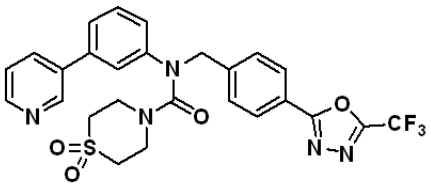
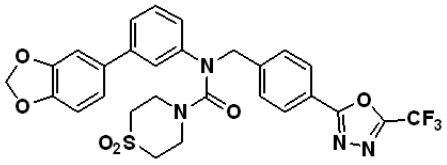
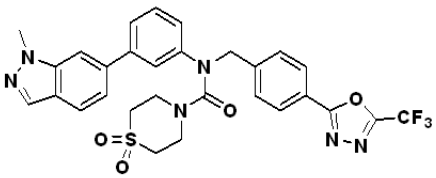
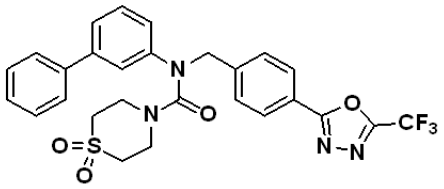
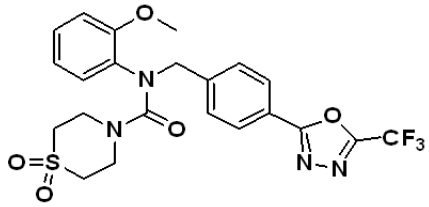
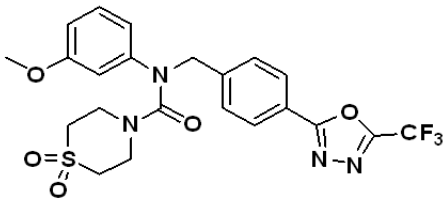
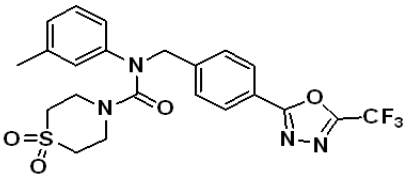
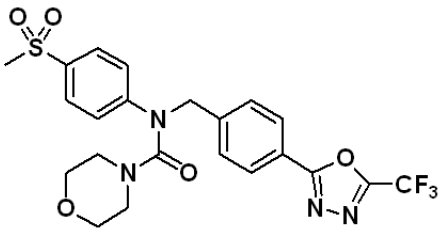
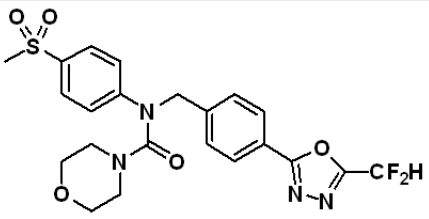
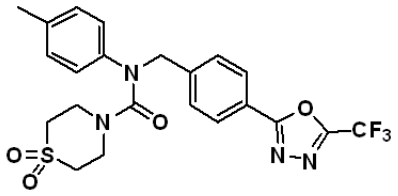
17		18	
19		20	
21		22	
23		24	
25		26	
27		28	
29		30	
31		32	

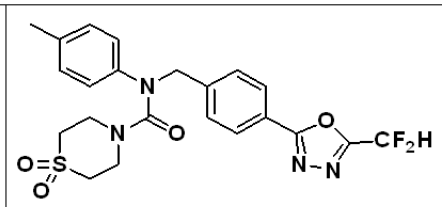
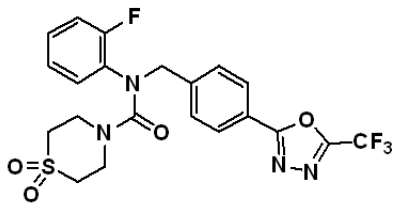
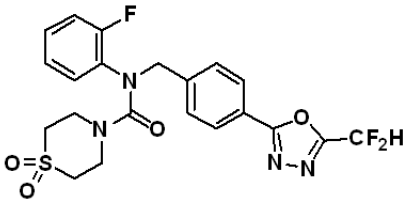
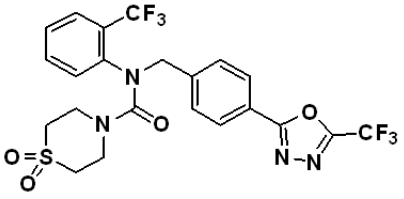
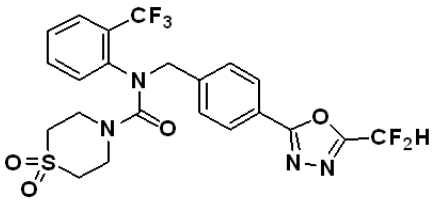
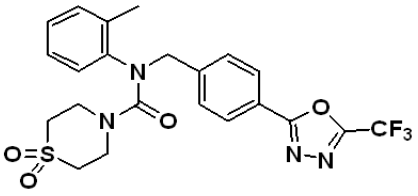
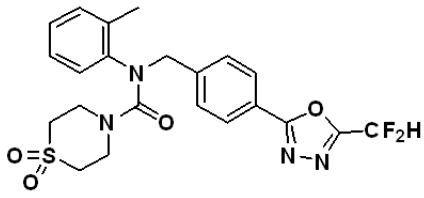
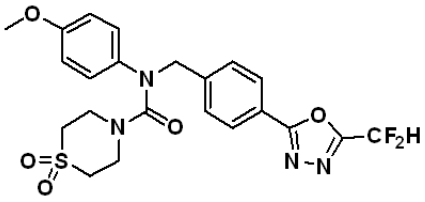
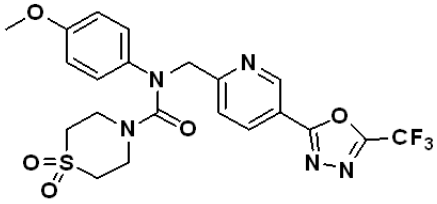
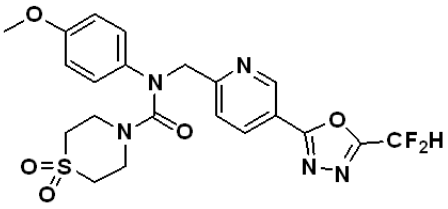
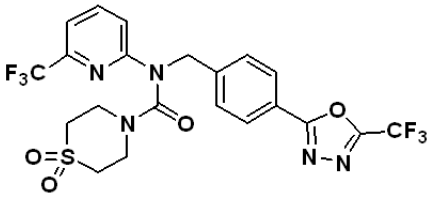
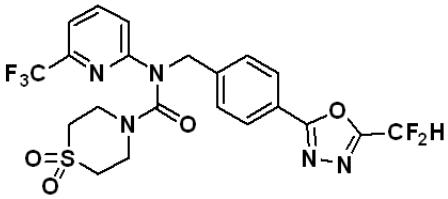
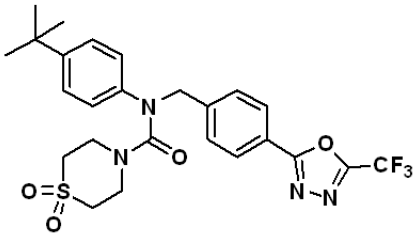
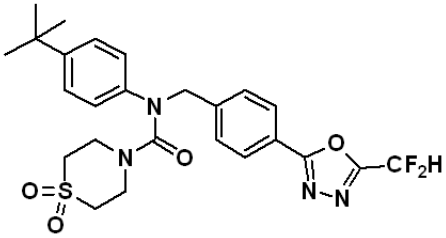
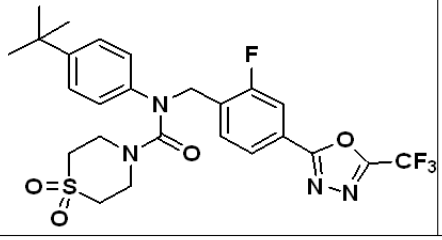
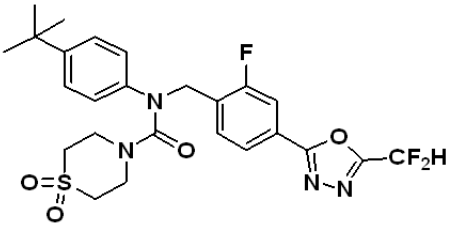
33		34	
35		36	
37		38	
39		40	
41		42	
43		44	
45		46	
47		48	

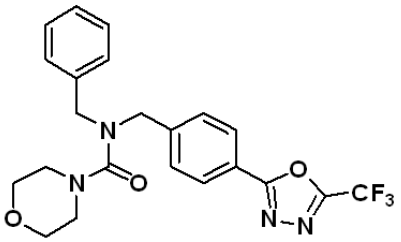
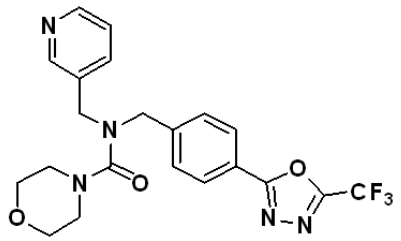
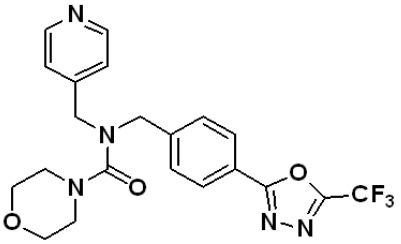
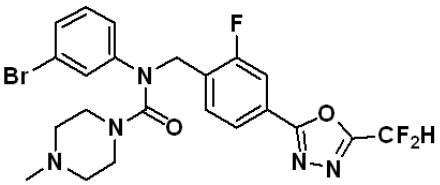
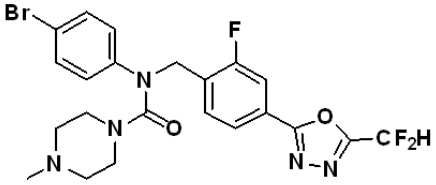
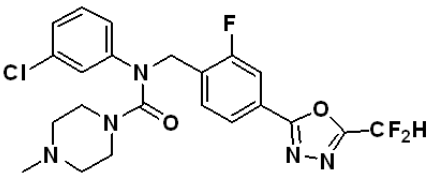
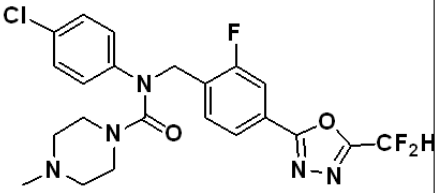
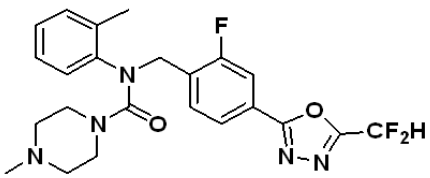
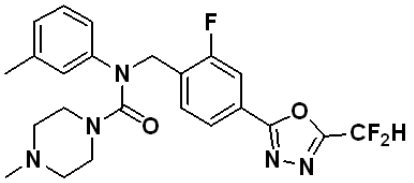
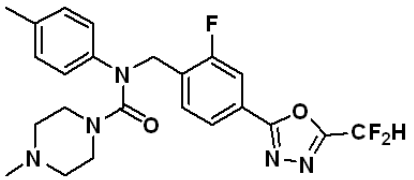
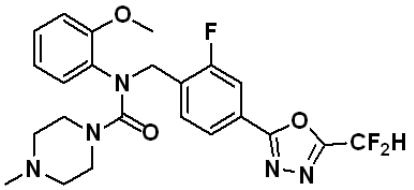
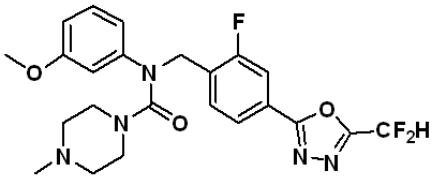
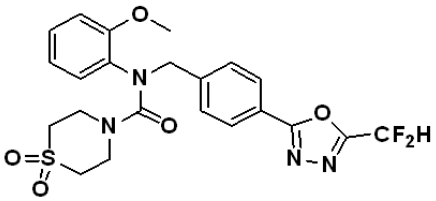
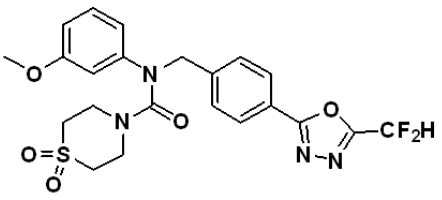
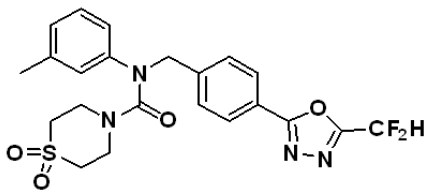
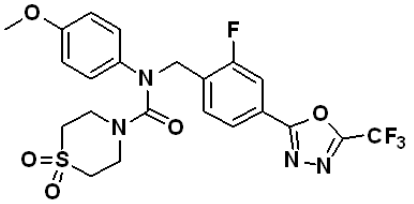
49		50	
51		52	
53		54	
55		56	
57		58	
59		60	
61		62	
63		64	

