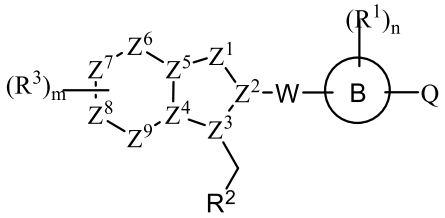
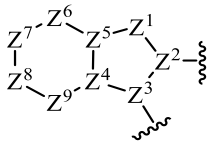
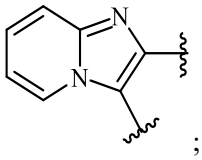
CLAIMS

1. A heterocyclic compound of formula I or a stereoisomer, a geometric isomer, a tautomer, a nitrogen oxide, a hydrate, a solvate, an ester, or a pharmaceutically acceptable salt thereof,



I

wherein,

 is  ;

m is 1, 2, 3 or 4;

R^3 is H, halogen, -OH, a C_1-C_6 haloalkyl, -CN or a C_1-C_6 alkyl; when m is not 1, R^3 is independently the same or different;

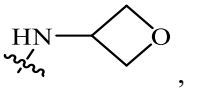
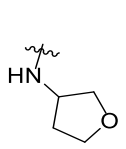
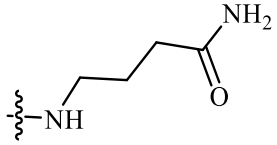
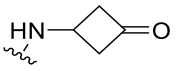
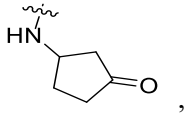
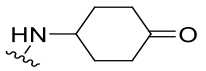
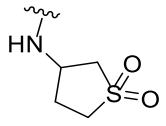
W is a single bond or -C(=O)-NH-;

 is phenyl;

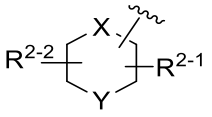
n is 1, 2, 3 or 4;

R^1 is independently H, halogen, -OH, -CN, an unsubstituted or substituted C_1-C_6 alkyl, or an unsubstituted or substituted C_1-C_6 alkyl-O-; wherein the substituted C_1-C_6 alkyl or the substituted C_1-C_6 alkyl-O- is substituted with one or more substituents independently selected from the following: halogen, -OH, $-CF_3$, -CN, -COOH, $-C(=O)NH_2$, a C_1-C_6 alkyl, a C_1-C_6 alkyl-O- or =O (i.e., two geminal hydrogens on a carbon atom are substituted with the group O); when a plurality of substituents are present, they are the same or different; and when n is not 1, R^1 is independently the same or different;

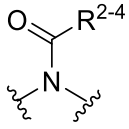
Q is $-NH-C(=O)-R^{1-1}$, $-O-C(=O)-N(R^{1-3}R^{1-4})$,$-S(=O)_2-N(R^{1-9}R^{1-10})$, $-N(R^{1-14}R^{1-15})$, $-NH-S(=O)_2-R^{1-16}$, an unsubstituted or substituted C_3-C_{10} cycloalkyl, an unsubstituted or substituted C_3-C_9 heterocycloalkyl, an unsubstituted or substituted C_3-C_9 heterocycloalkenyl, or an unsubstituted or substituted 5-10 membered heteroaryl; wherein the C_3-C_9 heterocycloalkyl contains 1-3 heteroatoms selected from one or more of O, S and N; the C_3-C_9 heterocycloalkenyl contains 1-3 heteroatoms selected from one or more of O, S and N; and the 5-10 membered heteroaryl contains 1-3 heteroatoms selected from one or more of O, S and N; the substituted C_3-C_{10} cycloalkyl, the substituted C_3-C_9 heterocycloalkyl, the substituted C_3-C_9 heterocycloalkenyl or the substituted 5-10 membered heteroaryl

is substituted with one or more substituents independently selected from the following: halogen, -OH, -CF_3, -CN, -COOH, -C(=O)NH_2, =O (i.e., two geminal hydrogens on a carbon atom are substituted with the group O), -N($R^{1\text{-}21}R^{1\text{-}22}$), -C(=O)-N($R^{1\text{-}23}R^{1\text{-}24}$), -S(=O)$_2$-N($R^{1\text{-}25}R^{1\text{-}26}$), -C(=O)-O-$R^{1\text{-}27}$, and a C_1-C_6 alkyl, a C_1-C_6 alkyl-O- or a C_3-C_6 cycloalkyl that is unsubstituted or substituted with one or more R^a, wherein when a plurality of R^a are present, they are the same or different, and each R^a is halogen, -OH, =O, -CF_3, -CN, -COOH or -C(=O)NH_2; and when a plurality of substituents are present, they are the same or different; the -O-C(=O)-N($R^{1\text{-}3}R^{1\text{-}4}$) is -O-C(=O)-NH-$CH_3$; -N($R^{1\text{-}14}R^{1\text{-}15}$) is -$NH_2$,  ,  ,  ,  ,  ,  , or  ;-NH-S(=O)$_2$-$R^{1\text{-}16}$ is -NH-S(=O)$_2$-CH_3;

wherein $R^{1\text{-}1}$,$R^{1\text{-}9}$, $R^{1\text{-}10}$, $R^{1\text{-}21}$, $R^{1\text{-}22}$, $R^{1\text{-}23}$, $R^{1\text{-}24}$, $R^{1\text{-}25}$, $R^{1\text{-}26}$ and $R^{1\text{-}27}$ are each independently H, an unsubstituted or substituted C_1-C_6 alkyl, an unsubstituted or substituted C_1-C_6 alkyl-O-, an unsubstituted or substituted C_2-C_6 alkenyl, an unsubstituted or substituted C_2-C_6 alkenyl-O-, an unsubstituted or substituted C_2-C_6 alkynyl, an unsubstituted or substituted C_3-C_{10} cycloalkyl, an unsubstituted or substituted C_3-C_9 heterocycloalkyl, an unsubstituted or substituted C_3-C_9 heterocycloalkenyl, an unsubstituted or substituted phenyl, or an unsubstituted or substituted 5-10 membered heteroaryl; wherein the C_3-C_9 heterocycloalkyl contains 1-3 heteroatoms selected from one or more of O, S and N; the C_3-C_9 heterocycloalkenyl contains 1-3 heteroatoms selected from one or more of O, S and N; and the 5-10 membered heteroaryl contains 1-3 heteroatoms selected from one or more of N, O and S; and the substituted C_1-C_6 alkyl, the substituted C_1-C_6 alkyl-O-, the substituted C_2-C_6 alkenyl, the substituted C_2-C_6 alkenyl-O-, the substituted C_2-C_6 alkynyl, the substituted C_3-C_{10} cycloalkyl, the substituted C_3-C_9 heterocycloalkyl, the substituted C_3-C_9 heterocycloalkenyl, the substituted phenyl or the substituted 5-10 membered heteroaryl is substituted with one or more substituents independently selected from the following: halogen, -OH, -CF_3, -CN, -COOH, -$COOCH_3$, -NH_2, =O), and a C_1-C_6 alkyl, a C_1-C_6 alkyl-O- or a C_3-C_6 cycloalkyl that is unsubstituted or substituted with one or more R^d, wherein when a plurality of R^d are present, they are the same or different, and each R^d is independently H, halogen, -OH, =O, -CF_3, -CN, -COOH or -C(=O)NH_2; and when a plurality of substituents are present, they are the same or different;

R^2 is independently  , an unsubstituted or substituted 5-6 membered heteroaryl; wherein the 5-6 membered heteroaryl contains 1-3 heteroatoms selected from one or more of N, O and S; and the substituted 5-6 membered heteroaryl is substituted with one or more substituents independently selected from the following: halogen, -OH, -CN, an unsubstituted or halogen-substituted C_1-C_6 alkyl, an unsubstituted or halogen-substituted C_1-C_6 alkyl-O-, $-C(=O)R^{2-7}$ or $-C(=O)N(R^{2-8}R^{2-9})$, wherein when a plurality of substituents are present, they are the same or different;

wherein, R^{2-1} and R^{2-2} are each independently H, halogen, -OH, -CN, an unsubstituted or substituted C_1-C_6 alkyl, an unsubstituted or substituted C_1-C_6 alkyl-O-, or =O; wherein the substituted C_1-C_6 alkyl or the substituted C_1-C_6 alkyl-O- is substituted with one or more substituents independently selected from the following: halogen, -OH, $-CF_3$, -CN, a C_1-C_6 alkyl, a C_1-C_6 alkyl-O- or =O (i.e., two geminal hydrogens on a carbon atom are substituted with the group O), and when a plurality of substituents are present, they are the same or different;

X and Y are each independently a single bond, methylene, -O-, $-N(R^{2-3})$- or  ;

$R^{2-3}$and R^{2-4} are each independently H, an unsubstituted or substituted C_1-C_6 alkyl, an unsubstituted or substituted C_3-C_8 cycloalkyl, an unsubstituted or substituted C_3-C_8 cycloalkyl-O-, or an unsubstituted or substituted C_1-C_6 alkyl-O-; wherein the substituted C_1-C_6 alkyl, the substituted C_3-C_8 cycloalkyl, the substituted C_3-C_8 cycloalkyl-O- or the substituted C_1-C_6 alkyl-O- is substituted with one or more substituents independently selected from the following: halogen, -OH, $-CF_3$, -CN, a C_1-C_6 alkyl, a C_1-C_6 alkyl-O- or =O (i.e., two geminal hydrogens on a carbon atom are substituted with the group O), and when a plurality of substituents are present, they are the same or different;

R^{2-7} is independently H, halogen, -OH, -CN, an unsubstituted or halogen-substituted C_1-C_6 alkyl, or an unsubstituted or halogen-substituted C_1-C_6 alkyl-O-; and

R^{2-8} and R^{2-9} are each independently H, or an unsubstituted or halogen-substituted C_1-C_6 alkyl.

2. The heterocyclic compound of formula I or the stereoisomer, the geometric isomer, the tautomer, the nitrogen oxide, the hydrate, the solvate, the ester, or the pharmaceutically acceptable salt thereof according to claim 1, wherein m is 1 or 2; and/or

when R^3 is halogen, the halogen is fluorine, chlorine, bromine or iodine; and/or

when R^3 is a C_1-C_6 alkyl, the C_1-C_6 alkyl is C_1-C_4 alkyl; and/or

when R^3 is a C_1-C_6 haloalkyl, the halogen is fluorine, chlorine, bromine or iodine; and/or

when R^3 is a C_1-C_6 haloalkyl, it contains one or more halogens; and/or

n is 1 or 2; and/or

each R^1 is independently located at position α or β of the linkage between  and Z^2; and/or

when R^1 is halogen, the halogen is fluorine, chlorine, bromine or iodine; and/or

when R^1 is an unsubstituted or substituted C_1-C_6 alkyl or an unsubstituted or substituted C_1-C_6 alkyl-O-, the C_1-C_6 alkyl is independently a C_1-C_4 alkyl; and/or

when R^1 is a substituted C_1-C_6 alkyl or a substituted C_1-C_6 alkyl-O-, and the substituents are each independently halogen, the halogen is fluorine, chlorine, bromine or iodine; and/or

when R^1 is a substituted C_1-C_6 alkyl or a substituted C_1-C_6 alkyl-O-, and the substituents are each independently a C_1-C_6 alkyl or a C_1-C_6 alkyl-O-, the C_1-C_6 alkyl in the substituents is independently a C_1-C_4 alkyl; and/or

when R^1 is a substituted C_1-C_6 alkyl or a substituted C_1-C_6 alkyl-O-, the number of the substituents is independently 1, 2 or 3; and/or