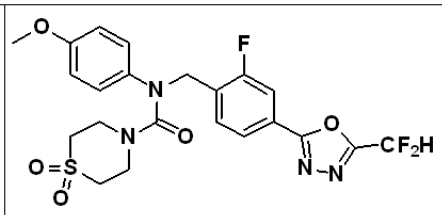
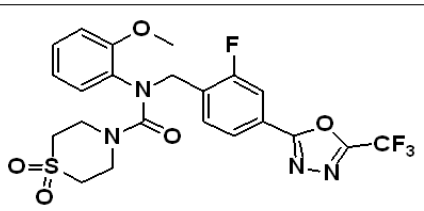
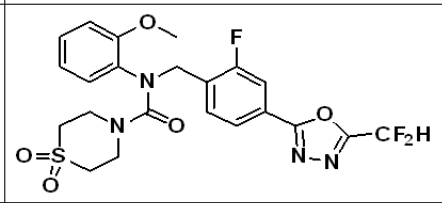
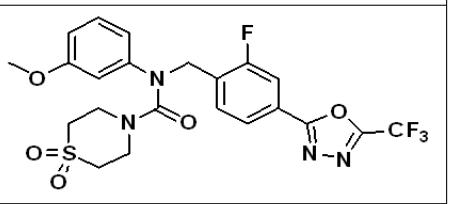
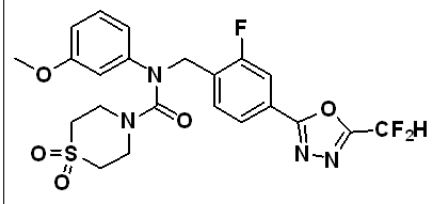
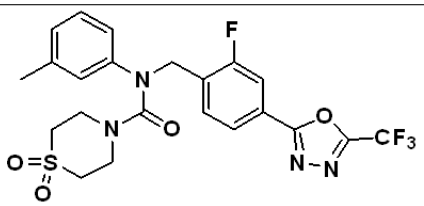
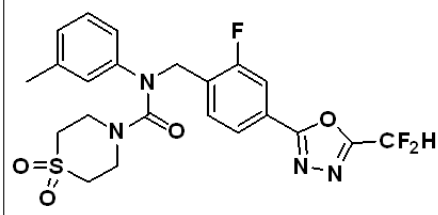
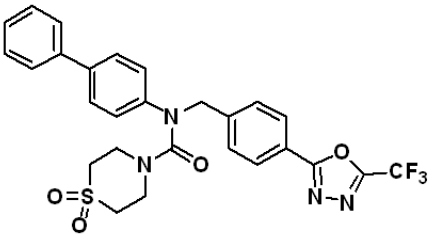
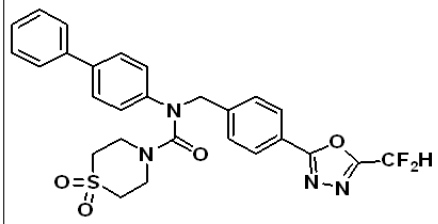
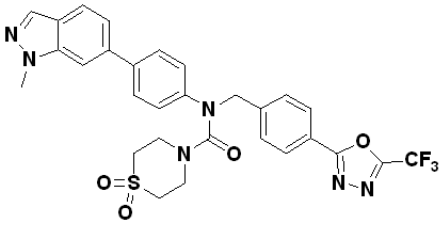
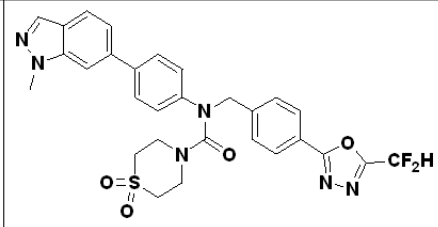
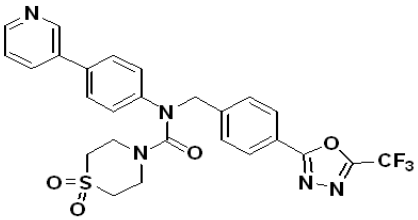
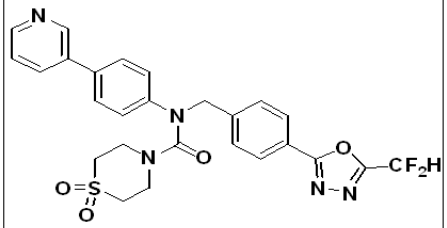
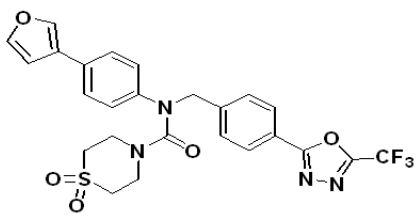
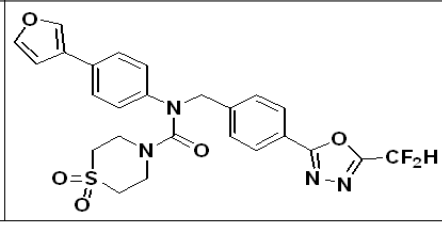
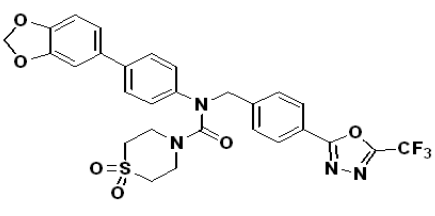
65		66	
67		68	
69		70	
71		72	
73		74	
75		76	
77		78	
79		80	
81		82	

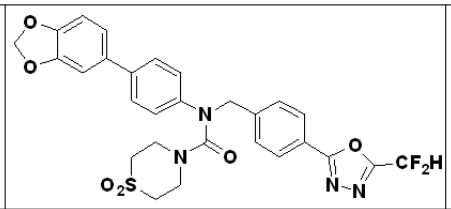
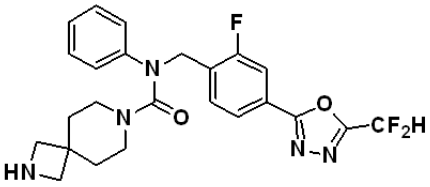
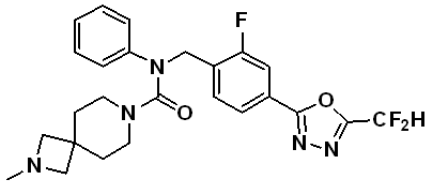
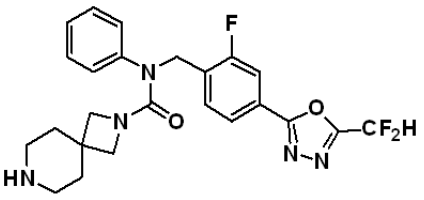
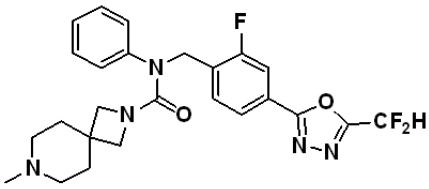
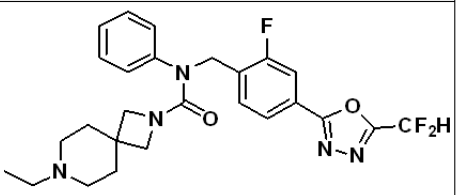
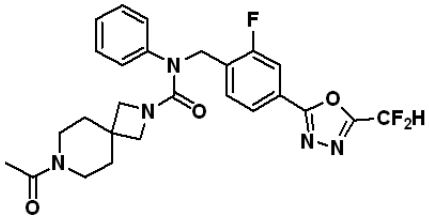
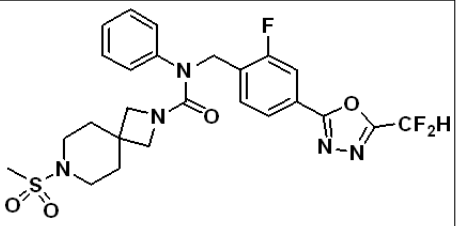
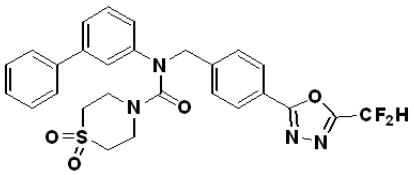
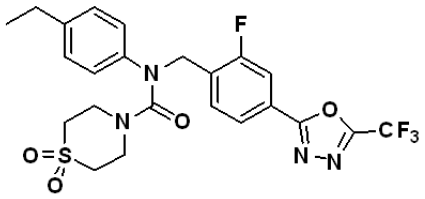
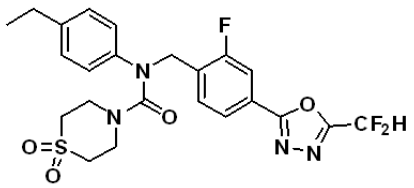
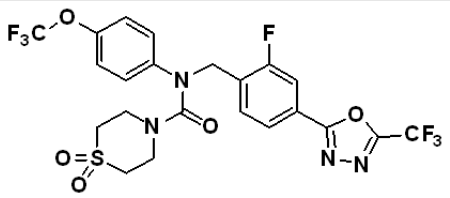
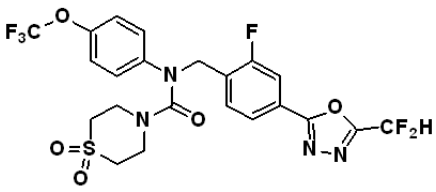
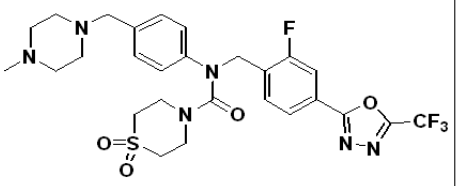
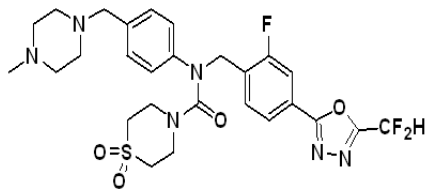
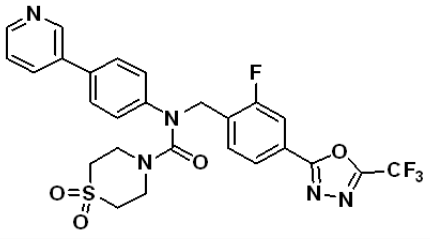
83		84	
85		86	
87		88	
89		90	
91		92	
93		94	
95		96	
97		98	

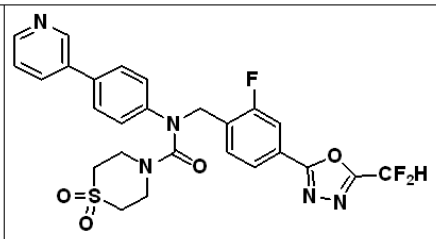
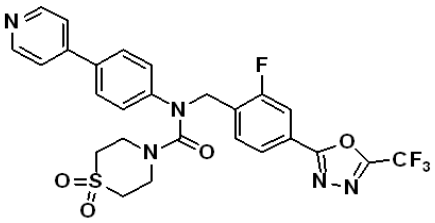
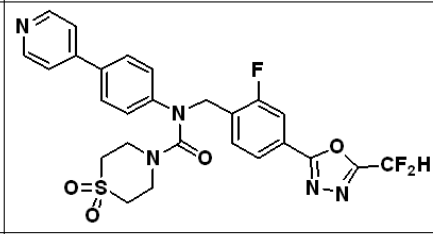
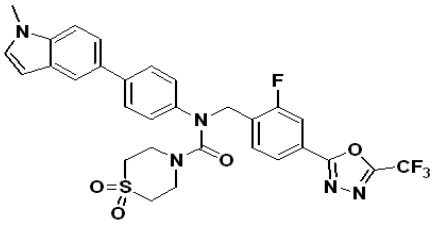
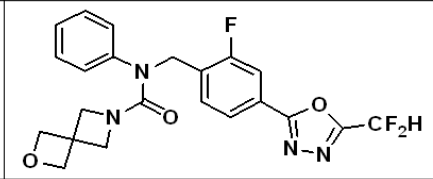
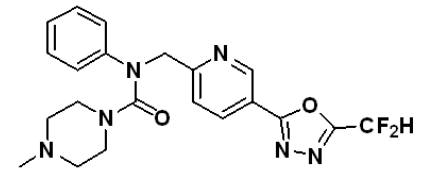
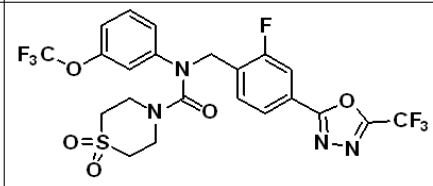
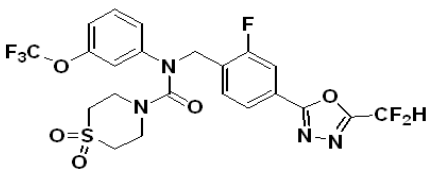
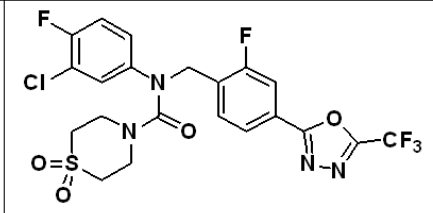
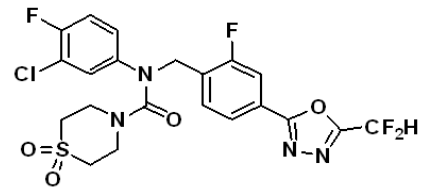
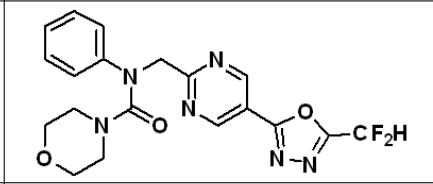
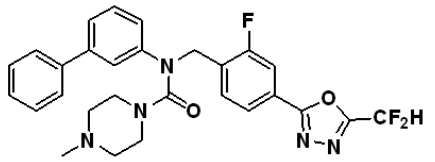
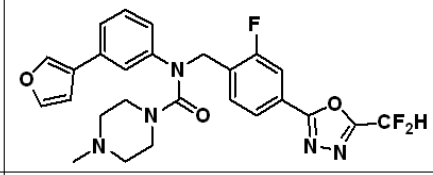
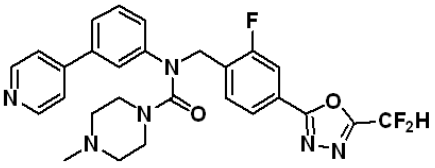
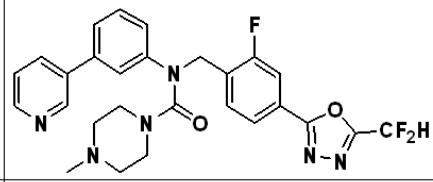
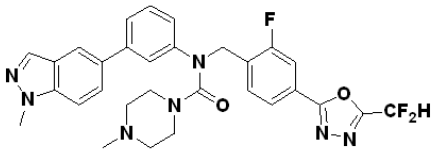
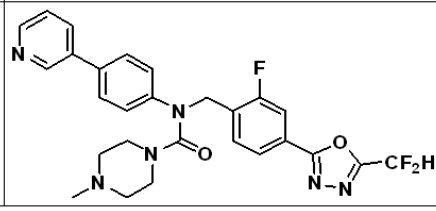
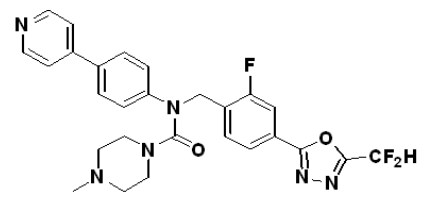
99		100	
101		102	
103		104	
105		106	
107		108	
109		110	
111		112	
113		114	

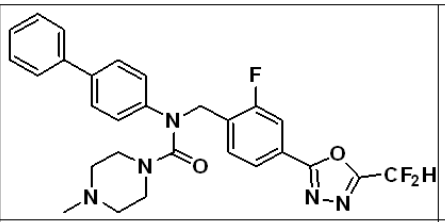
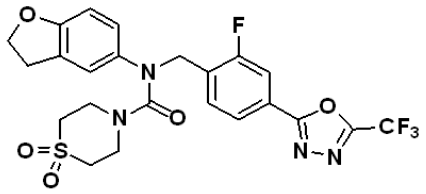
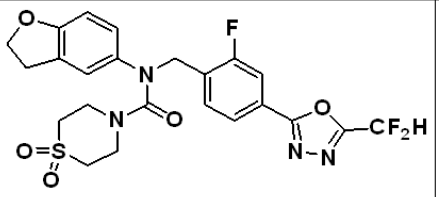
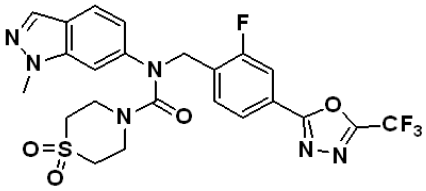
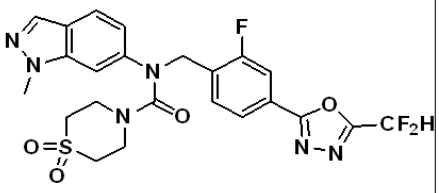
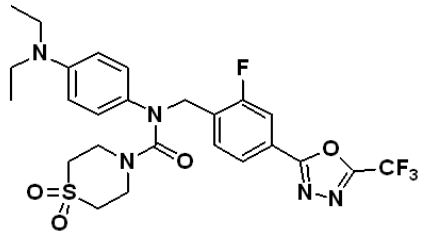
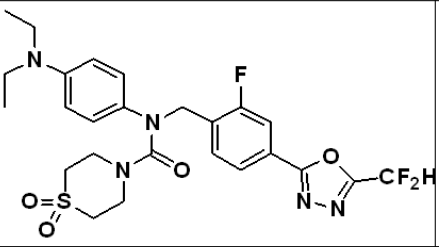
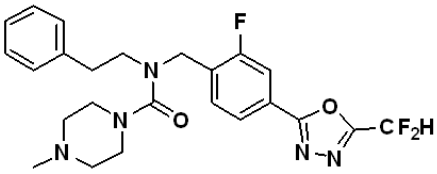
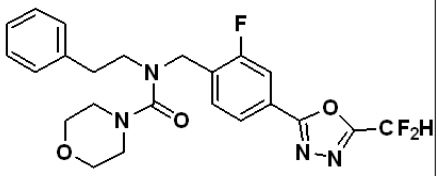
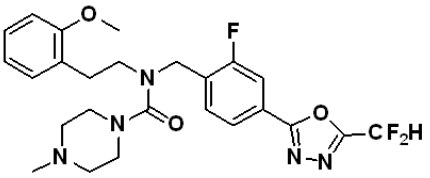
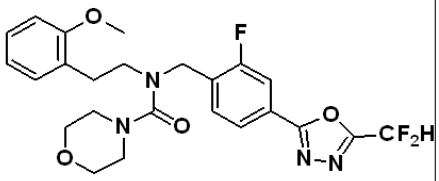
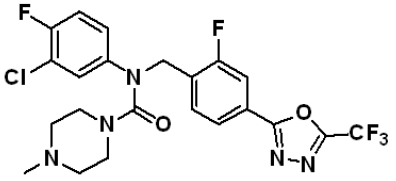
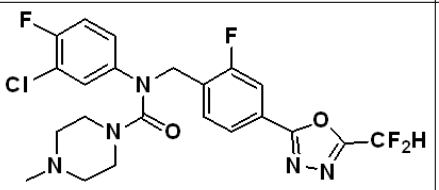
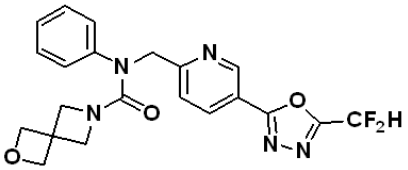
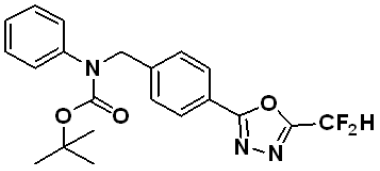
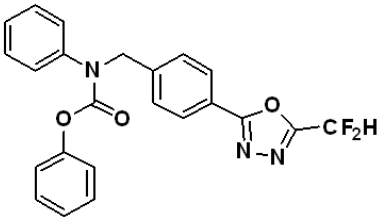
115		116	
117		118	
119		120	
121		122	
123		124	
125		126	
127		128	
129		130	

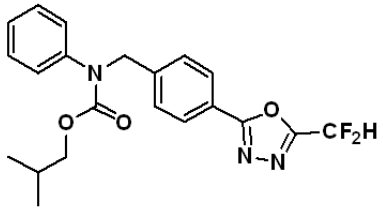
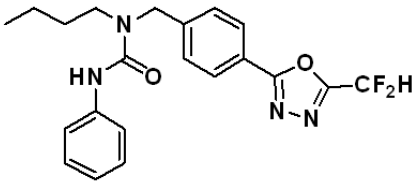
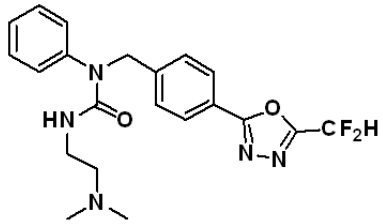
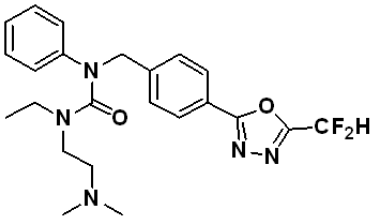
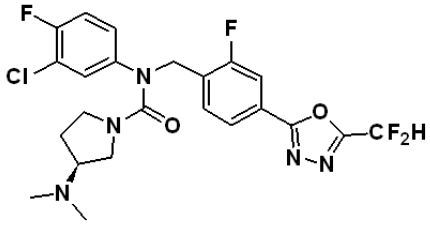
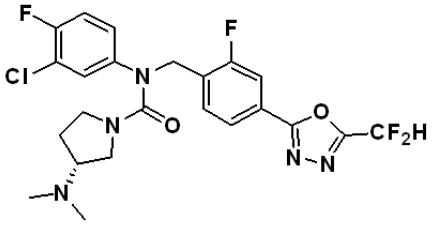
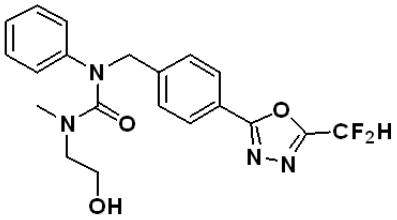
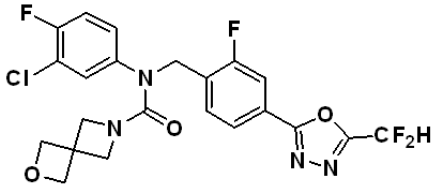
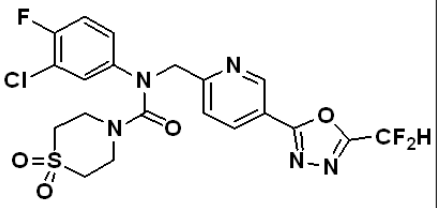
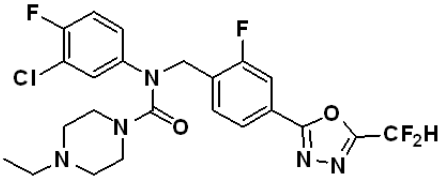
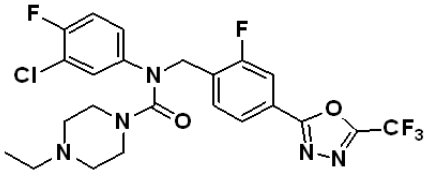
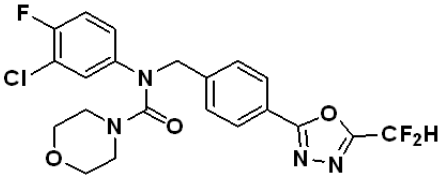
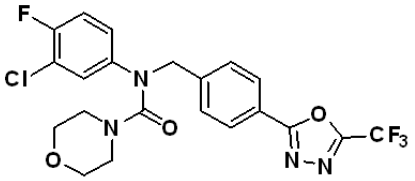
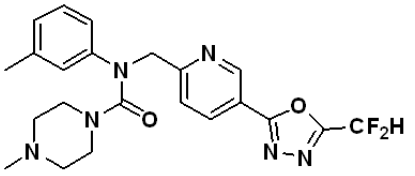
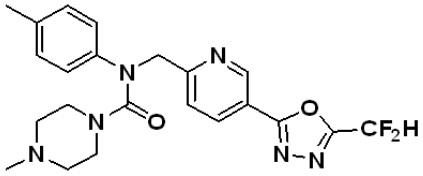
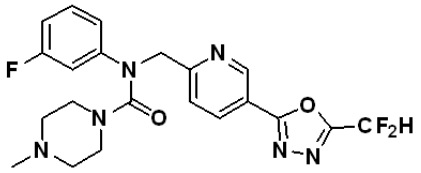
131		132	
133		134	
135		136	
137		138	
139		140	
141		142	
143		144	
145		146	

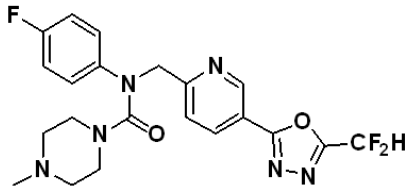
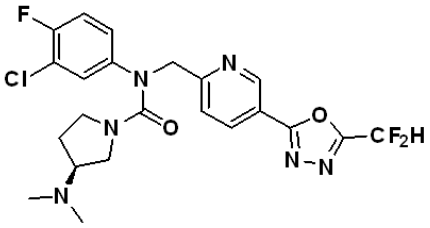
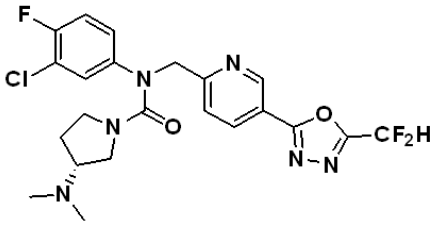
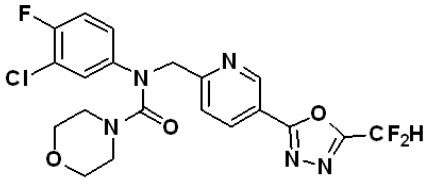
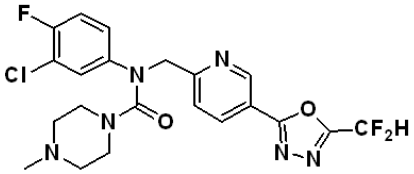
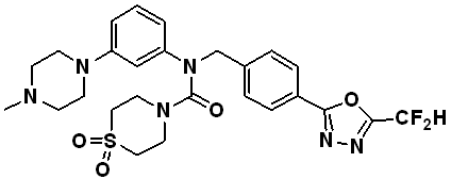
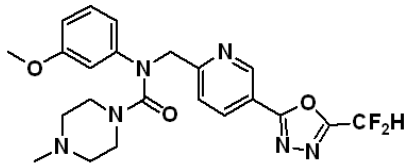
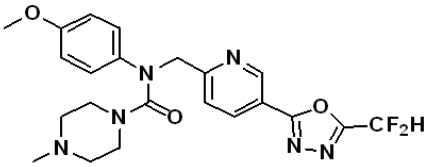
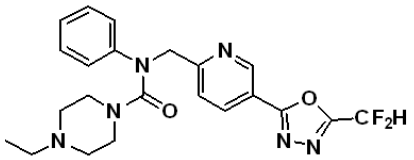
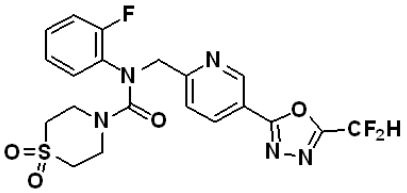
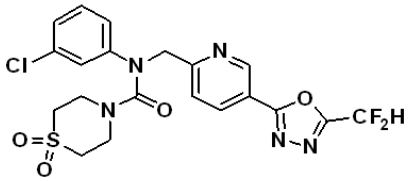
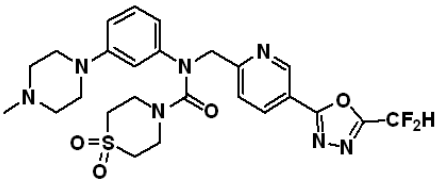
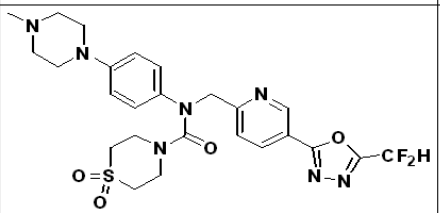
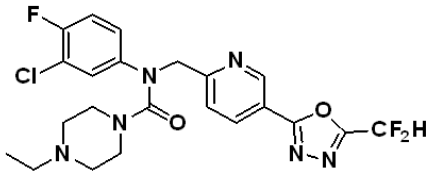
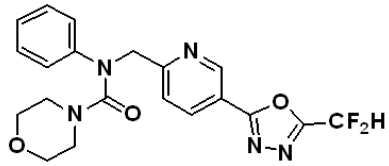
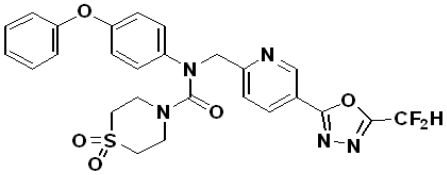
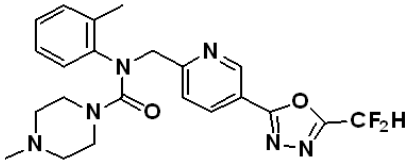
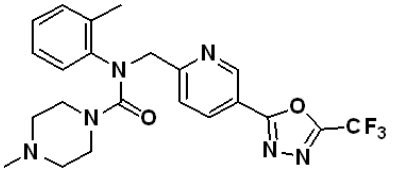
147		148	
149		150	
151		152	
153		154	
155		156	
157		158	
159		160	
161		162	