Q is located at position β or γ of the linkage between  and W;

when Q is an unsubstituted or substituted C_3-C_{10} cycloalkyl, the C_3-C_{10} cycloalkyl is cyclopropyl, cyclobutyl, cyclopentyl, cyclohexyl, cycloheptyl or cyclooctyl; and/or

when Q is an unsubstituted or substituted C_3-C_9 heterocycloalkyl, the C_3-C_9 heterocycloalkyl is a C_3-C_5 heterocycloalkyl, wherein the C_3-C_5 heterocycloalkyl contains 1-3 heteroatoms selected from one or more of O, S and N; and/or

when Q is an unsubstituted or substituted C_3-C_9 heterocycloalkenyl, the C_3-C_9 heterocycloalkenyl is a C_3-C_5 heterocycloalkenyl, wherein the C_3-C_5 heterocycloalkenyl contains 1-3 heteroatoms selected from one or more of O, S and N; and/or

when Q is an unsubstituted or substituted C_6-C_{10} aryl, the C_6-C_{10} aryl is phenyl; and/or

when Q is an unsubstituted or substituted 5-10 membered heteroaryl, the 5-10 membered heteroaryl is a 5-6 membered heteroaryl, and the 5-6 membered heteroaryl is imidazolyl, oxazolyl, furanyl, thienyl, pyrrolyl, pyrazolyl, isoxazolyl, pyridinyl, triazolyl or pyrimidinyl; and/or

when Q is a substituted C_3-C_{10} cycloalkyl, a substituted C_3-C_9 heterocycloalkyl, a substituted C_3-C_9 heterocycloalkenyl or a substituted 5-10 membered heteroaryl, the number of substituents is independently 1, 2, 3 or 4; and/or

when Q is a substituted C_3-C_{10} cycloalkyl, a substituted C_3-C_9 heterocycloalkyl, a substituted C_3-C_9 heterocycloalkenyl or a substituted 5-10 membered heteroaryl, and the substituent is halogen, the halogen is independently fluorine, chlorine, bromine, or iodine; and/or

the C_1-C_6 alkyl in the C_1-C_6 alkyl or the C_1-C_6 alkyl-O- that is unsubstituted or substituted with one or more R^a is independently methyl, ethyl, *n*-propyl, isopropyl, *n*-butyl, isobutyl, *sec*-butyl or *tert*-butyl; and/or

the C_3-C_6 cycloalkyl in the C_3-C_6 cycloalkyl that is unsubstituted or substituted with one or more R^a is independently cyclopropyl, cyclobutyl, cyclopentyl or cyclohexyl; and/or

when R^a is halogen, the halogen is independently fluorine, chlorine, bromine or iodine; and/or

when R^d is independently halogen, the halogen is independently fluorine, chlorine, bromine or iodine; and/or

the number of R^d is independently 1 or 2; and/or

when R^2 is independently an unsubstituted or substituted 5-6 membered heteroaryl, the 5-6 membered heteroaryl is independently pyridinyl; and/or

when R^2 is independently a substituted 5-6 membered heteroaryl that may be substituted with halogen, a halogen-substituted C_1-C_6 alkyl or a halogen-substituted C_1-C_6 alkyl-O-, the halogen in the substituents is independently fluorine, chlorine, bromine or iodine; and/or

when R^2 is independently a substituted 5-6 membered heteroaryl that may be substituted with an unsubstituted or halogen-substituted C_1-C_6 alkyl, or an unsubstituted or halogen-substituted C_1-C_6 alkyl-O-, the C_1-C_6 alkyl in the substituents is independently methyl, ethyl, *n*-propyl, isopropyl, *n*-butyl, isobutyl, *sec*-butyl or *tert*-butyl.

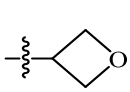
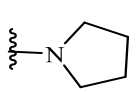
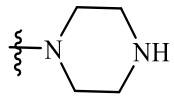
3. The heterocyclic compound of formula I or the stereoisomer, the geometric isomer, the tautomer, the nitrogen oxide, the hydrate, the solvate, the ester, or the pharmaceutically acceptable salt thereof according to claim 2, wherein

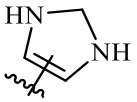
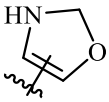
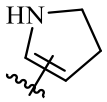
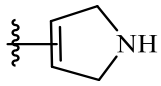
when R^3 is a C_1-C_6 alkyl, the C_1-C_6 alkyl is methyl; and/or

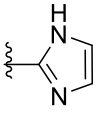
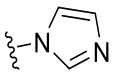
when R^3 is a C_1-C_6 haloalkyl, it contains 1, 2 or 3 halogens; and/or

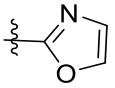
when R^1 is an unsubstituted or substituted C_1-C_6 alkyl or an unsubstituted or substituted C_1-C_6 alkyl-O-, the C_1-C_6 alkyl is methyl; and/or

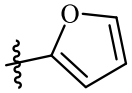
when R^1 is a substituted C_1-C_6 alkyl or a substituted C_1-C_6 alkyl-O-, and the substituents are each independently a C_1-C_6 alkyl or a C_1-C_6 alkyl-O-, the C_1-C_6 alkyl in the substituents is methyl; and/or

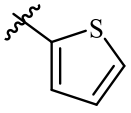
when Q is an unsubstituted or substituted C_3-C_5 heterocycloalkyl, the C_3-C_5 heterocycloalkyl is  ,  ,  ; and/or

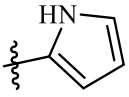
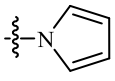
when Q is an unsubstituted or substituted C_3-C_5 heterocycloalkenyl, the C_3-C_5 heterocycloalkenyl is C_4-C_5 heterocycloalkenyl, and the C_4-C_5 heterocycloalkenyl is  ,  ,  or  ; and/or

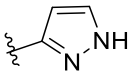
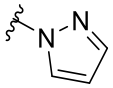
when Q is imidazolyl, the imidazolyl is  or  ; and/or

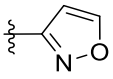
when Q is oxazolyl, the oxazolyl is  ; and/or

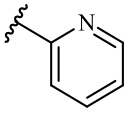
when Q is furanyl, the furanyl is  , and/or

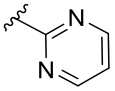
when Q is thienyl, the thienyl is  ; and/or

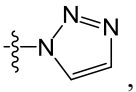
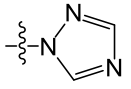
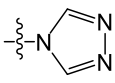
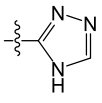
when Q is pyrrolyl, the pyrrolyl is  or  ; and/or

when Q is pyrazolyl, the pyrazolyl is  or  ; and/or

when Q is isoxazolyl, the isoxazolyl is  ; and/or

when Q is pyridinyl, the pyridinyl is  ; and/or

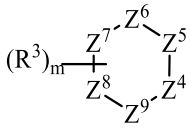
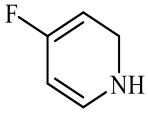
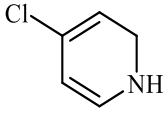
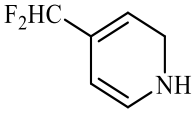
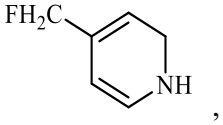
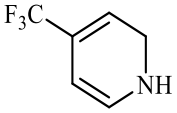
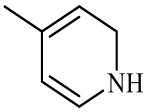
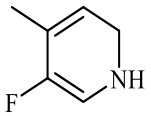
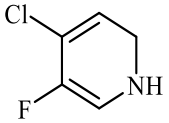
when Q is pyrimidinyl, the pyrimidinyl is  ; and/or

when Q is triazolyl, and the triazolyl is  ,  ,  or  ; and/or

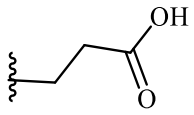
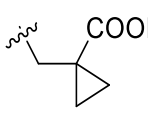
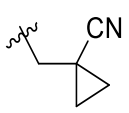
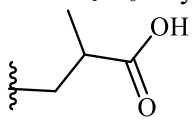
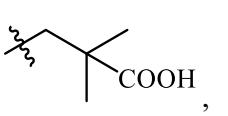
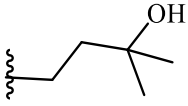
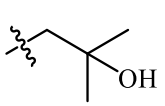
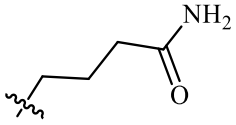
when Q is a substituted C_3-C_{10} cycloalkyl, a substituted C_3-C_9 heterocycloalkyl, a substituted C_3-C_9 heterocycloalkenyl or a substituted 5-10 membered heteroaryl, and the substituent is fluorine.

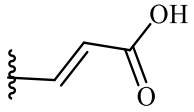
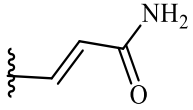
4. The heterocyclic compound of formula I or the stereoisomer, the geometric isomer, the tautomer, the nitrogen oxide, the hydrate, the solvate, the ester, or the pharmaceutically acceptable salt thereof according to claim 1 or 2, wherein when R^1 is a substituted C_1-C_6 alkyl or a substituted C_1-C_6 alkyl-O-, and the substituents are each independently halogen, the C_1-C_6 alkyl in the substituted C_1-C_6 alkyl or the substituted C_1-C_6 alkyl-O- is independently $-CF_3$; and/or

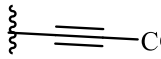
when R^3 is a C_1-C_6 haloalkyl, the C_1-C_6 haloalkyl is $-CF_3$, $-CH_2F$ or $-CHF_2$; and/or

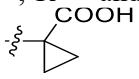
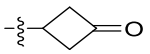
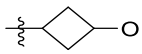
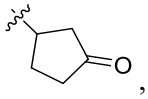
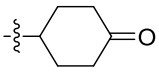
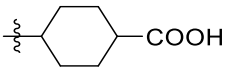

is  ,  ,  ,  ,  ,  ,  or  ; and/or

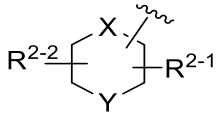
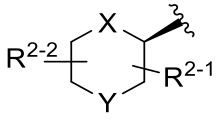
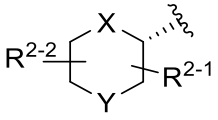
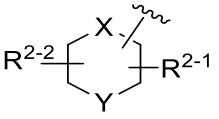
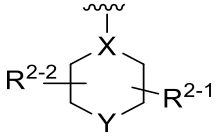
when n is 2, each R^1 is independently located at position α of the linkage between  and Z^2; or at least one R^1 is located at position β of the linkage between  and Z^2; and/or

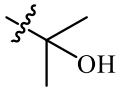
when R^{1-1}, R^{1-9}, R^{1-10}, R^{1-21}, R^{1-22}, R^{1-23}, R^{1-24}, R^{1-25}, R^{1-26} and R^{1-27} are each a substituted C_1-C_6 alkyl, the substituted C_1-C_6 alkyl is  ,  ,  ,  ,  ,  ,  or  ; and/or

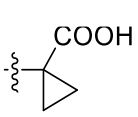
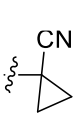
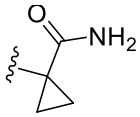
when R^{1-1}, R^{1-9}, R^{1-10}, R^{1-21}, R^{1-22}, R^{1-23}, R^{1-24}, R^{1-25}, R^{1-26} and R^{1-27} are each a substituted C_2-C_6 alkenyl, the substituted C_2-C_6 alkenyl is  or  ; and/or

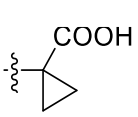
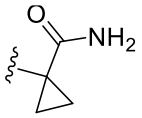
when R^{1-1}, R^{1-9}, R^{1-10}, R^{1-21}, R^{1-22}, R^{1-23}, R^{1-24}, R^{1-25}, R^{1-26} and R^{1-27} are each a substituted C_2-C_6 alkynyl, the substituted C_2-C_6 alkynyl is  ; and/or

when R^{1-1}, R^{1-9}, R^{1-10}, R^{1-21}, R^{1-22}, R^{1-23}, R^{1-24}, R^{1-25}, R^{1-26} and R^{1-27} are each a substituted C_3-C_{10} cycloalkyl, the substituted C_3-C_{10} cycloalkyl is  ,  ,  ,  ,  ,  or  ; and/or

 is  or  ; or  is  .

5. The heterocyclic compound of formula I or the stereoisomer, the geometric isomer, the tautomer, the nitrogen oxide, the hydrate, the solvate, the ester, or the pharmaceutically acceptable salt thereof according to claim 1, wherein the C_1-C_6 alkyl substituted with one or more R^a is  or  ; and/or

the C_3-C_6 cycloalkyl substituted with one or more R^a is  ,  ,  or  ; and/or

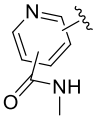
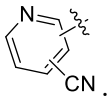
the C_3-C_6 cycloalkyl substituted with one or more R^d is  ,  or  ; and/or

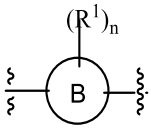
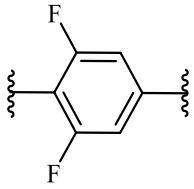
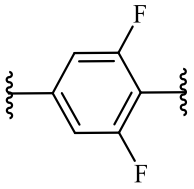
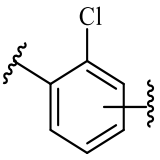
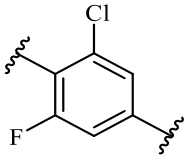
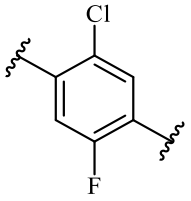
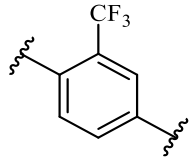
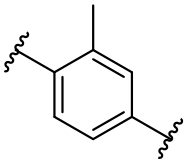
$-N(R^{1-21}R^{1-22})$ is $-NHCH_3$ or $-NH_2$; and/or

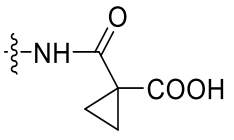
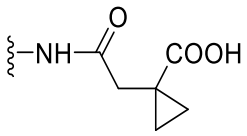
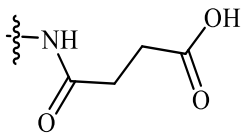
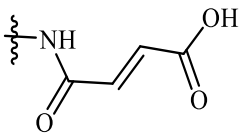
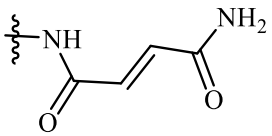
$-C(=O)-N(R^{1-23}R^{1-24})$ is $-C(=O)-NH_2$ or $-C(=O)-NHCH_3$; and/or

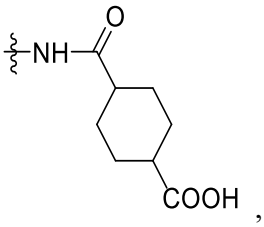
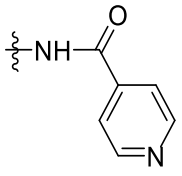
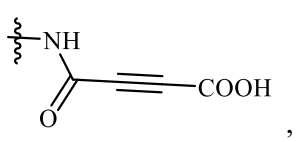
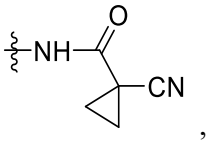
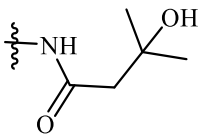
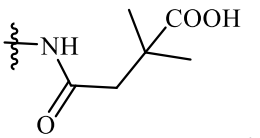
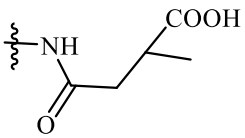
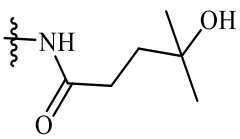
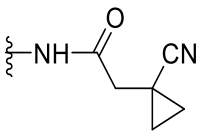
$-S(=O)_2-N(R^{1-25}R^{1-26})$ is $-S(=O)_2-NH_2$; and/or

$-C(=O)-O-R^{1-27}$ is $-COOH$, $-COOC_2H_5$ or $-COOCH_3$; and/or

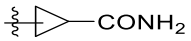
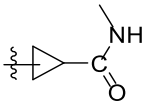
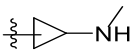
when R^2 is independently an unsubstituted or substituted 5-6 membered heteroaryl, the substituted 5-6 membered heteroaryl is independently  or  .

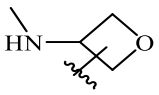
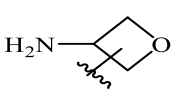
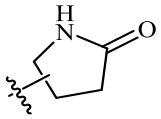
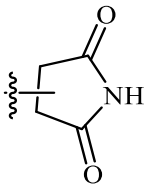
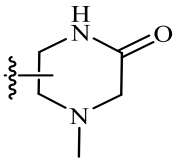
6. The heterocyclic compound of formula I or the stereoisomer, the geometric isomer, the tautomer, the nitrogen oxide, the hydrate, the solvate, the ester, or the pharmaceutically acceptable salt thereof according to any one of the preceding claims, wherein when  is phenyl,  is  ,  ,  ,  ,  ,  or  ; and/or

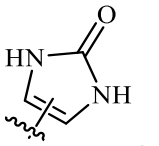
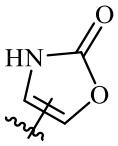
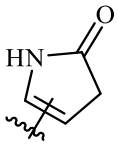
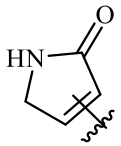
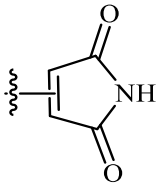
$-NH-C(=O)-R^{1-1}$ is $-NH-C(=O)-CH_3$, $-NH-C(=O)-O-CH_3$,  ,  ,  ,  ,  ,

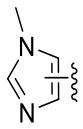
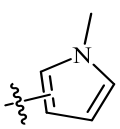
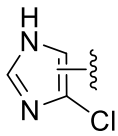
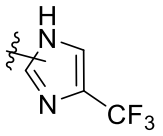
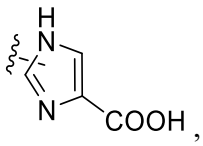
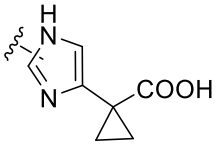
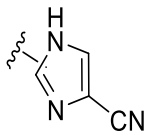
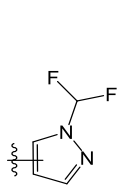
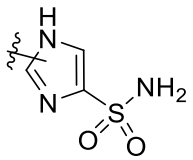
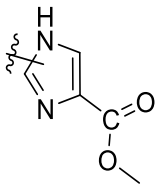
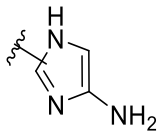
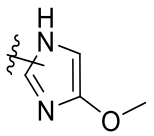
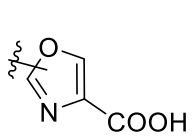
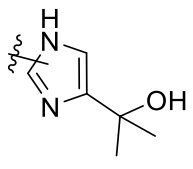
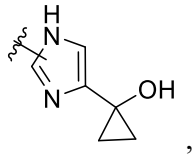
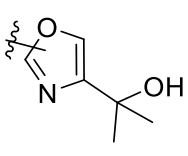
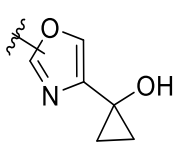
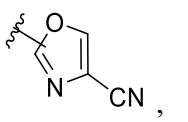









or ; and/or

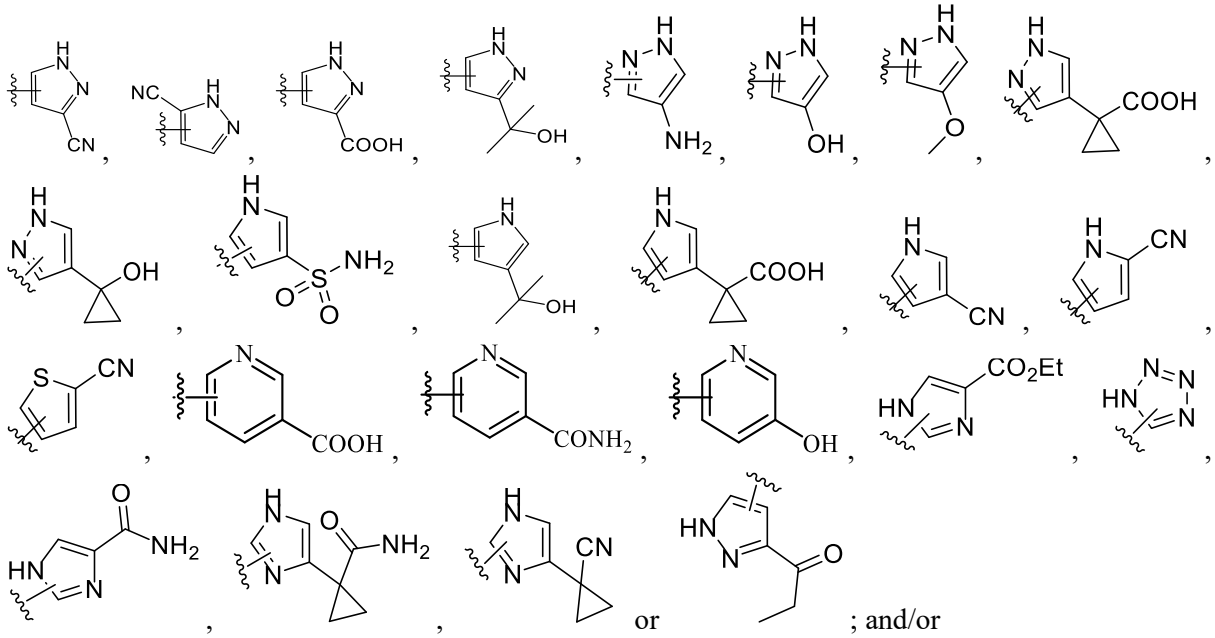
$-S(=O)_2-N(R^{1-9}R^{1-10})$ is $-S(=O)_2-NH-CH_3$ or $-SO_2NH_2$; and/or

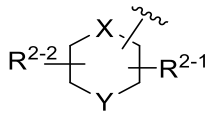
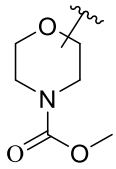
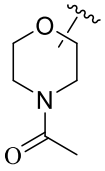
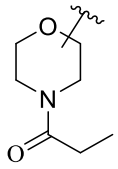
when Q is a substituted C_3-C_{10} cycloalkyl, the substituted C_3-C_{10} cycloalkyl is  ,

or  ; and/or

when Q is a substituted C_3-C_9 heterocycloalkyl, the substituted C_3-C_9 heterocycloalkyl is




or  ; and/or

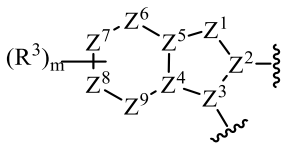
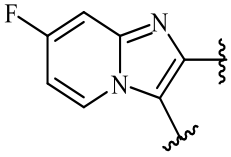
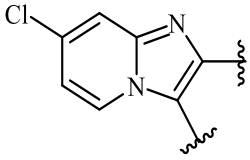
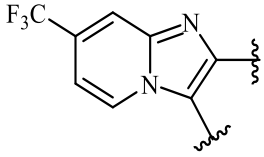
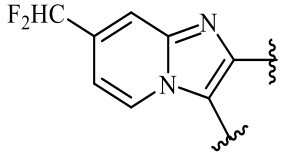
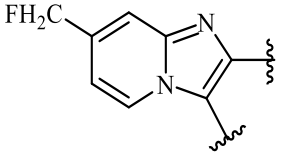
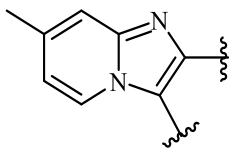
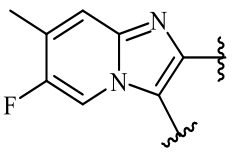
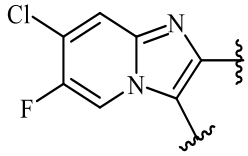
when Q is a substituted C_3-C_9 heterocycloalkenyl, the substituted C_3-C_9 heterocycloalkenyl is




or  ; and/or

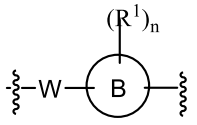
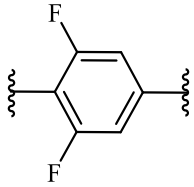
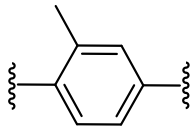
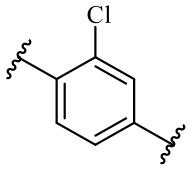
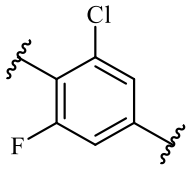
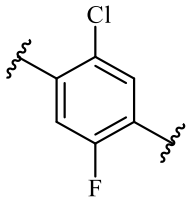
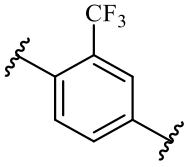
when Q is a substituted 5-10 membered heteroaryl, the substituted 5-10 membered heteroaryl is





















when R^2 is  , R^2 is  ,  or  .

7. The heterocyclic compound of formula I or the stereoisomer, the geometric isomer, the tautomer, the nitrogen oxide, the hydrate, the solvate, the ester, or the pharmaceutically acceptable salt thereof according to claim 1, wherein

 is  ,  ,  ,  ,  ,  ,  , or  ; and/or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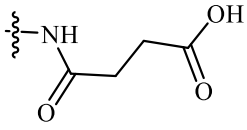
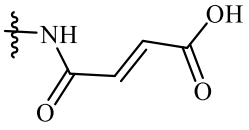
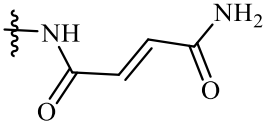
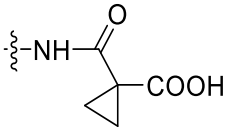
Q is -NH-C(=O)-CH$_3$, -NH-C(=O)-O-CH$_3$, 



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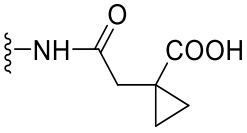
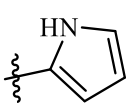
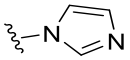
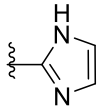
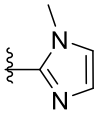
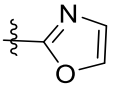
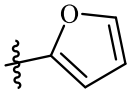
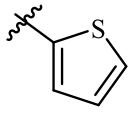
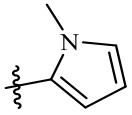
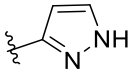
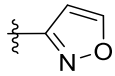
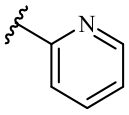
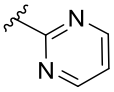
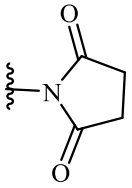
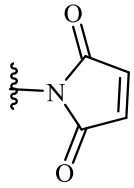
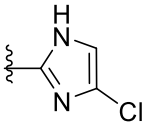
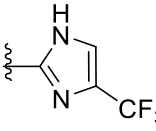
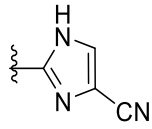
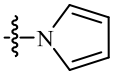
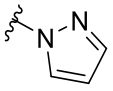
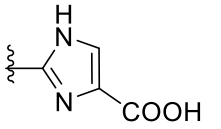
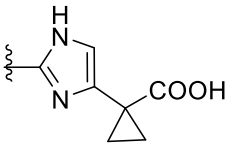
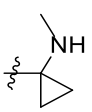
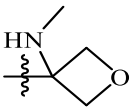
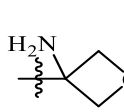
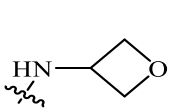
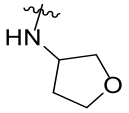
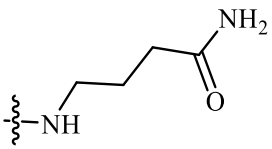
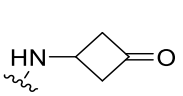