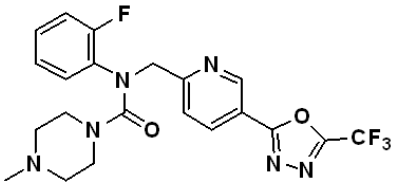
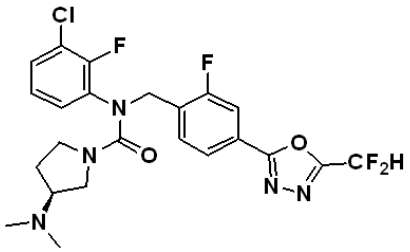
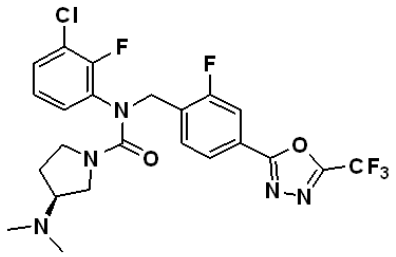
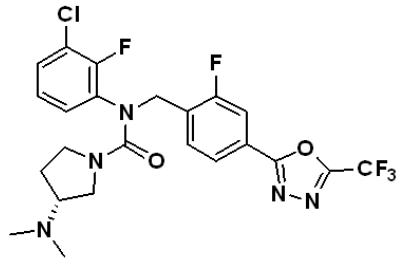
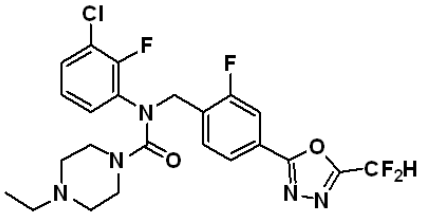
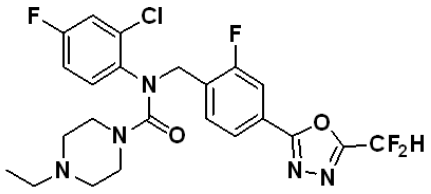
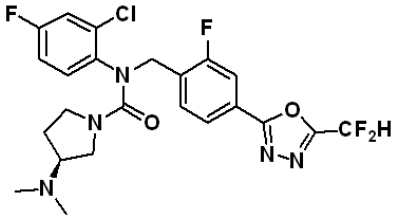
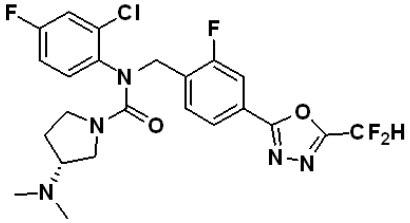
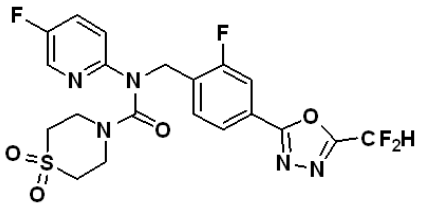
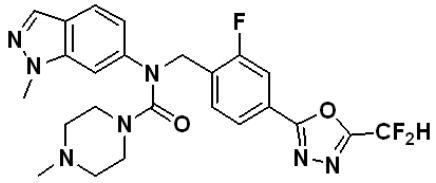
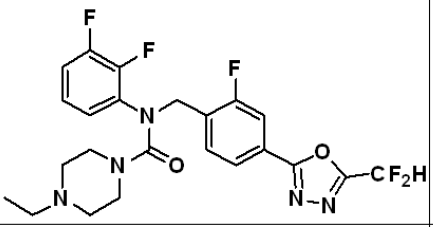
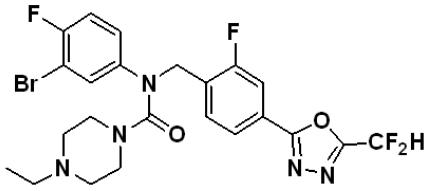
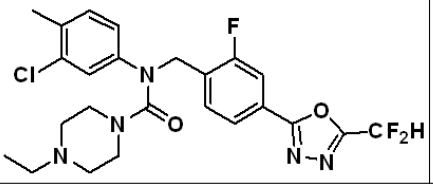
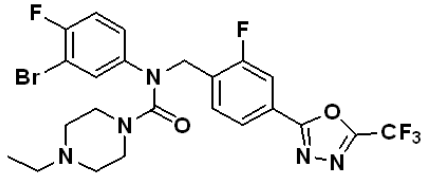
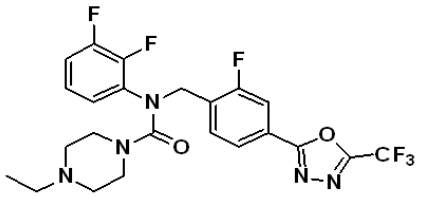
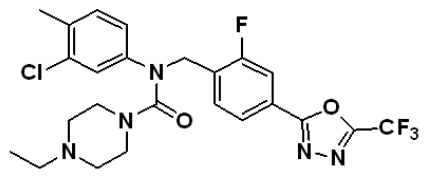
163		164	
165		166	
167		168	
169		170	
171		172	
173		174	
175		176	
177		178	

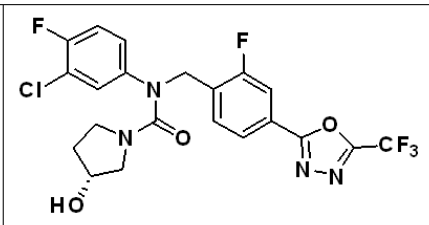
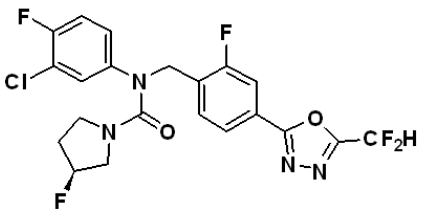
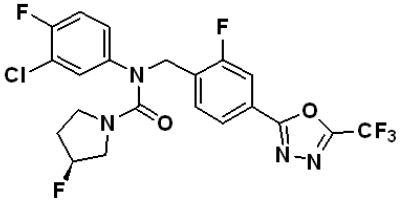
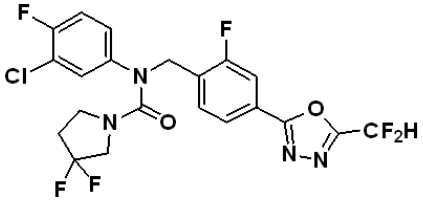
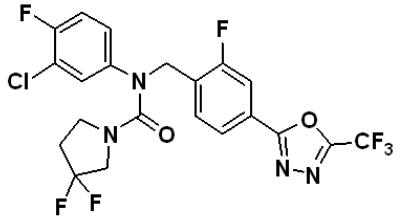
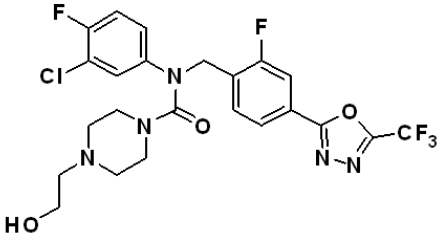
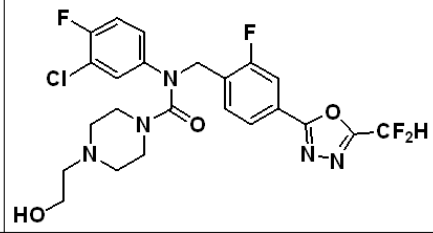
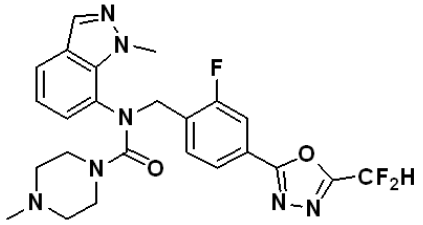
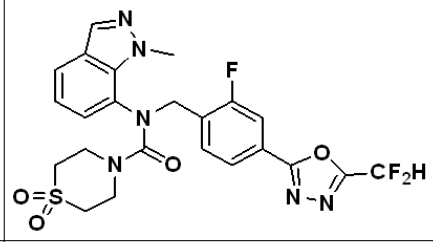
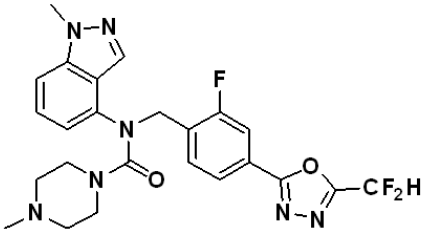
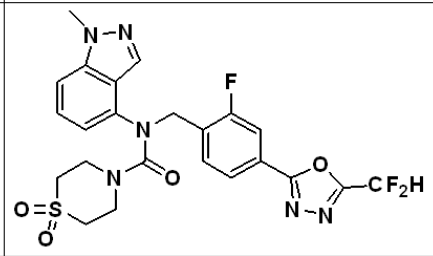
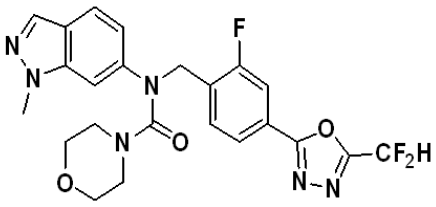
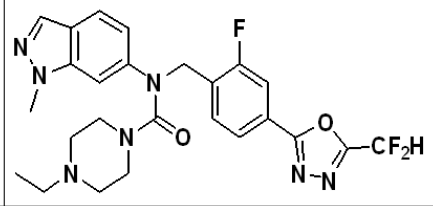
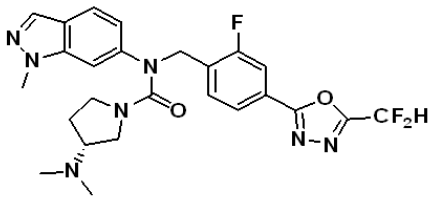
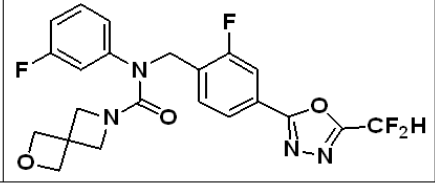
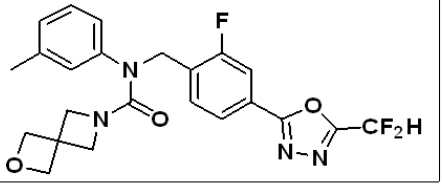
179		180	
181		182	
183		184	
185		186	
187		188	
189		190	
191		192	
193		194	
195		196	

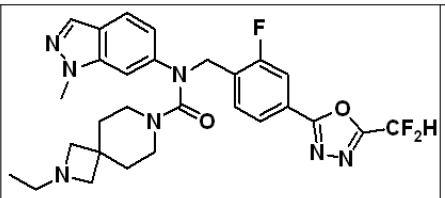
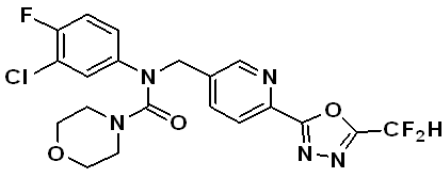
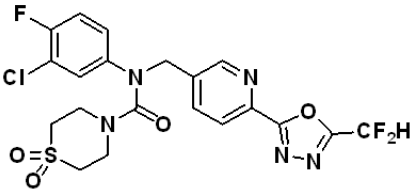
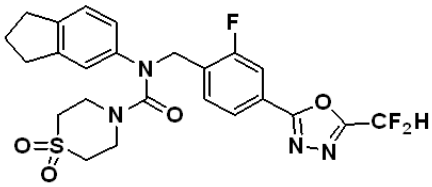
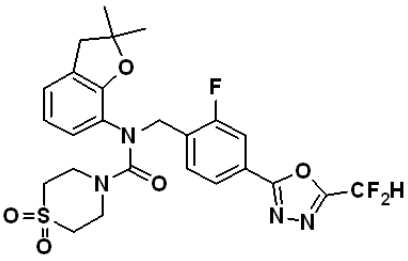
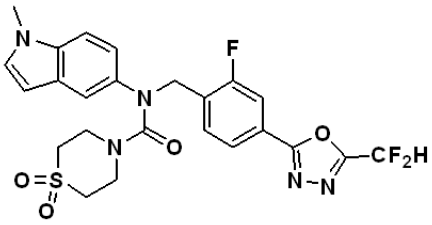
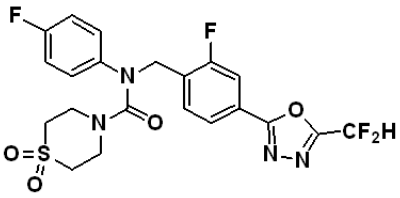
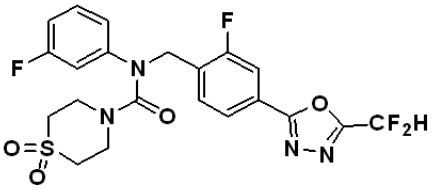
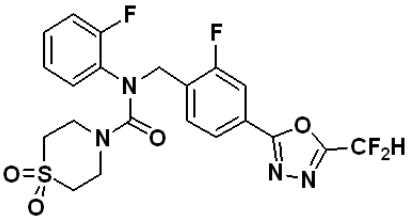
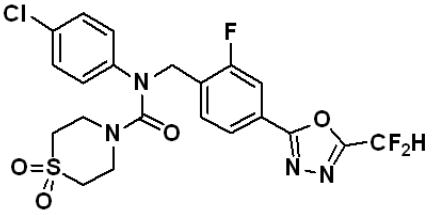
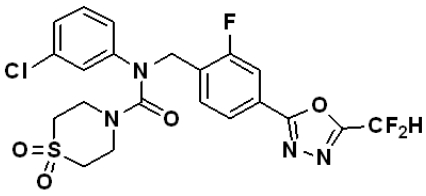
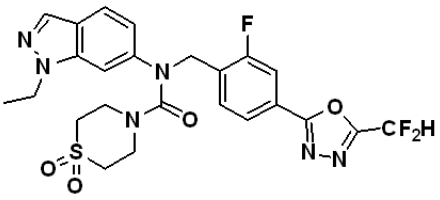
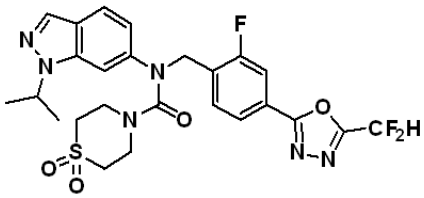
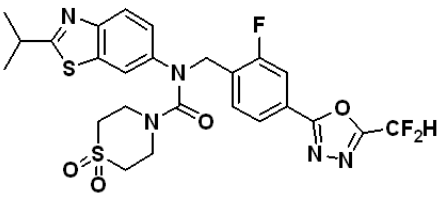
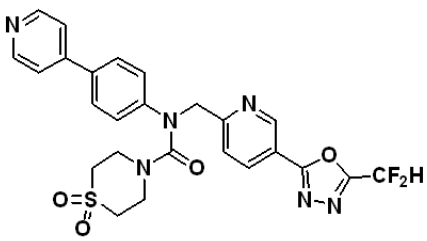
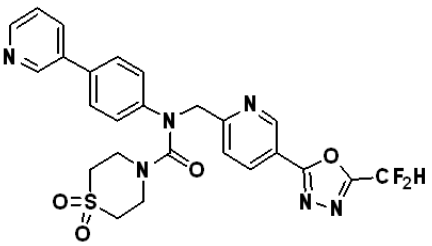
197		198	
199		200	
201		202	
203		204	
205		206	
207		208	
209		210	
211		212	