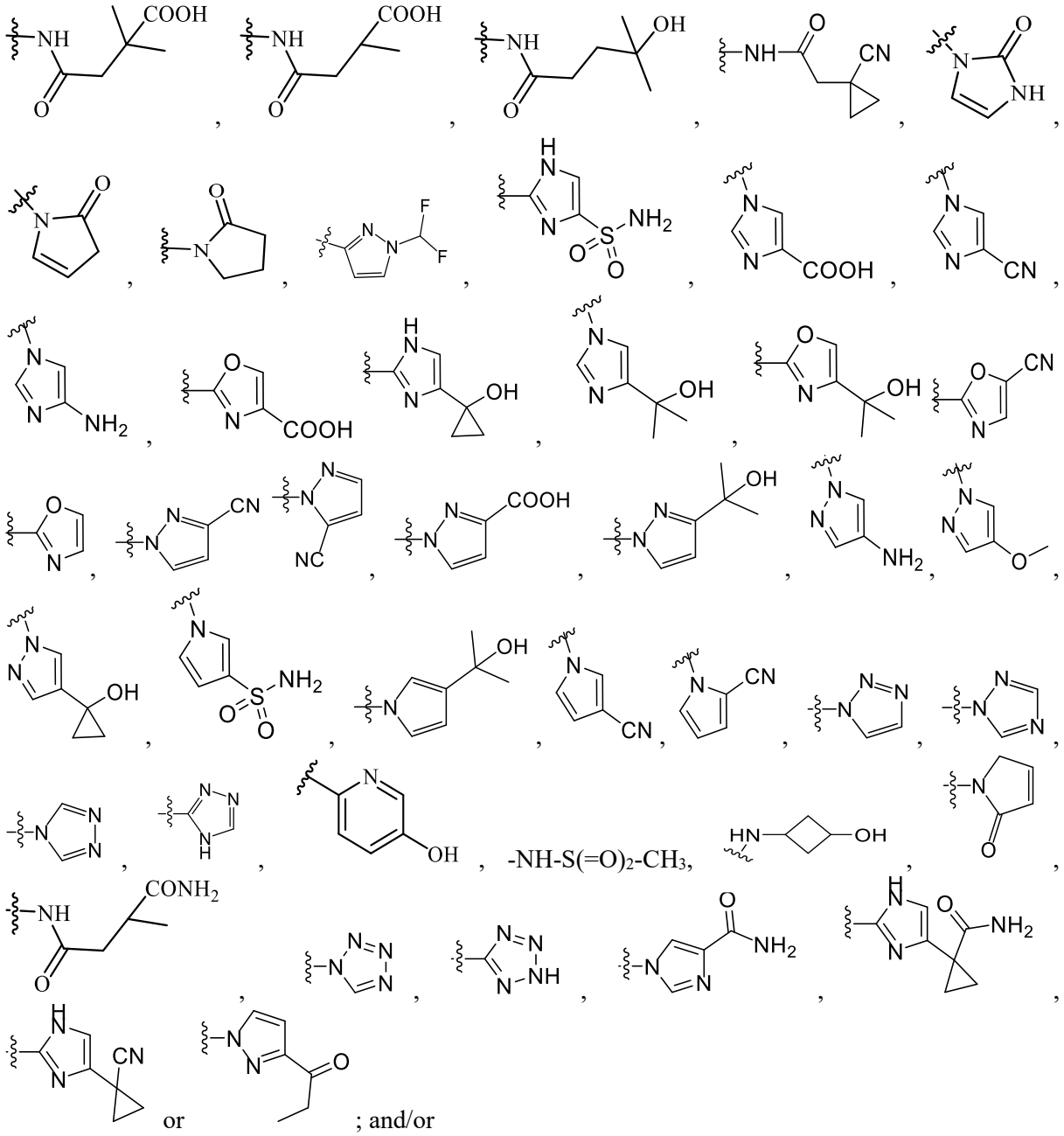

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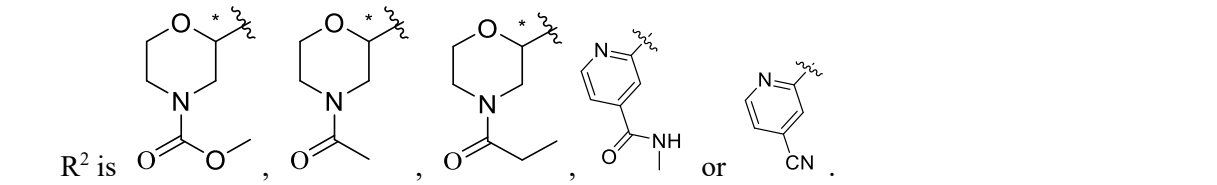


; and/or

R^2 is .

8. The heterocyclic compound of formula I or the stereoisomer, the geometric isomer, the tautomer, the nitrogen oxide, the hydrate, the solvate, the ester, or the pharmaceutically acceptable salt thereof according to claim 1, wherein

R^3 is halogen, -CHF_2, -CH_2F or a C_1-C_6 alkyl;

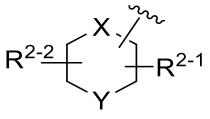
Q is -NH-C(=O)-R^{1-1}, an unsubstituted or substituted C_3-C_{10} cycloalkyl, an unsubstituted or substituted C_3-C_9 heterocycloalkyl, or an unsubstituted or substituted 5-10 membered heteroaryl,

wherein the C_3-C_9 heterocycloalkyl contains 1-3 heteroatoms selected from one or more of O, S and N, the 5-10 membered heteroaryl contains 1-3 heteroatoms selected from one or more of N, O and S; the substituted C_3-C_{10} cycloalkyl, the substituted C_3-C_9 heterocycloalkyl or the substituted 5-10 membered heteroaryl is substituted with one or more substituents independently selected from the following: -N($R^{1-21}R^{1-22}$), -C(=O)-N($R^{1-23}R^{1-24}$), -S(=O)$_2$-N($R^{1-25}R^{1-26}$) or -C(=O)-O-R^{1-27}, wherein when a plurality of substituents are present, they are the same or different;

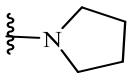
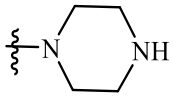
R^{1-1}, R^{1-21}, R^{1-22}, R^{1-23}, R^{1-24}, R^{1-25}, R^{1-26} and R^{1-27} are each independently H, an unsubstituted or substituted C_1-C_6 alkyl, an unsubstituted or substituted C_2-C_6 alkynyl, an unsubstituted or substituted C_3-C_{10} cycloalkyl, an unsubstituted or substituted C_3-C_9 heterocycloalkyl, or an unsubstituted or substituted 5-10 membered heteroaryl, wherein the C_3-C_9 heterocycloalkyl contains 1-3 heteroatoms selected from one or more of O, S and N, the 5-10 membered heteroaryl contains 1-3 heteroatoms selected from one or more of N, O and S; and the substituted C_1-C_6 alkyl, the substituted C_2-C_6 alkynyl, the substituted C_3-C_9 heterocycloalkyl or the substituted 5-10 membered heteroaryl is substituted with one or more substituents independently selected from the following: halogen, -OH, -CN, =O, -COOH, -C(=O)NH_2, -$COOCH_3$, -NH_2, and a C_1-C_6 alkyl, a C_1-C_6 alkyl-O- or a C_3-C_6 cycloalkyl that is unsubstituted or substituted with one or more R^d, wherein when a plurality of R^d are present, they are the same or different, and each R^d is independently H, halogen, -OH, =O, -CF_3, -CN, -COOH or -C(=O)NH_2; and when a plurality of substituents are present, they are the same or different; or

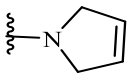
R^3 is halogen, a C_1-C_6 haloalkyl or a C_1-C_6 alkyl;

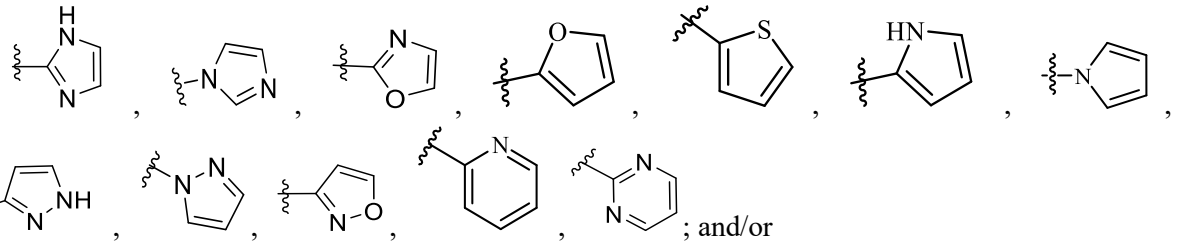
Q is -NH-C(=O)-R^{1-1}, -S(=O)$_2$-N($R^{1-9}R^{1-10}$), an unsubstituted or substituted C_3-C_{10} cycloalkyl, an unsubstituted or substituted C_3-C_9 heterocycloalkyl, an unsubstituted or substituted C_3-C_9 heterocycloalkenyl, or an unsubstituted or substituted 5-10 membered heteroaryl, wherein the C_3-C_9 heterocycloalkyl contains 1-3 heteroatoms selected from one or more of O, S and N, the C_3-C_9 heterocycloalkenyl contains 1-3 heteroatoms selected from one or more of O, S and N, and the 5-10 membered heteroaryl contains 1-3 heteroatoms selected from one or more of N, O and S; the substituted C_3-C_{10} cycloalkyl, the substituted C_3-C_9 heterocycloalkyl, the substituted C_3-C_9 heterocycloalkenyl or the substituted 5-10 membered heteroaryl is substituted with one or more substituents independently selected from the following: -OH, -CF_3, -CN, -N($R^{1-21}R^{1-22}$), -C(=O)-N($R^{1-23}R^{1-24}$), -S(=O)$_2$-N($R^{1-25}R^{1-26}$), -C(=O)-O-R^{1-27}, =O (i.e., two geminal hydrogens on a carbon atom are substituted with the group O), and a C_1-C_6 alkyl, a C_1-C_6 alkyl-O- or a C_3-C_6 cycloalkyl that is unsubstituted or substituted with one or more R^a, wherein when a plurality of R^a are present, they are the same or different, and each R^a is halogen, -OH or -COOH; and when a plurality of substituents are present, they are the same or different;

R^2 is independently  , or an unsubstituted or substituted 5-6 membered heteroaryl; wherein the 5-6 membered heteroaryl contains 1-3 heteroatoms selected from one or more of N, O and S, and the substituted 5-6 membered heteroaryl is substituted with one or more substituents independently selected from the following: halogen, -OH, -CN, an unsubstituted or halogen-substituted C_1-C_6 alkyl, an unsubstituted or halogen-substituted C_1-C_6 alkyl-O-, $-C(=O)R^{2-7}$ or $-C(=O)N(R^{2-8}R^{2-9})$, wherein when a plurality of substituents are present, they are the same or different.

9. The heterocyclic compound of formula I or the stereoisomer, the geometric isomer, the tautomer, the nitrogen oxide, the hydrate, the solvate, the ester, or the pharmaceutically acceptable salt thereof according to claim 2, wherein

when Q is an unsubstituted or substituted C_3-C_5 heterocycloalkyl, the C_3-C_5 heterocycloalkyl is a C_4-C_5 heterocycloalkyl, wherein the C_4-C_5 heterocycloalkyl contains 1-2 heteroatoms selected from one or more of N, O and S; and the C_3-C_5 heterocycloalkyl is  or  ; and/or

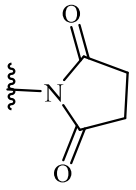
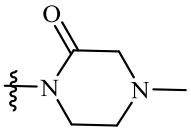
when Q is an unsubstituted or substituted C_3-C_5 heterocycloalkenyl, the C_3-C_5 heterocycloalkenyl is a C_4-C_5 heterocycloalkenyl, wherein the C_4-C_5 heterocycloalkenyl contains 1-2 heteroatoms selected from one or more of N, O and S, and the C_4-C_5 heterocycloalkenyl is  ; and/or

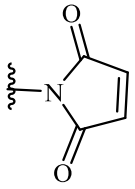
when Q is an unsubstituted or substituted 5-6 membered heteroaryl, the 5-6 membered heteroaryl is  ; and/or

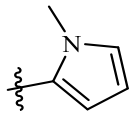
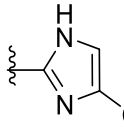
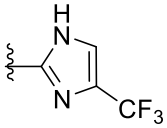
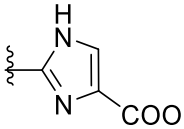
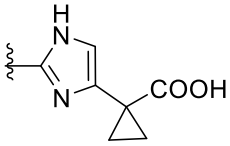
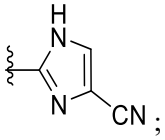
when Q is a substituted C_3-C_5 heterocycloalkyl, a substituted C_3-C_5 heterocycloalkenyl, or a substituted 5-6 membered heteroaryl, and the substituent is halogen, the halogen is fluorine; and/or

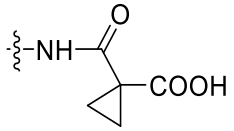
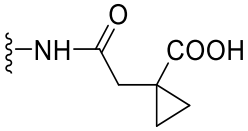
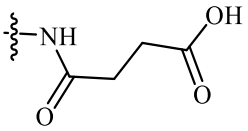
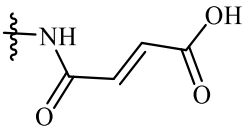
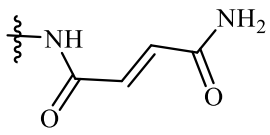
when Q isa substituted C_3-C_5 heterocycloalkyl, a substituted C_3-C_5 heterocycloalkenyl, or a substituted 5-6 membered heteroaryl, and the substituent is a C_1-C_6 alkyl or a C_1-C_6 alkyl-O- substituted with one or more R^a, the C_1-C_6 alkyl in the substituent is methyl.

10. The heterocyclic compound of formula I or the stereoisomer, the geometric isomer, the tautomer, the nitrogen oxide, the hydrate, the solvate, the ester, or the pharmaceutically acceptable salt

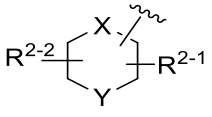
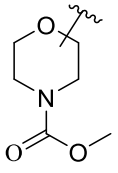
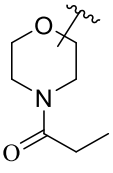
thereof according to any one of the preceding claims, wherein when Q is a substituted C_3-C_5 heterocycloalkyl, the substituted C_3-C_5 heterocycloalkyl is  or  ; and/or

when Q is a substituted C_3-C_5 heterocycloalkenyl, the substituted C_3-C_5 heterocycloalkenyl is  ; and/or

when Q is a substituted 5-6 membered heteroaryl, the substituted 5-6 membered heteroaryl is ,  ,  ,  ,  ,  or  ; and/or

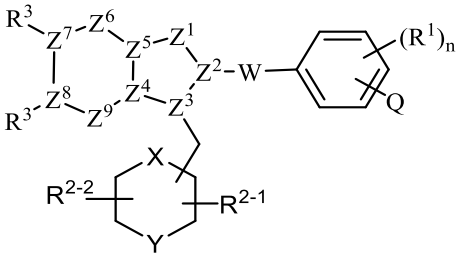
when Q is -NH-C(=O)-R^{1-1}, the -NH-C(=O)-R^{1-1} is -NH-C(=O)-CH_3, -NH-C(=O)-O-CH_3,  ,  ,  ,  or  ; and/or

when Q is -S(=O)$_2$-N($R^{1-9}R^{1-10}$), the -S(=O)$_2$-N($R^{1-9}R^{1-10}$) is -S(=O)$_2$-NH-CH_3; and/or

when R^2 is  , R^2 is  or  .

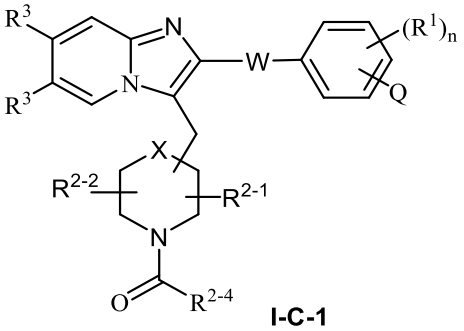
11. The heterocyclic compound of formula I or the stereoisomer, the geometric isomer, the tautomer, the nitrogen oxide, the hydrate, the solvate, the ester, or the pharmaceutically acceptable salt thereof according to any one of the preceding claims , wherein

the heterocyclic compound of formula I is of formula I-C as shown below:

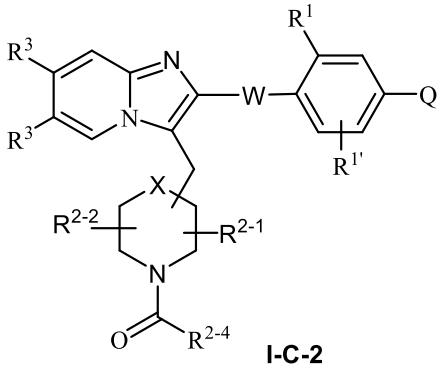


I-C ;

preferably, the heterocyclic compound of formula I is of formula I-C-1 as shown below:

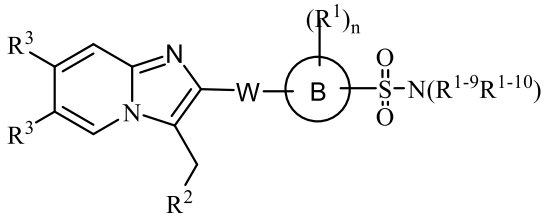


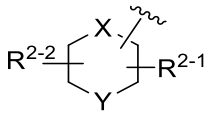
I-C-1 ; and more preferably, the heterocyclic compound of formula I is of formula I-C-2 as shown below:



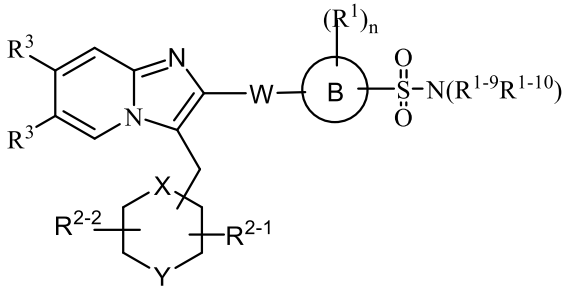
I-C-2

the heterocyclic compound of formula I is of formula I-E as shown below:

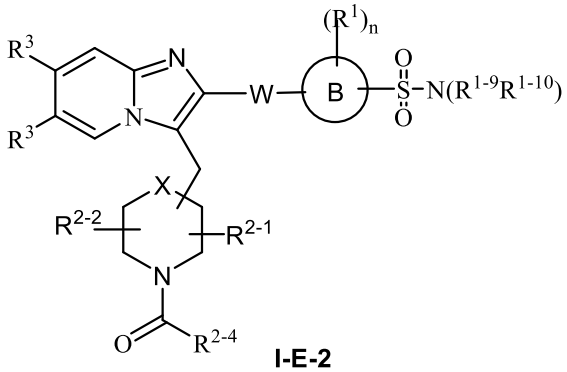


I-E ; wherein R^2 is independently  , or an unsubstituted or substituted 5-6 membered heteroaryl; for example, W is a single bond;

preferably, the heterocyclic compound of formula I is of formula I-E-1 as shown below:



I-E-1 ; for example,  is phenyl or 6 membered heteroaryl; and more preferably, the heterocyclic compound of formula I is of formula I-E-2 as shown below:



I-E-2 ; for example,  is phenyl.

12. The heterocyclic compound of formula I or the stereoisomer, the geometric isomer, the tautomer, the nitrogen oxide, the hydrate, the solvate, he ester, or the pharmaceutically acceptable salt thereof according to any one of the preceding claims, wherein

m is 1 or 2; and/or

R^3 is H, halogen, -OH, a C_1-C_6 haloalkyl or a C_1-C_6 alkyl; and/or

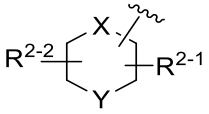
W is a single bond; and/or

n is 1 or 2; and/or

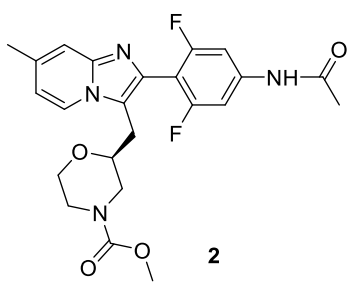
R^1 is independently H, halogen, -OH, -CN or an unsubstituted or substituted C_1-C_6 alkyl; and/or

the substituent in R^1 is independently one or more selected from the following: halogen, -OH, -CN or -C(=O)NH_2; and/or

Q is -NH-C(=O)-R^{1-1}, -S(=O)$_2$-N($R^{1-9}R^{1-10}$), -NH-S(=O)$_2$-R^{1-16}, or an unsubstituted or substituted 5-10 membered heteroaryl an unsubstituted or substituted C_3-C_9 heterocycloalkyl, an unsubstituted or substituted C_3-C_9 heterocycloalkenyl, or an unsubstituted or substituted 5-10 membered heteroaryl; and/or

R^2 is independently  .

13. The heterocyclic compound of formula I or the stereoisomer, the geometric isomer, the tautomer, the nitrogen oxide, the hydrate, the solvate, , the ester, or the pharmaceutically acceptable salt thereof according to any one of the preceding claims, wherein the heterocyclic compound of formula I is preferably any one of the following compounds:



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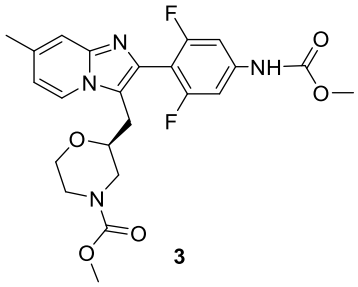

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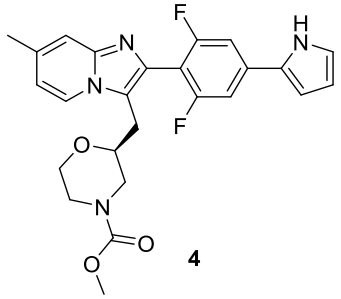

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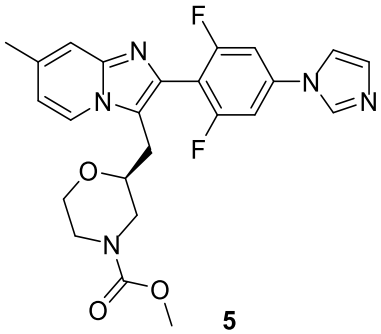

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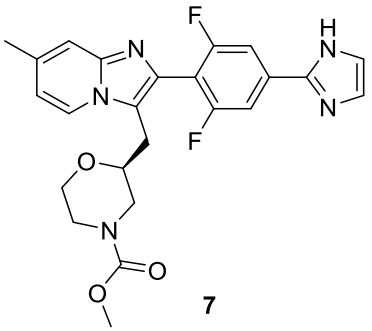

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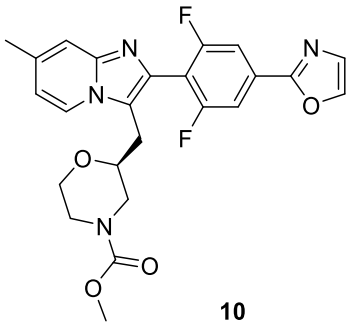

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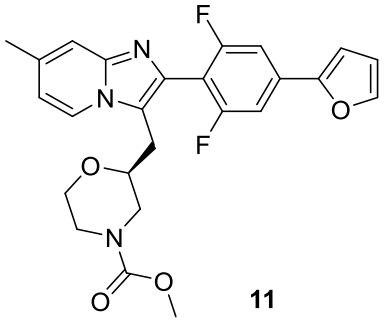

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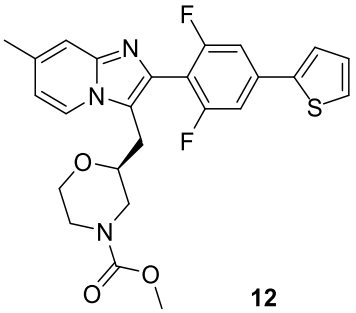

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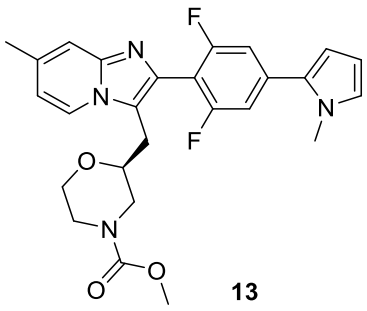

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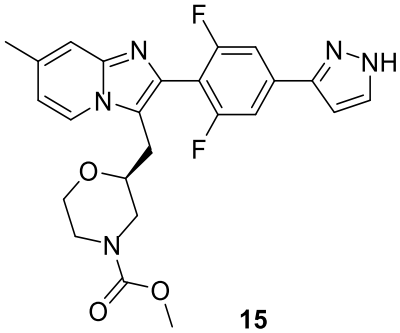

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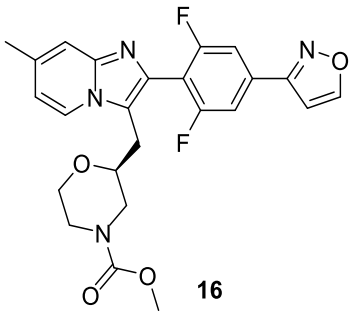