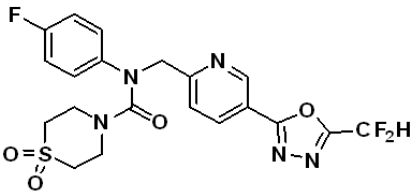
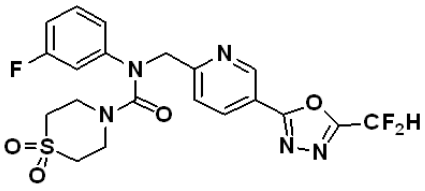
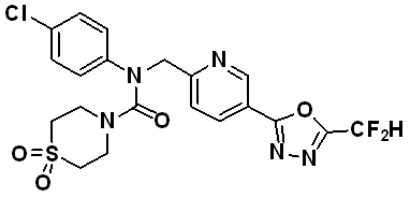
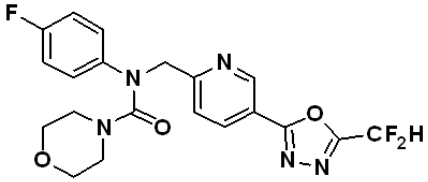
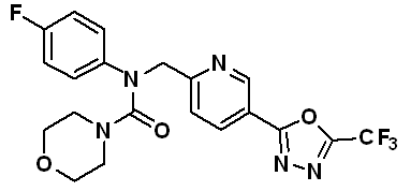
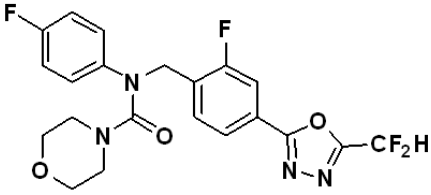
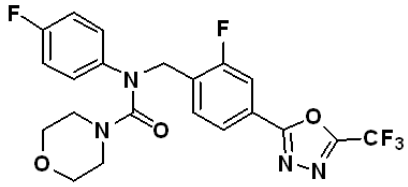
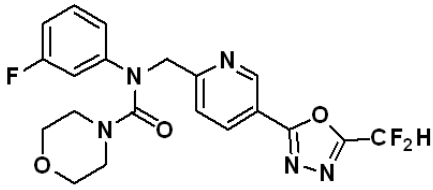
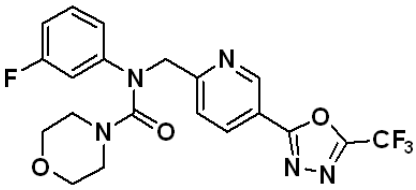
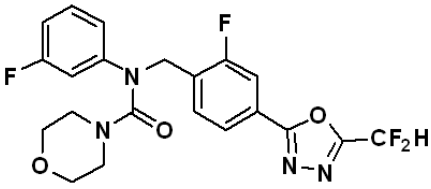
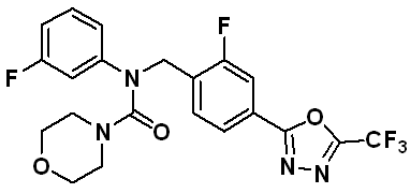
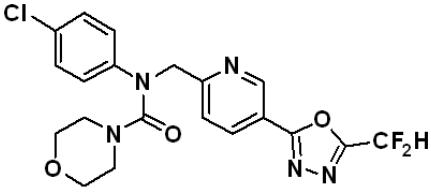
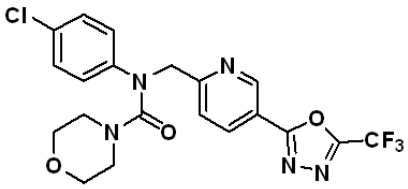
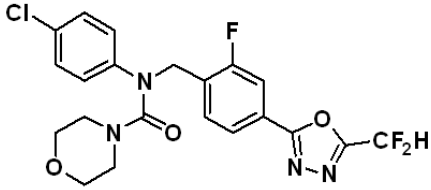
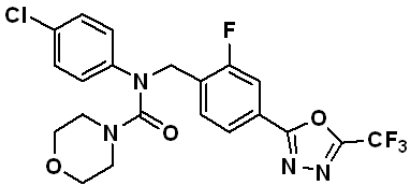
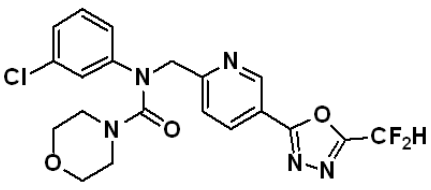
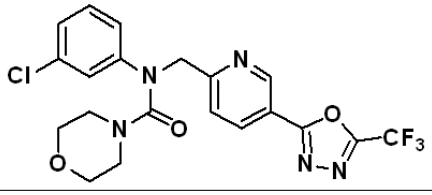
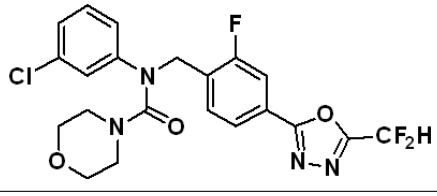
213		214	
215		216	
217		218	
219		220	
221		222	
223		224	
225		226	
227		228	

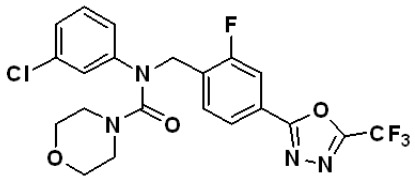
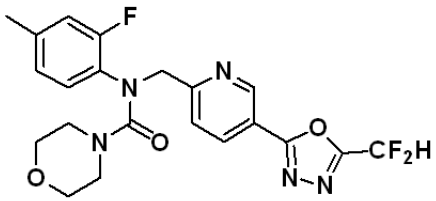
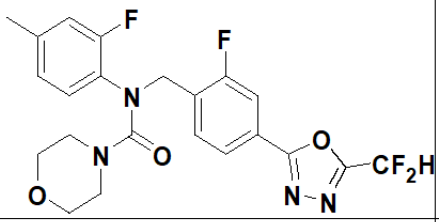
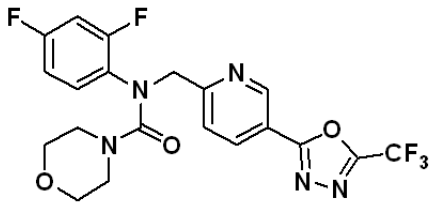
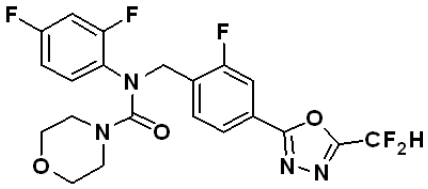
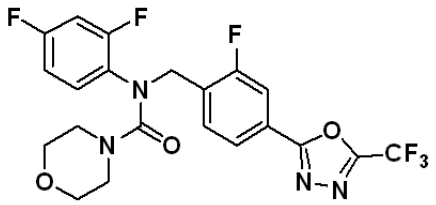
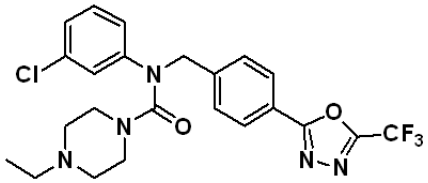
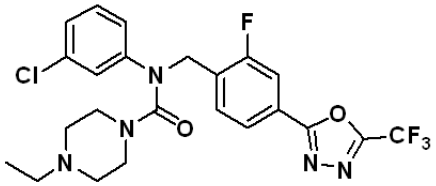
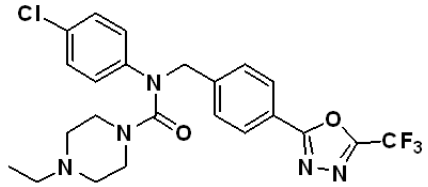
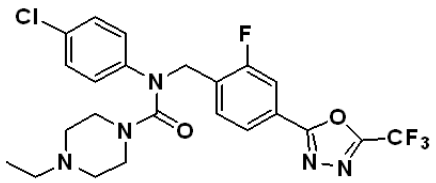
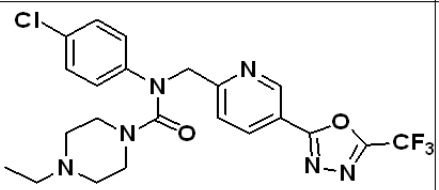
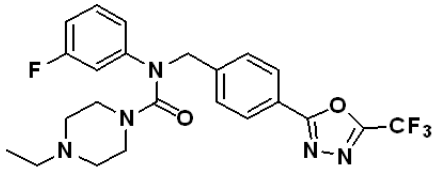
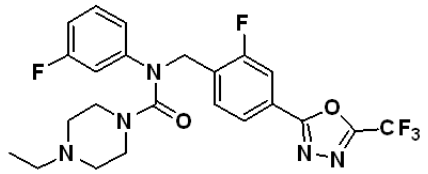
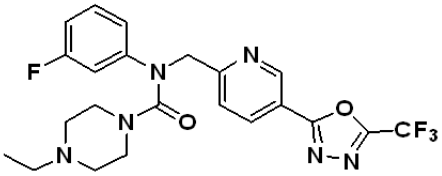
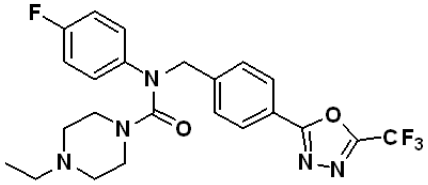
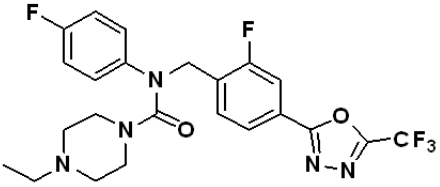
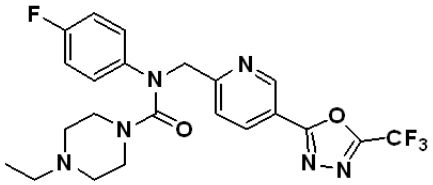
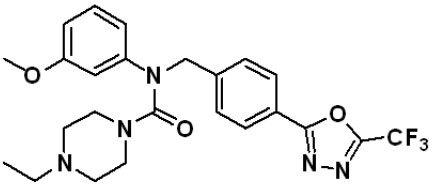
229		230	
231		232	
233		234	
235		236	
237		238	
239		240	
241		242	
243		244	
245		246	

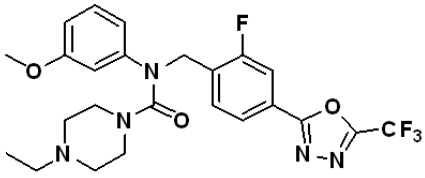
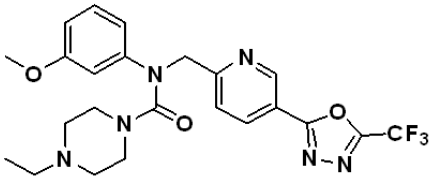
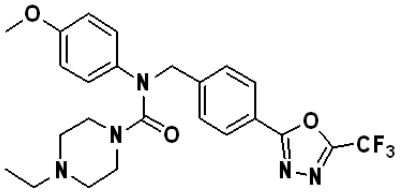
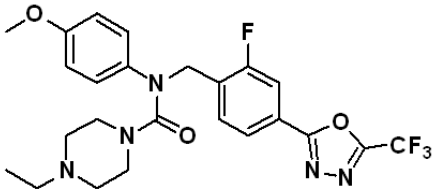
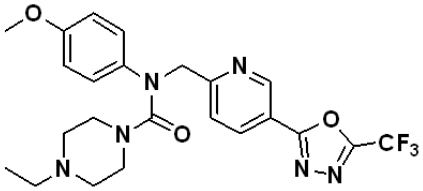
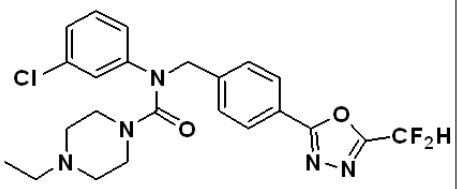
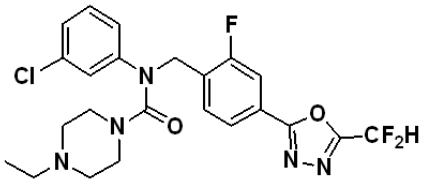
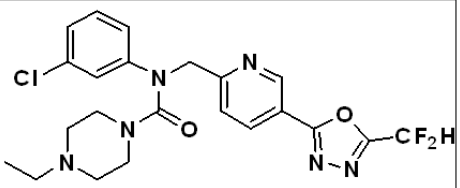
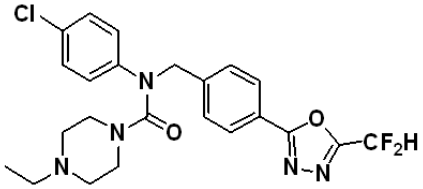
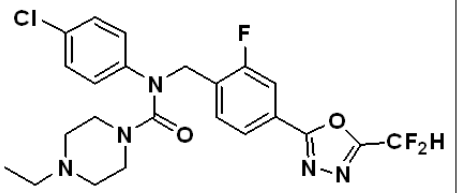
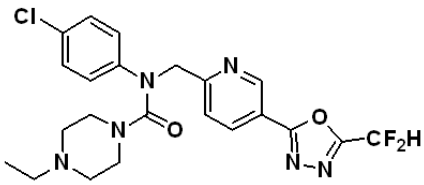
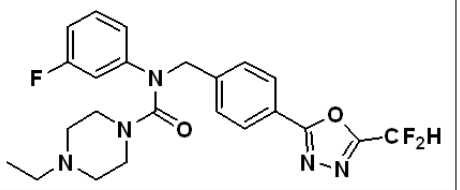
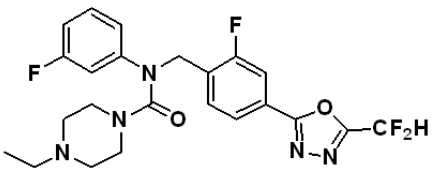
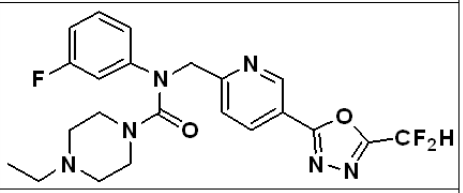
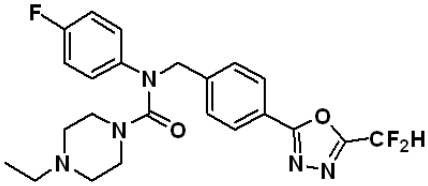
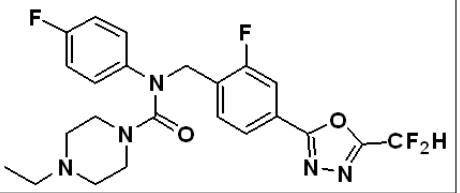
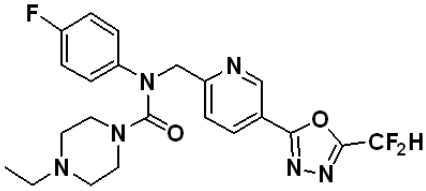
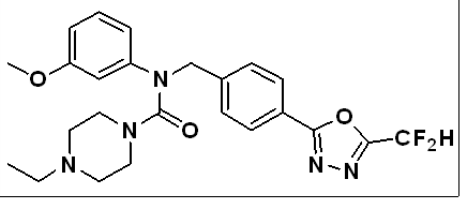
247		248	
249		250	
251		252	
253		254	
255		256	
257		258	
259		260	
261		262	