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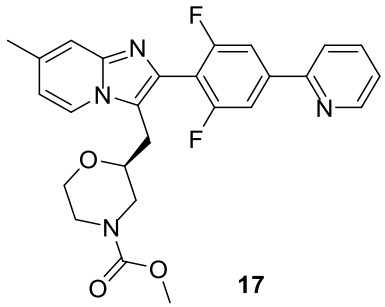

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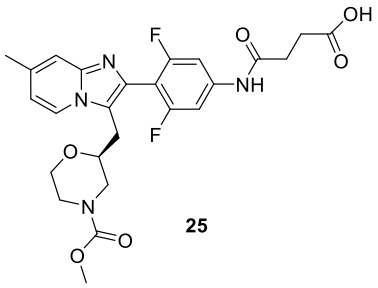

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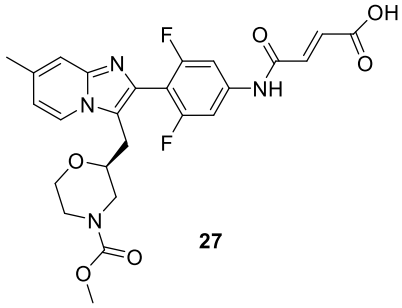

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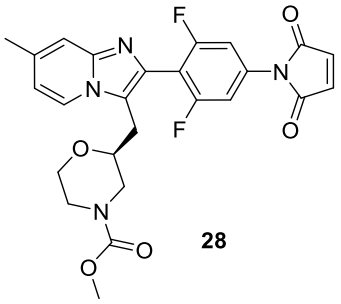

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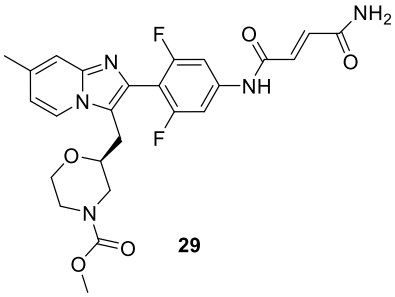

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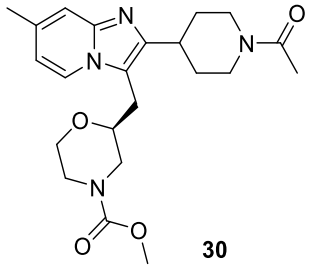

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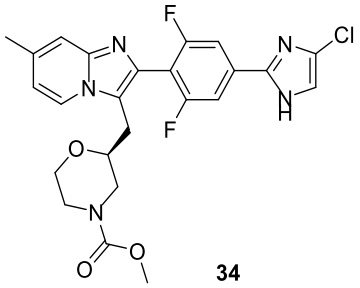

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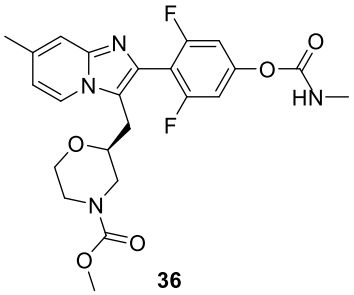

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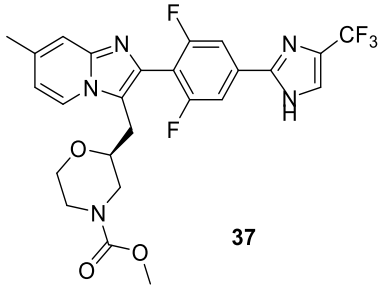

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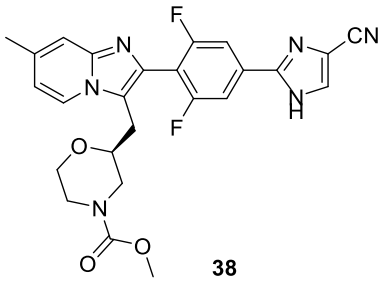

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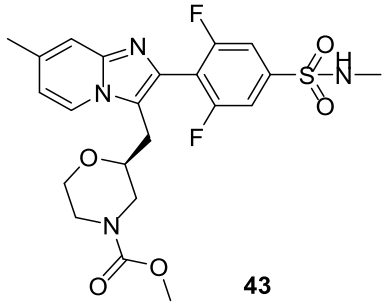

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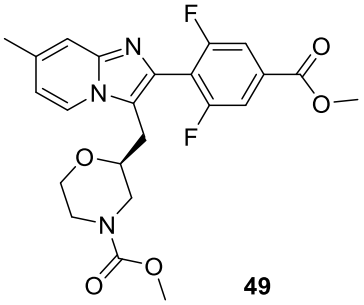

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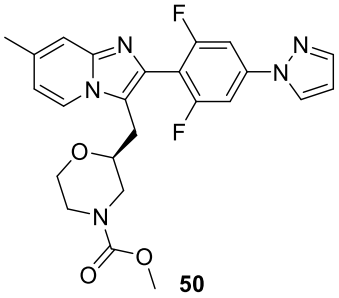

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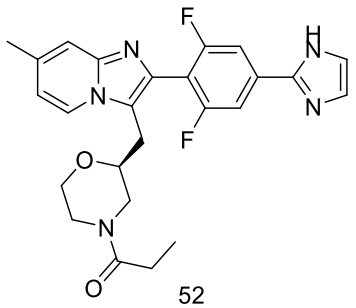
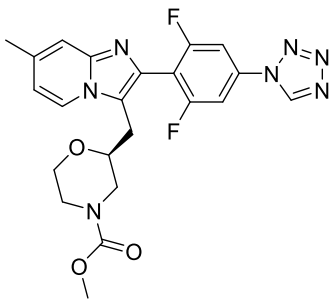
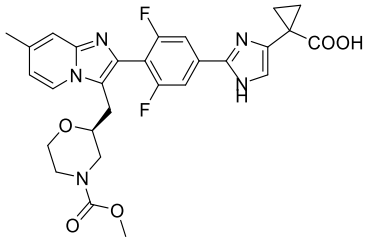


52 , , , , , , , 

58 , 

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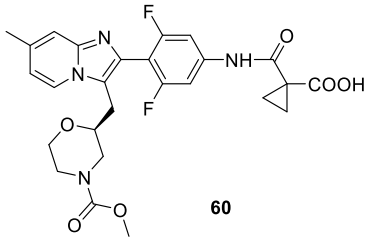
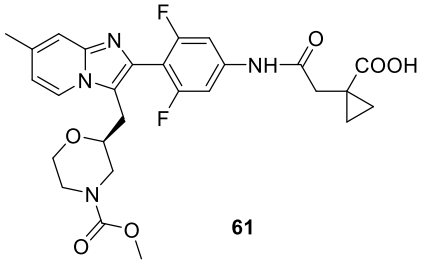
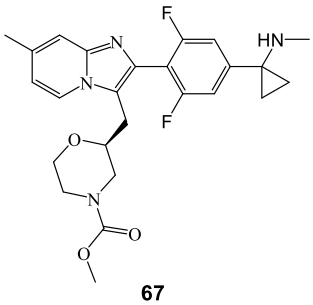


60 , 

61 , 

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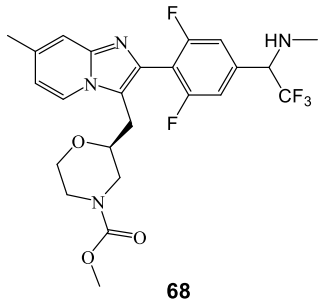
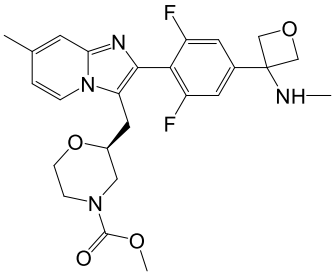
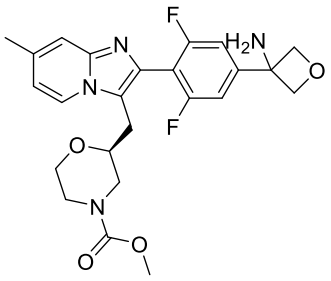


68 , 

69 , 

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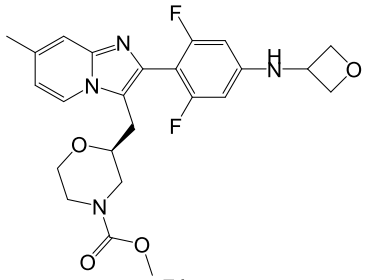
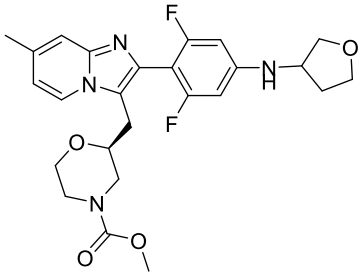
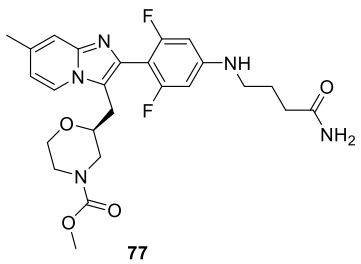


71 , 

75 , 

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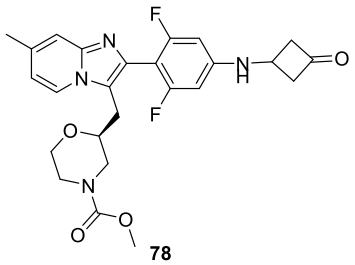
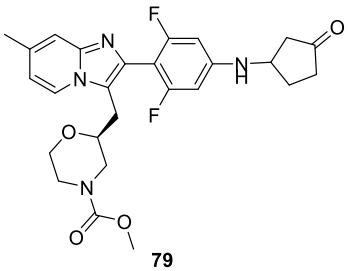
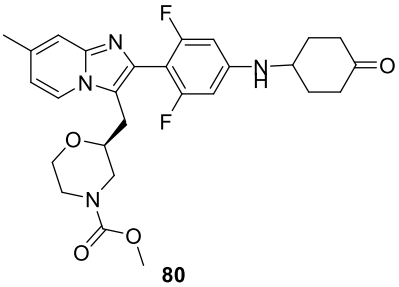


78 , 

79 , 

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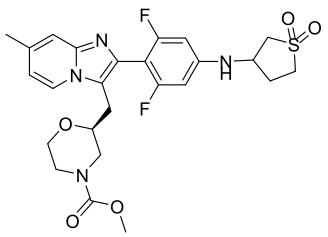

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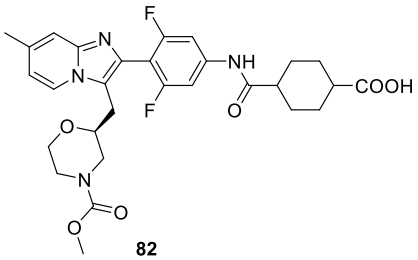

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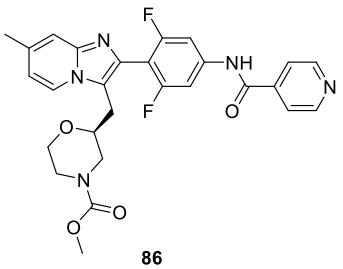

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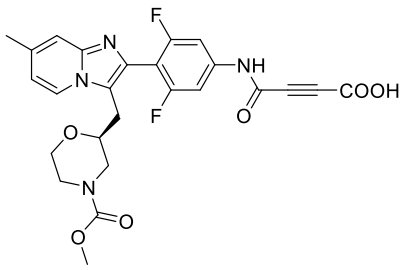

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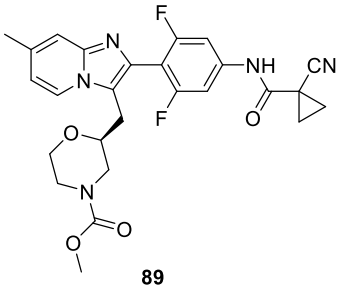

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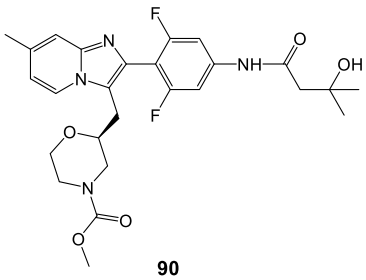

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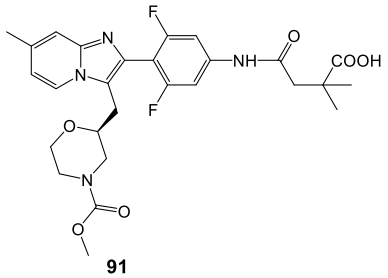

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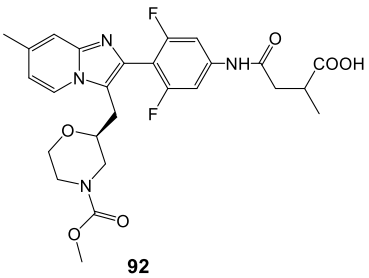

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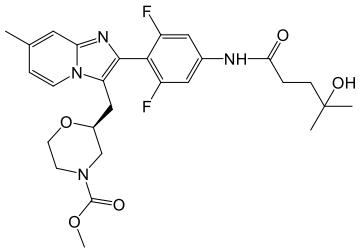