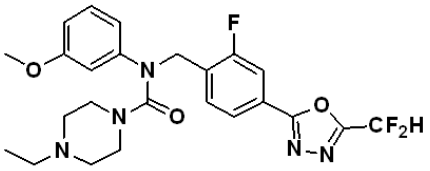
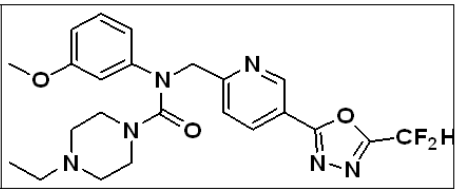
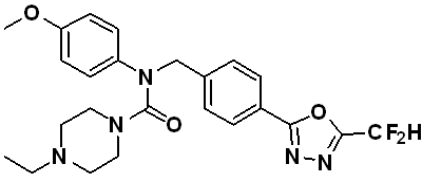
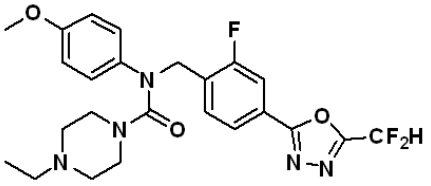
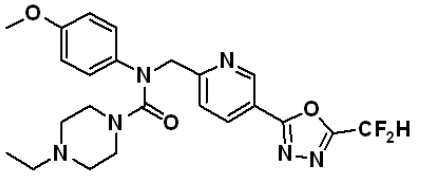
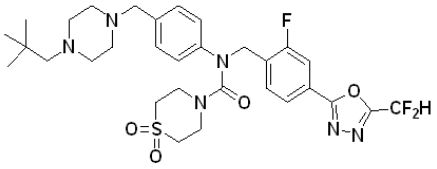
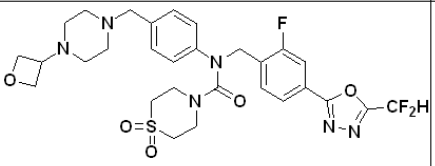
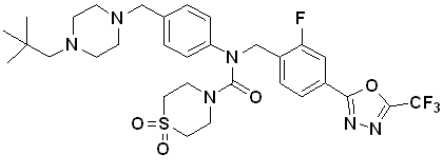
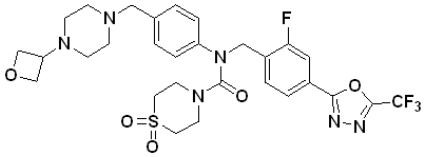
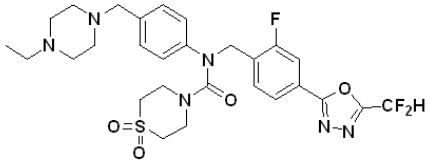
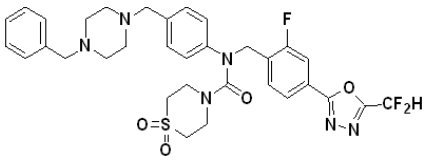
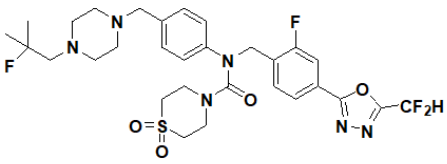
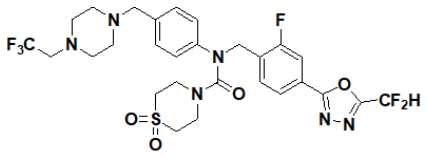
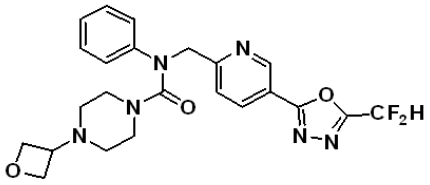
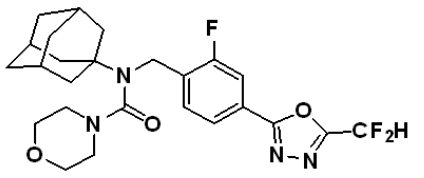
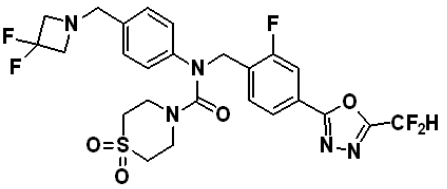
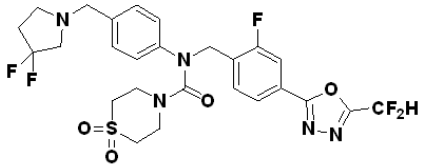
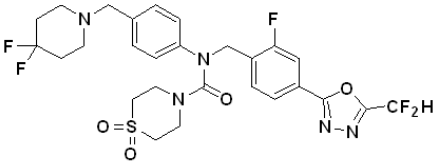
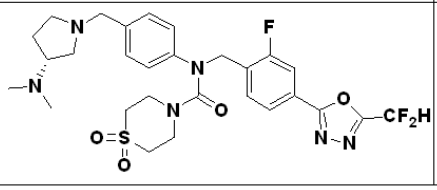
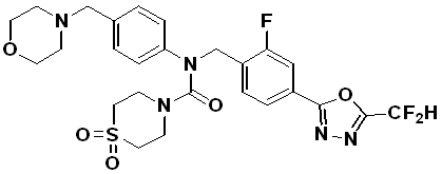
263		264	
265		266	
267		268	
269		270	
271		272	
273		274	
275		276	
277		278	

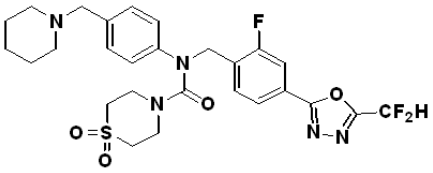
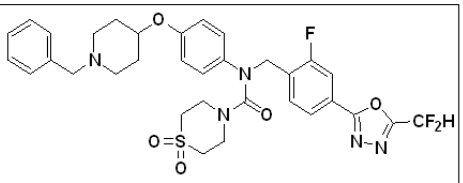
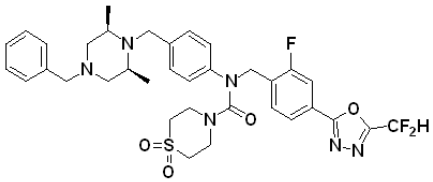
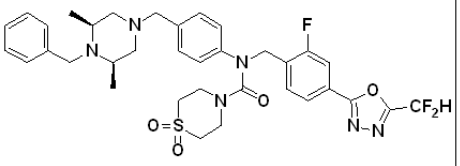
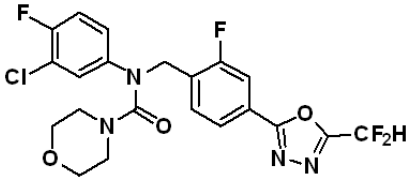
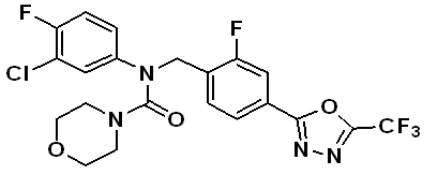
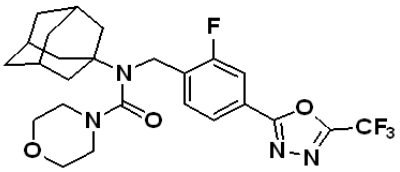
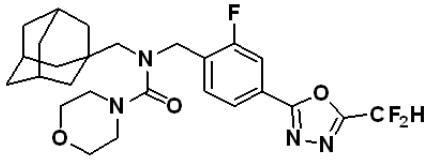
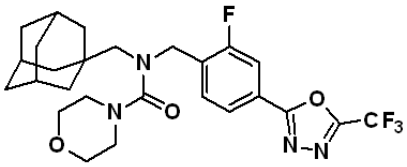
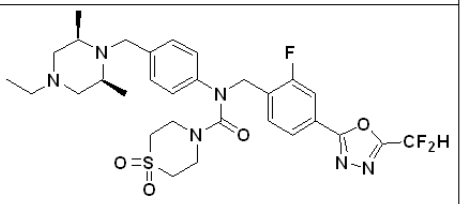
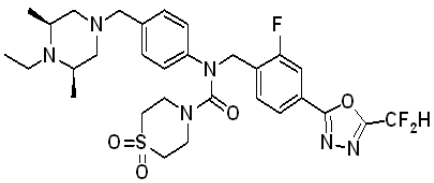
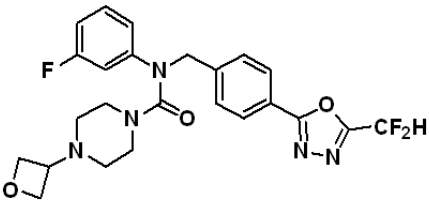
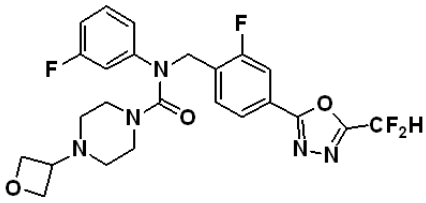
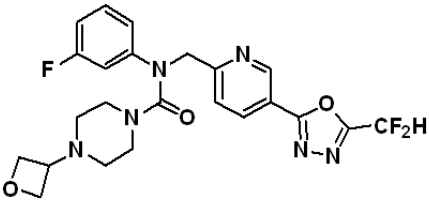
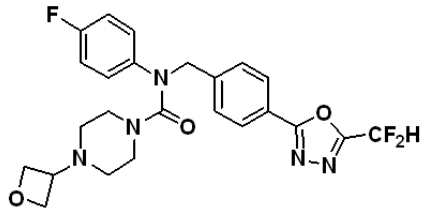
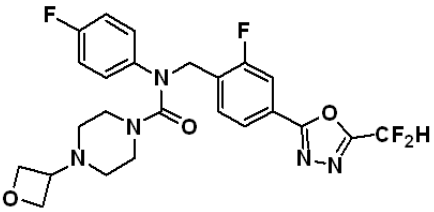
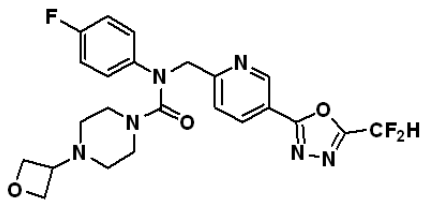
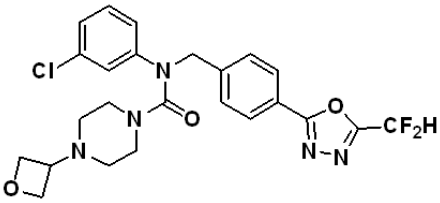
279		280	
281		282	
283		284	
285		286	
287		288	
289		290	
291		292	
293		294	

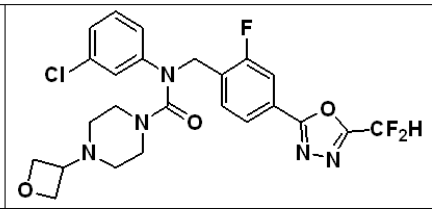
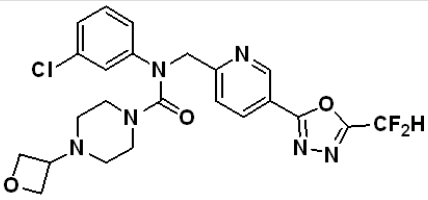
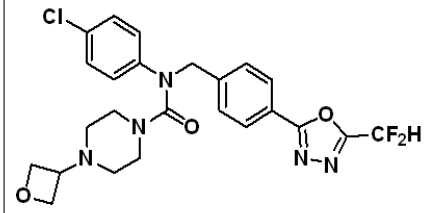
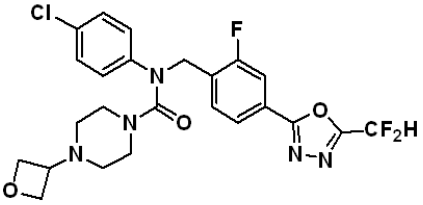
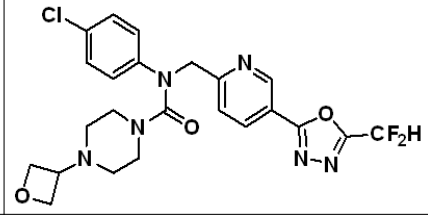
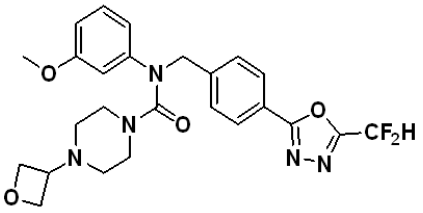
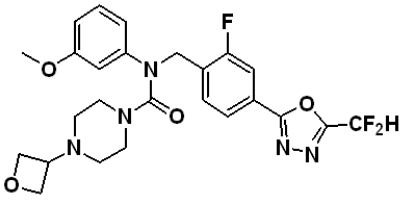
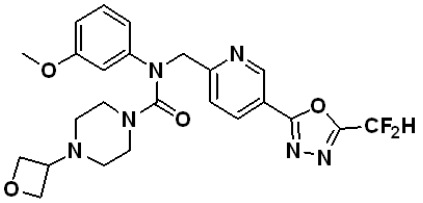
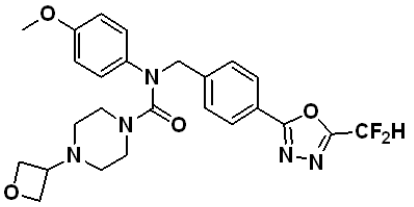
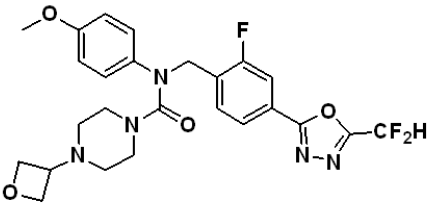
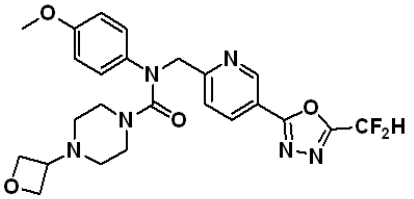
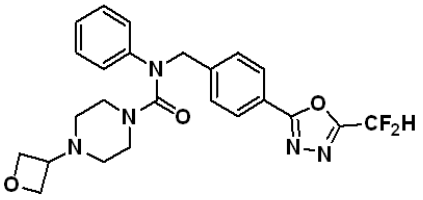
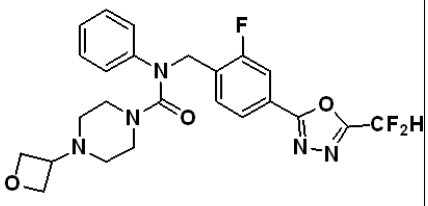
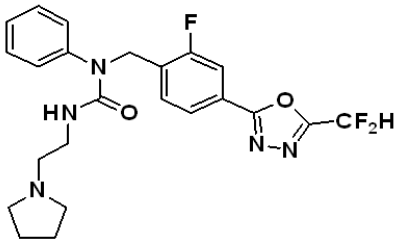
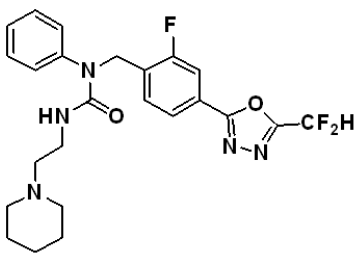
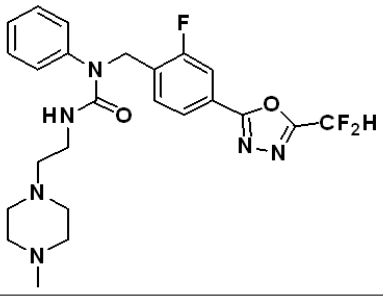
295		296	
297		298	
299		300	
301		302	
303		304	
305		306	
307		308	
309		310	
311		312	

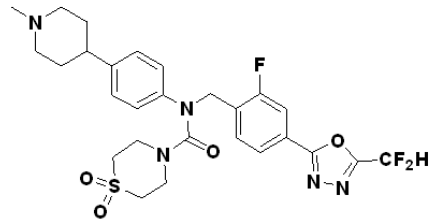
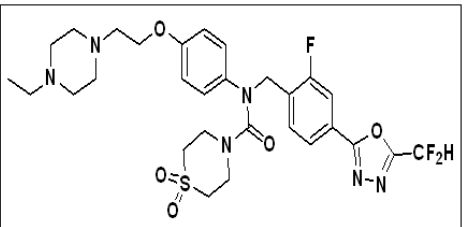
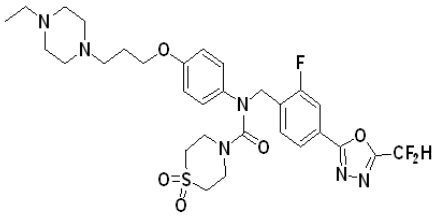
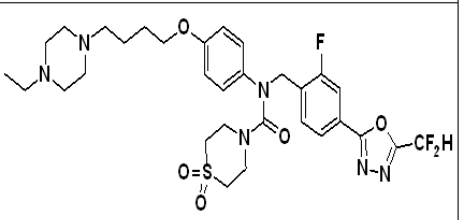
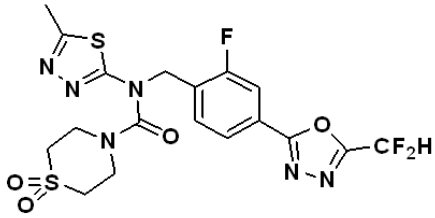
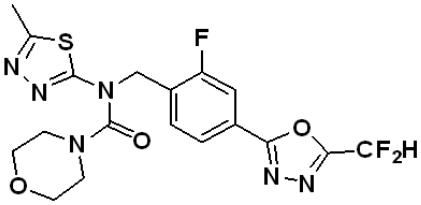
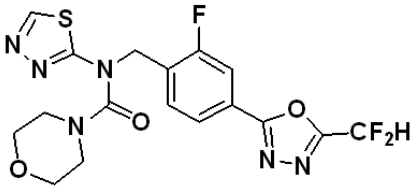
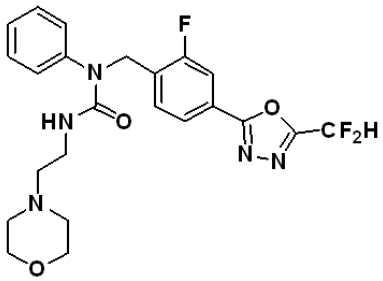
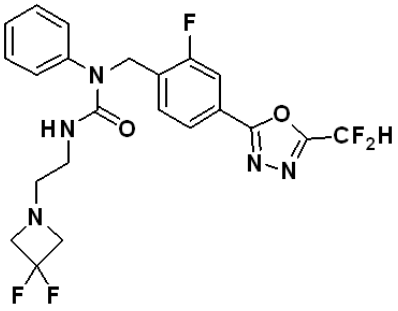
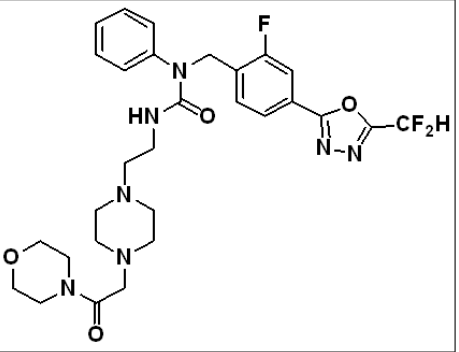
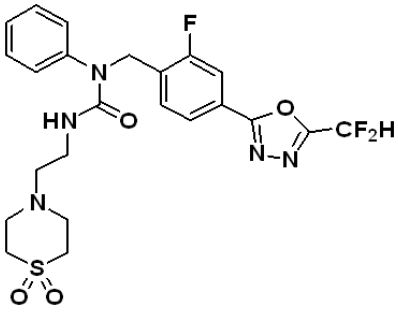
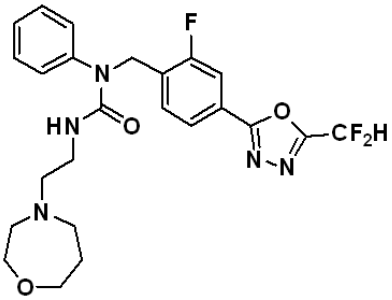
313		314	
315		316	
317		318	
319		320	
321		322	
323		324	
325		326	
327		328	
329		330	

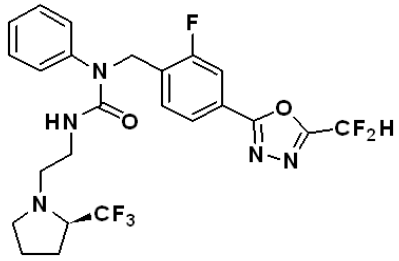
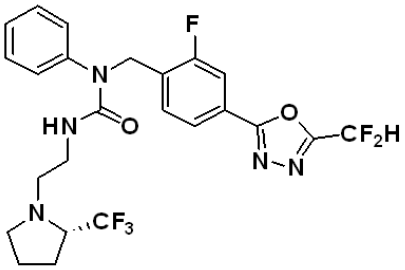
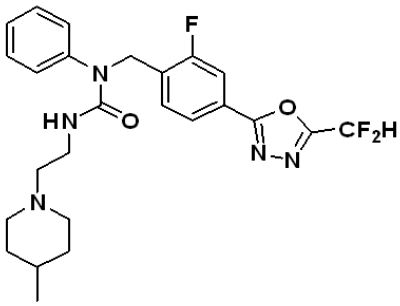
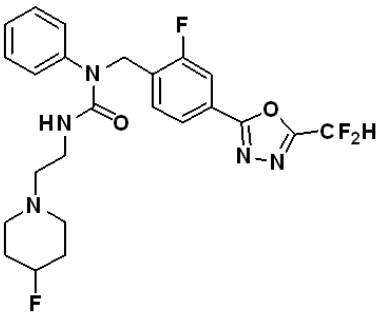
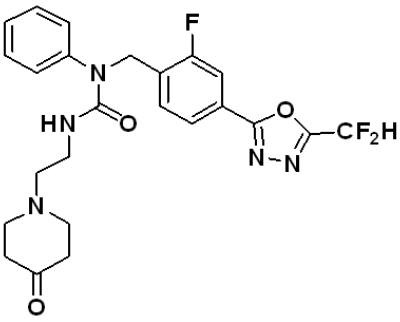
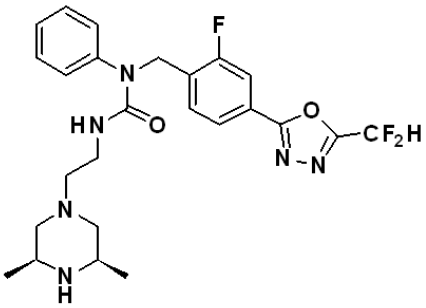
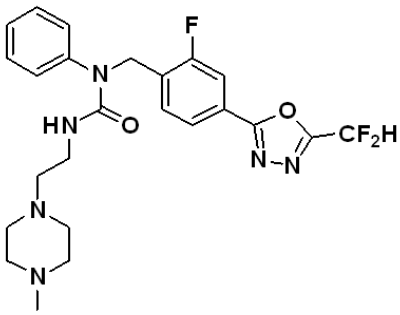
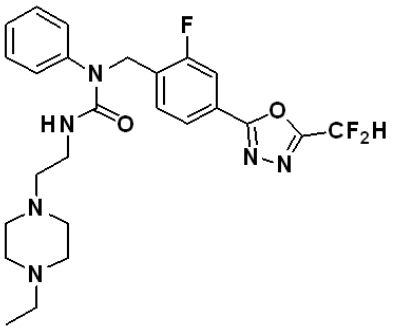
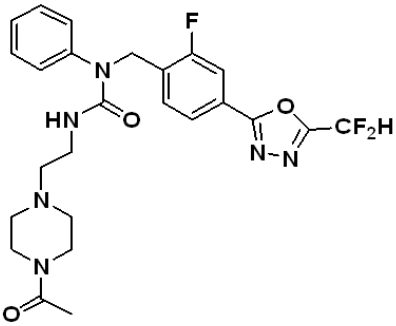
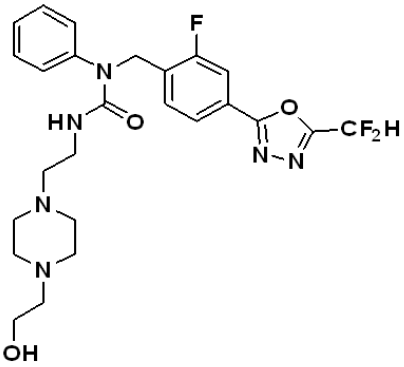
331		332	
333		334	
335		336	
337		338	
339		340	
341		342	
343		344	
345		346	
347		348	

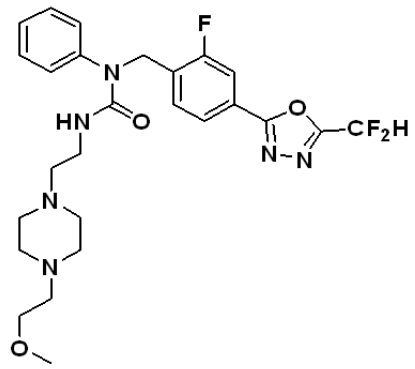
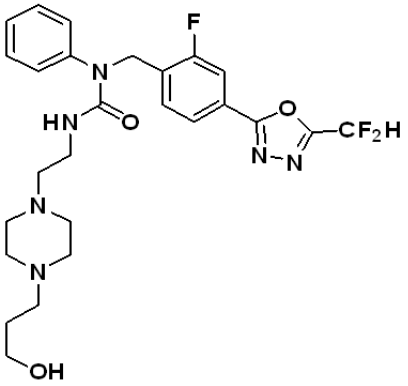
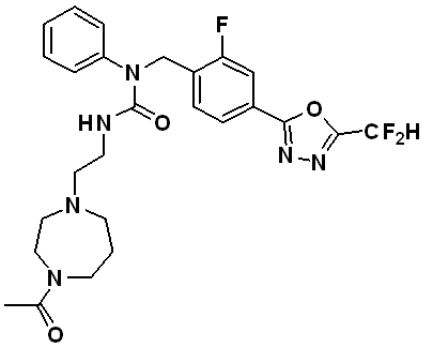
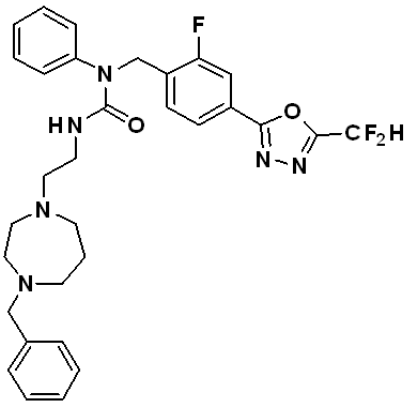
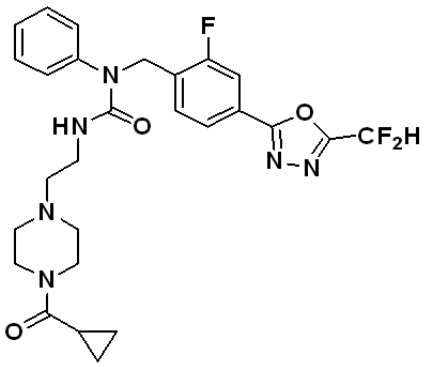
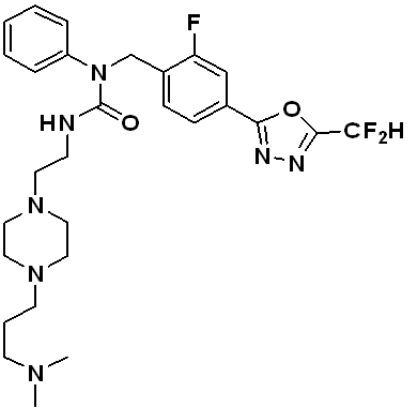
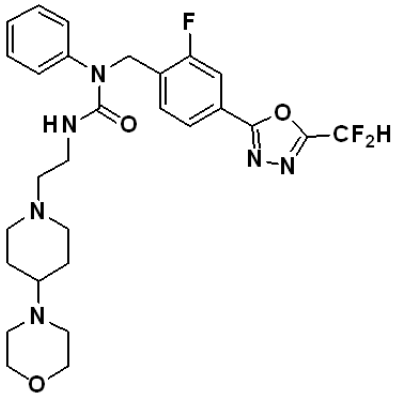
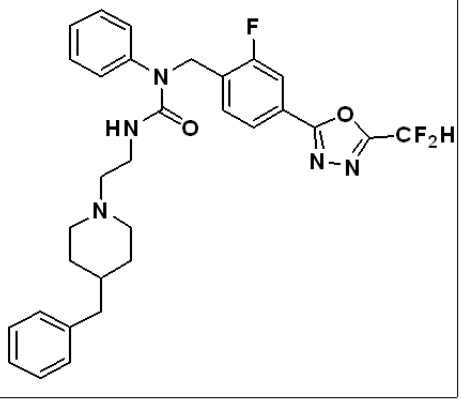
349		350	
351		352	
353		354	
355		356	
357		358	
359		360	
361		362	
363		364	
365		366	
367		368	