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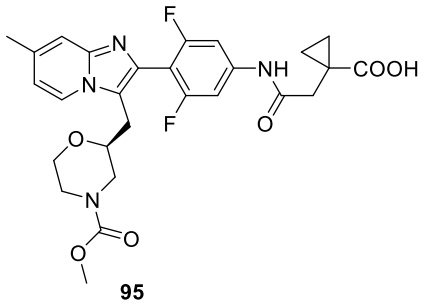

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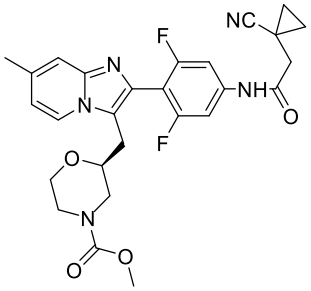

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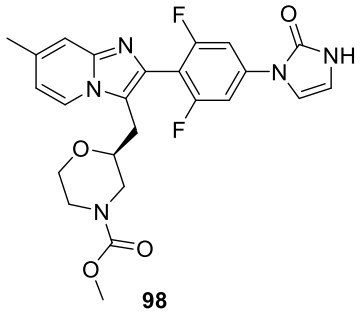

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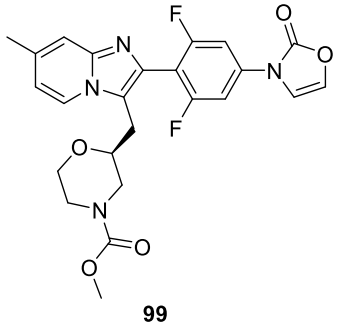

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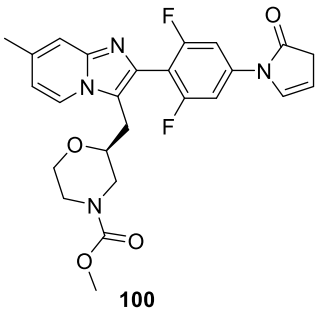

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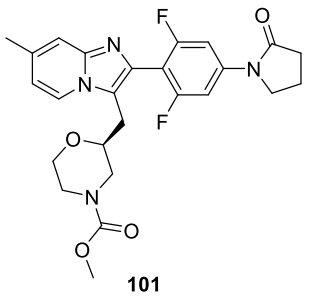

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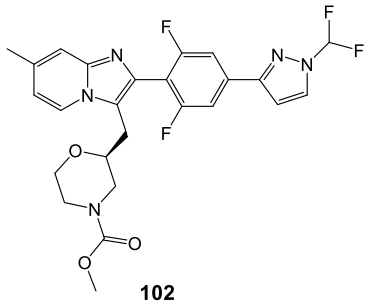

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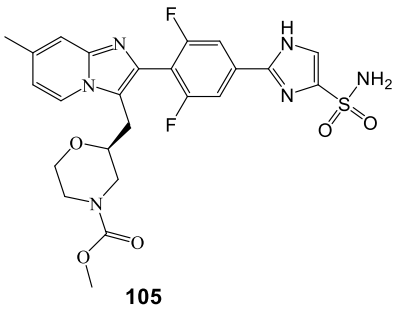

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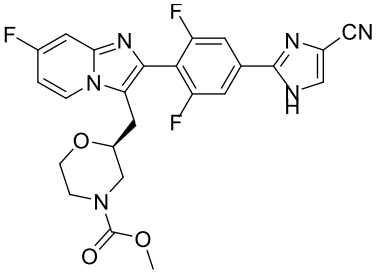

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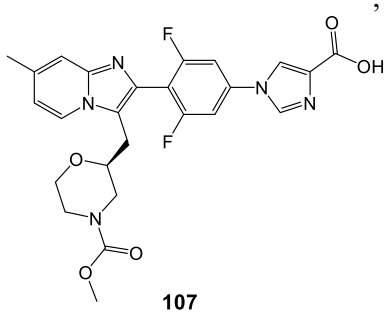

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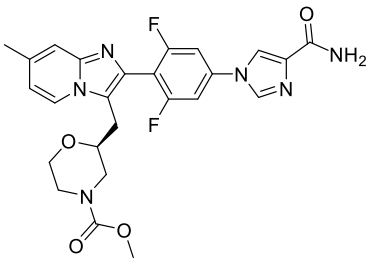

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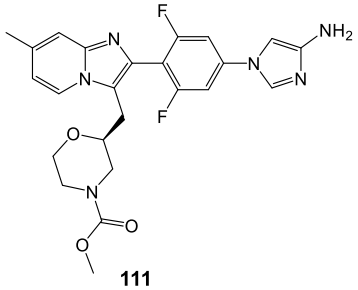

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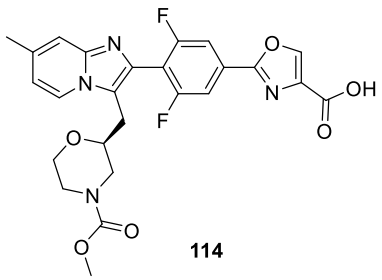

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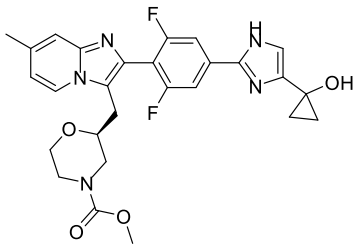

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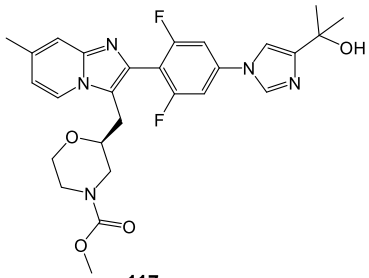

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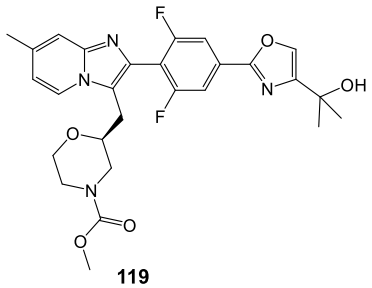

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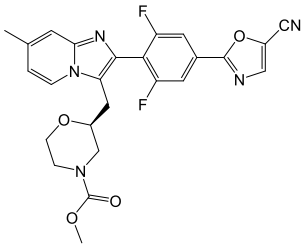

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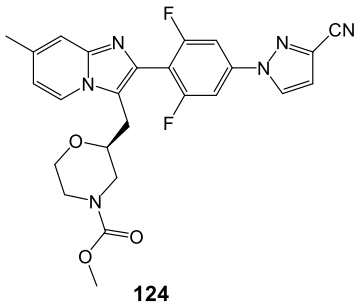

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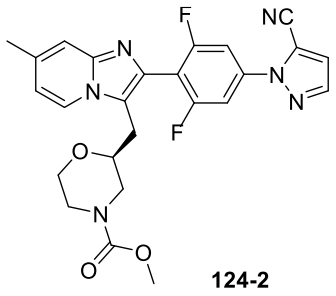

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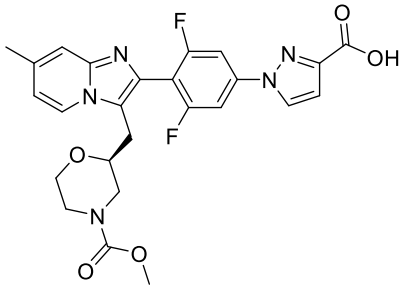

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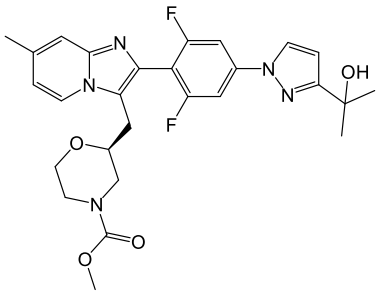

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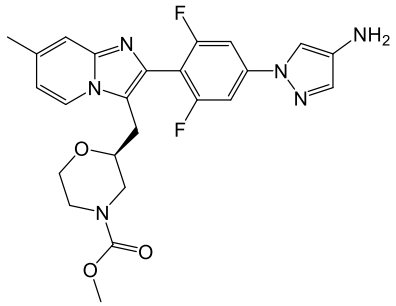

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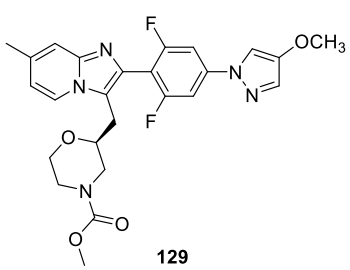

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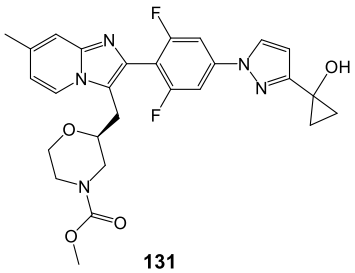

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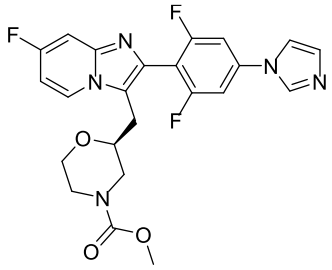

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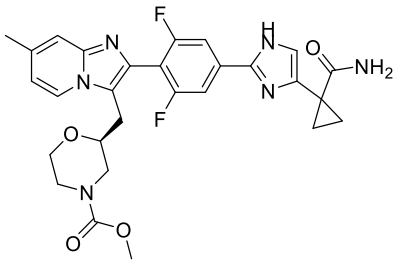

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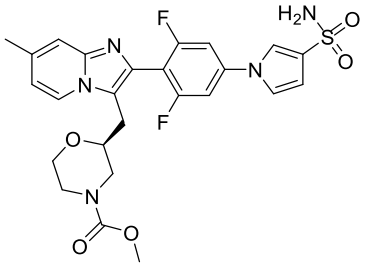

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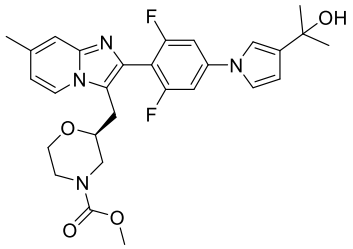

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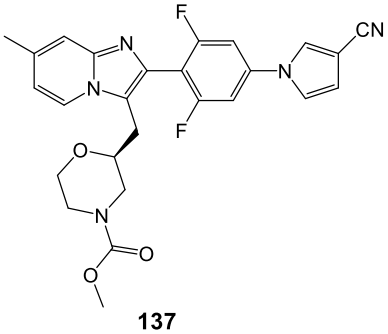

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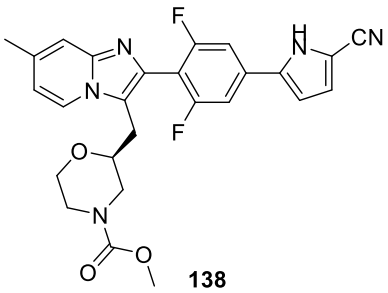

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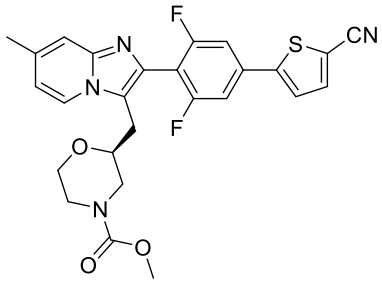

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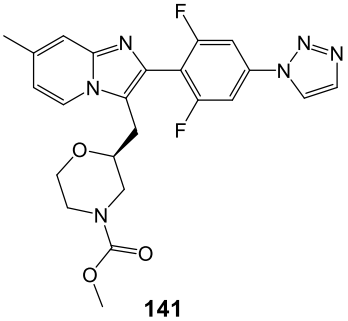

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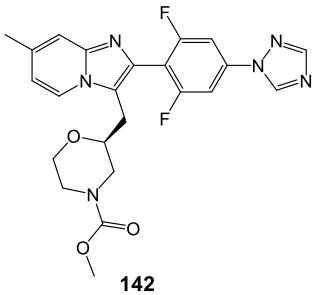

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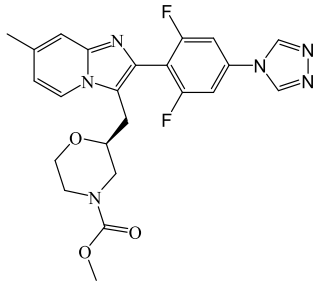

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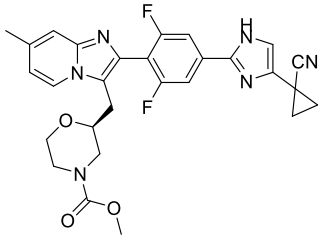

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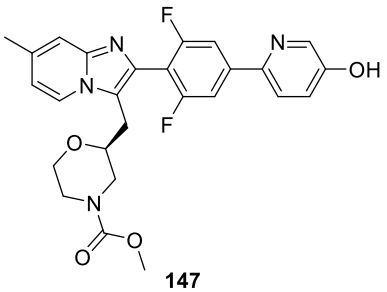