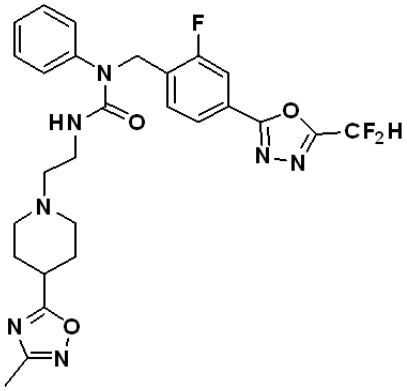
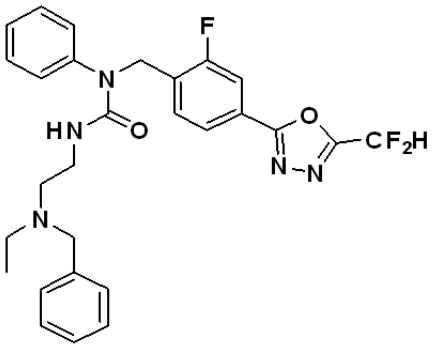
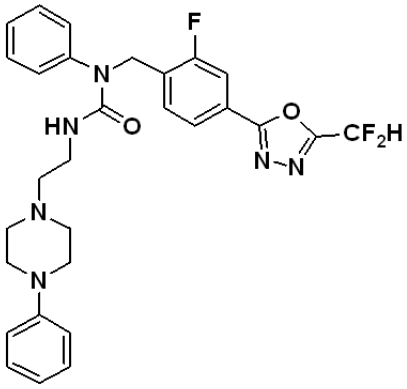
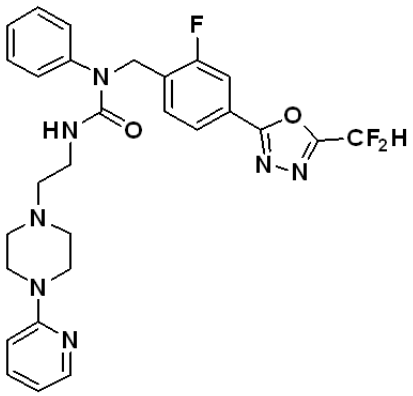
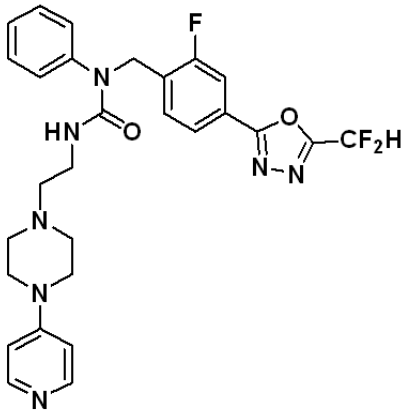
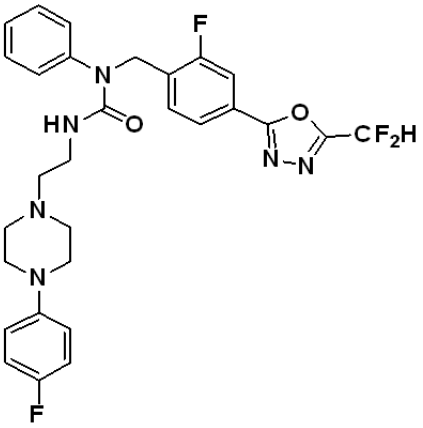
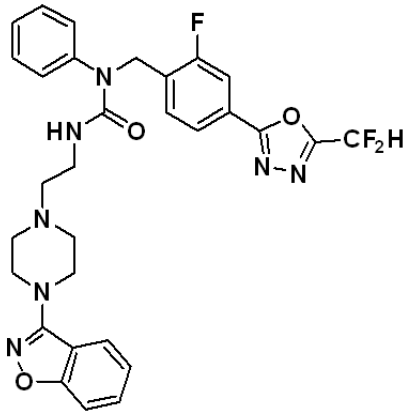
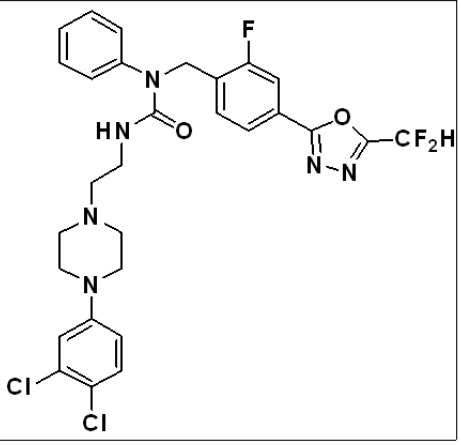
369		370	
371		372	
373		374	
375		376	
377		378	
379		380	
381		382	
383		384	
385		386	

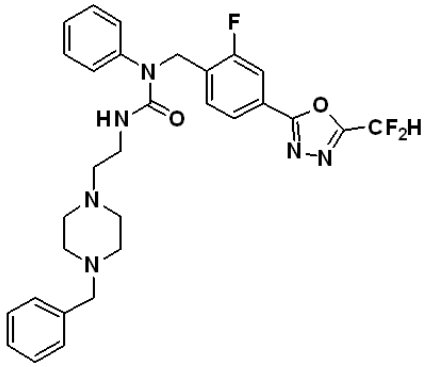
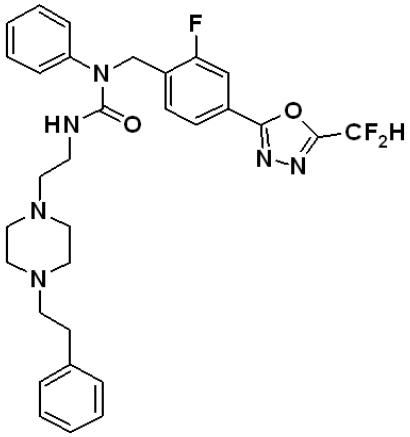
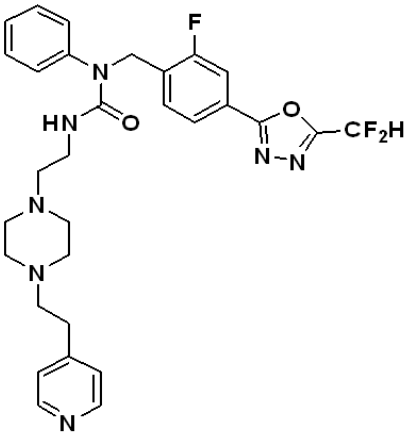
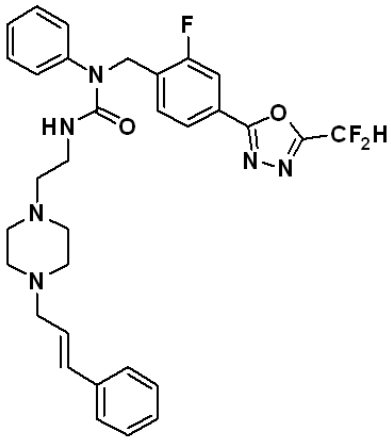
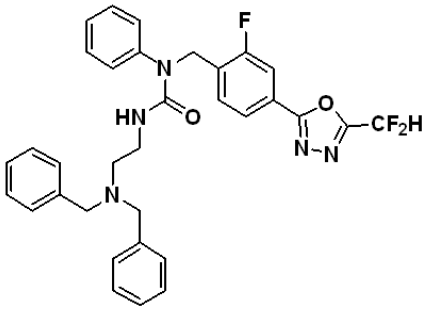
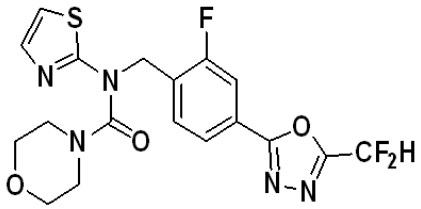
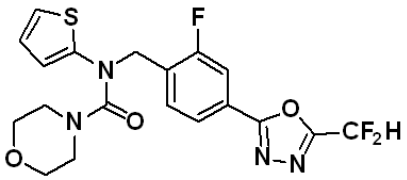
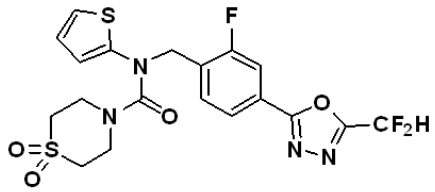
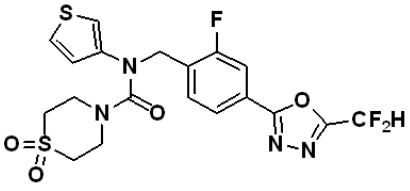
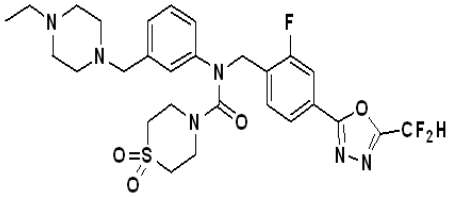
387		388	
389		390	
391		392	
393		394	
395		396	
397		398	
399		400	
401		402	

403		404	
405		406	
407		408	
409		410	
411		412	
413		414	

415		416	
417		418	
419		420	
421		422	
423		424	

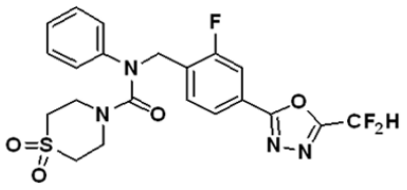
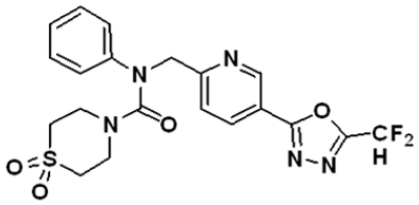
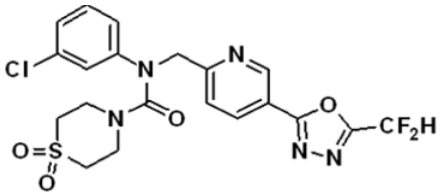
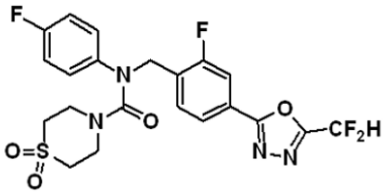
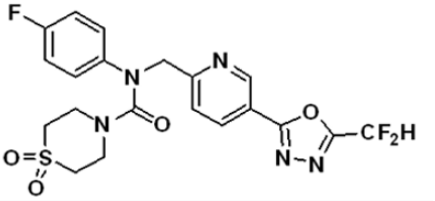
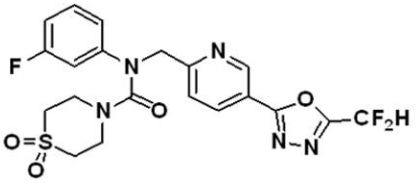
425		426	
427		428	
429		430	
431		432	

433		434	
435		436	
437		438	
439		440	

441		442	
443		444	
445		446	
447		448	
449		450	

6. A pharmaceutical composition for preventing or treating heart failure,

comprising a compound, optical isomers thereof or pharmaceutically acceptable salts thereof as an active ingredient, wherein the compound has the following structure:

Compound	Structure
40	
43	
239	
285	
295	
296	

7. The pharmaceutical composition of claims 1, 5 or 6, wherein the heart failure is

at least one selected from the group consisting of Heart Failure with Preserved Ejection Fraction(HFpEF), Heart Failure with Midrange Ejection Fraction (HFmrEF) and Heart Failure with Reduced Ejection Fraction (HFrEF).

8. The pharmaceutical composition of claims 1, 5 or 6, wherein the heart failure includes Cardiomyopathy.

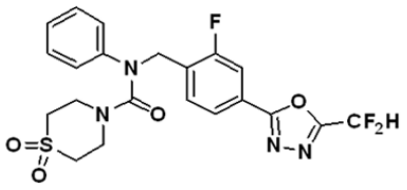
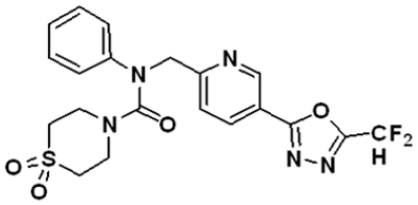
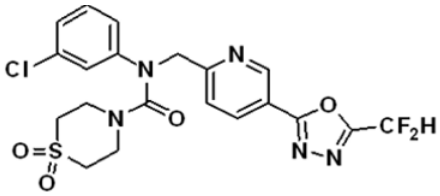
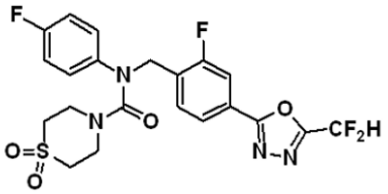
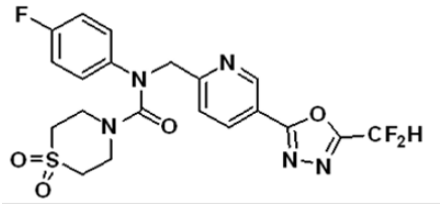
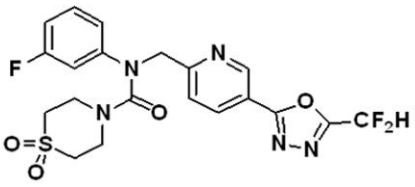
9. The pharmaceutical composition of claims 8, wherein the Cardiomyopathy is at least one selected from the group consisting of Hypertrophic Cardiomyopathy(HCMP), Restrictive Cardiomyopathy and Dilated Cardiomyopathy(DCMP).

10. The pharmaceutical composition of claims 1, 5 or 6, wherein the pharmaceutical composition is to be orally administered.

11. A compound represented by the above formula I, optical isomers thereof or pharmaceutically acceptable salts thereof for use in preventing or treating heart failure, wherein the formula I is the same as in claim 1.

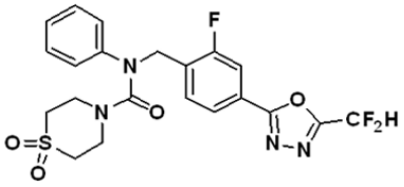
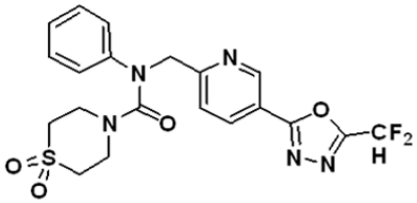
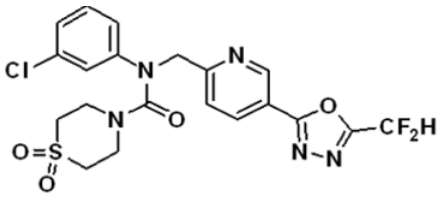
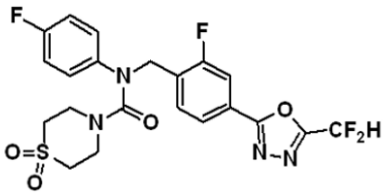
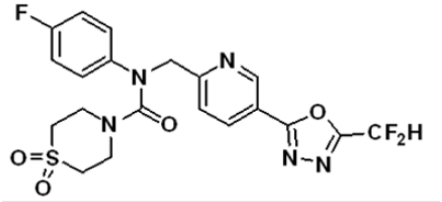
12. A compound, optical isomers thereof or pharmaceutically acceptable salts thereof for use in preventing or treating heart failure, wherein the compound has the following structure:

Compound	**Structure**

40	
43	
239	
285	
295	
296	

13. A use of the compound represented by above formula I, optical isomers thereof or pharmaceutically acceptable salts thereof in preparing a medicament for preventing or treating heart failure, wherein the formula I is the same as in claim 1.

14. A use of a compound, optical isomers thereof or pharmaceutically acceptable salts thereof in preparing a medicament for preventing or treating heart failure, wherein the compound has the following structure:

Compound	Structure
40	
43	
239	
285	
295	

296	