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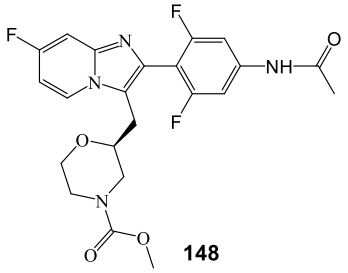

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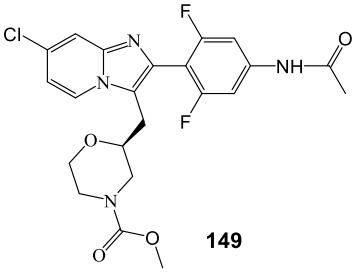

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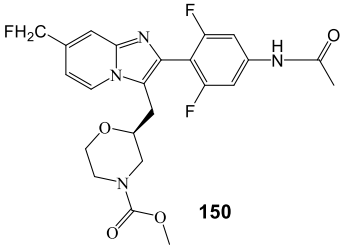

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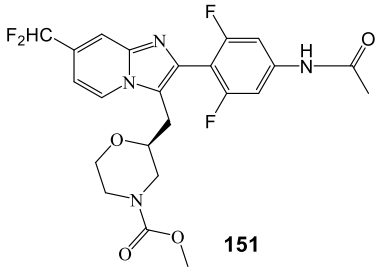

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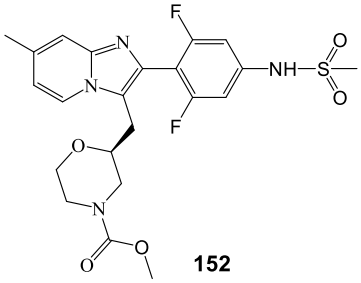

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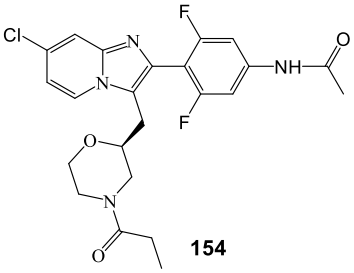

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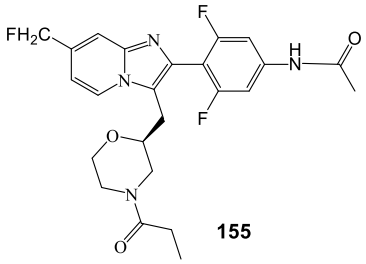

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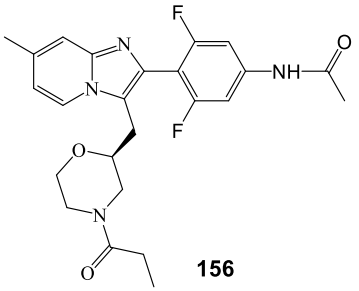

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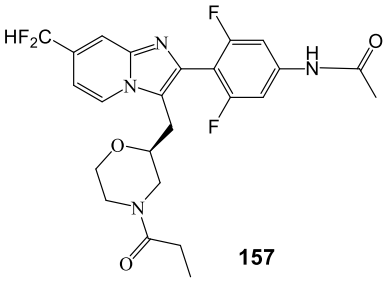

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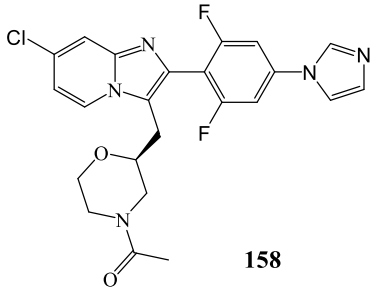

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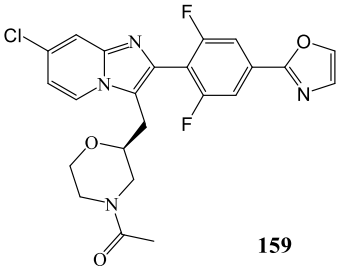

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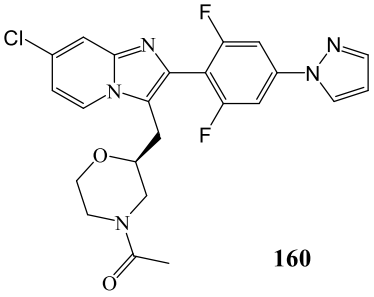

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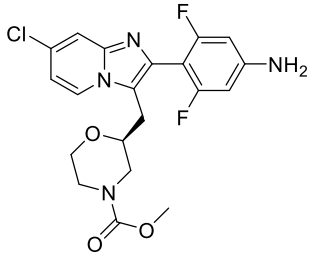

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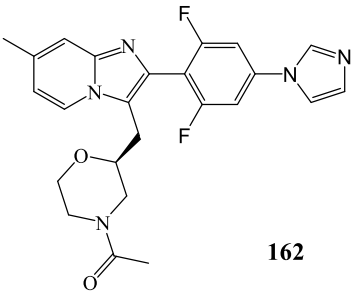

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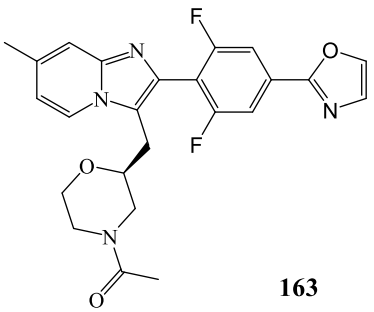

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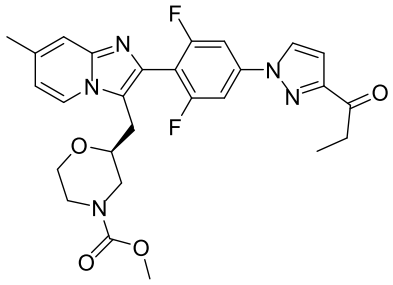

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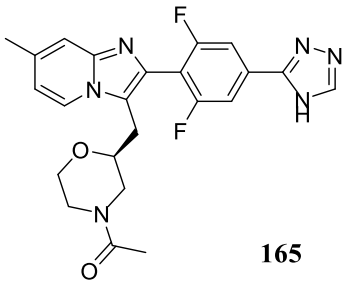

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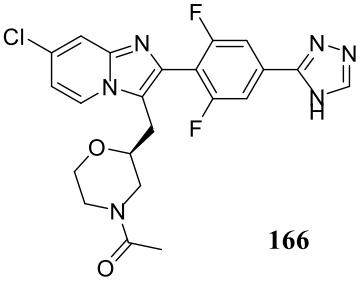

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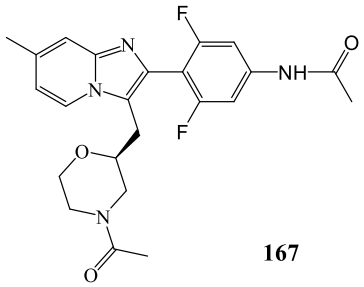

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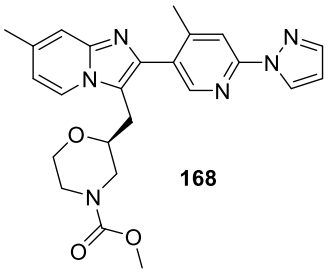

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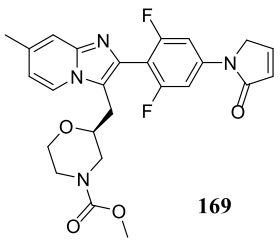

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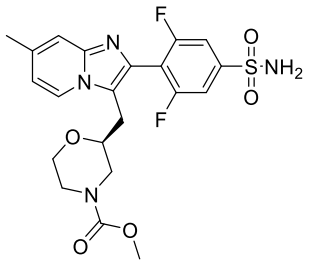

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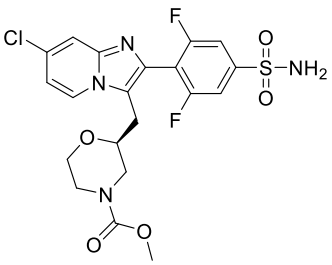

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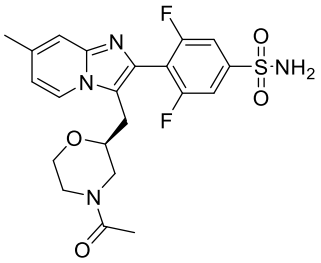

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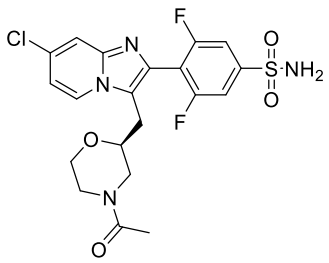

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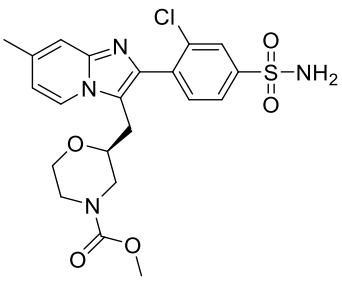

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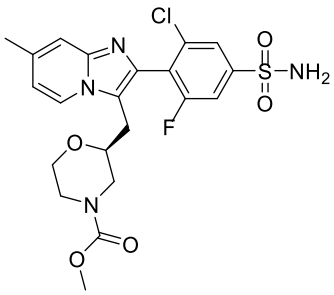

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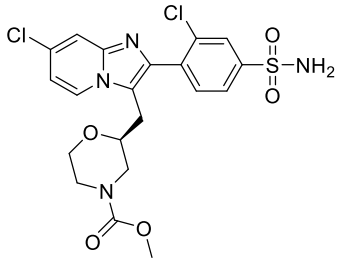

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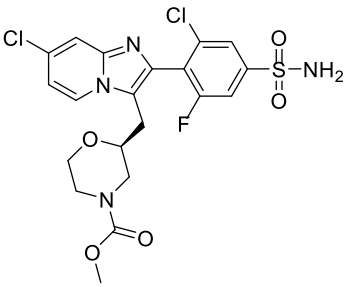

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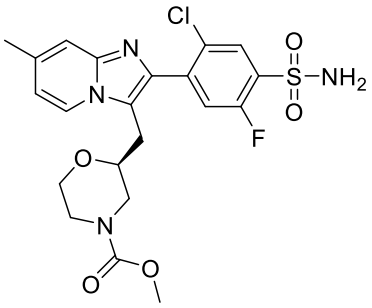

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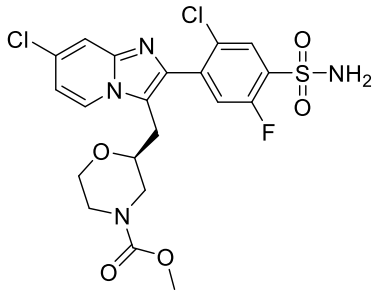

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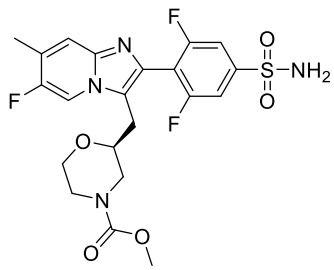

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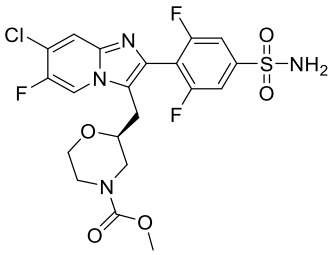

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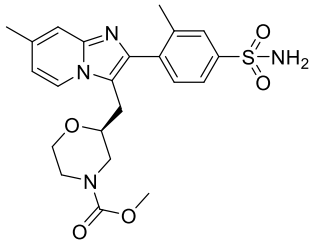

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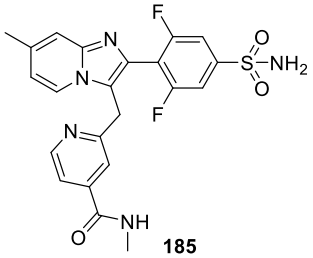

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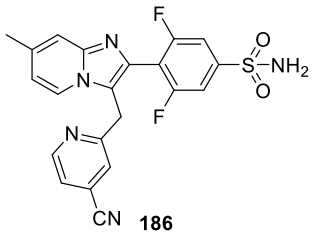

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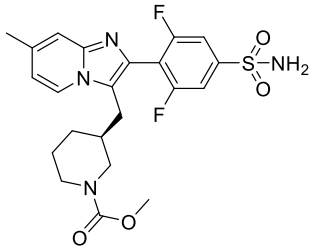

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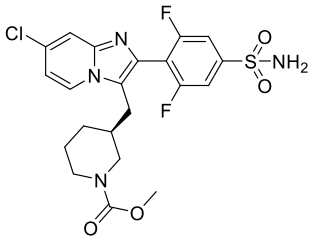

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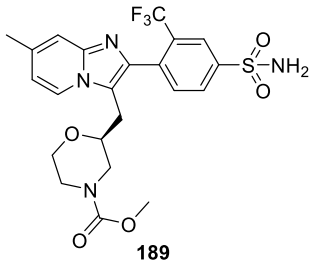

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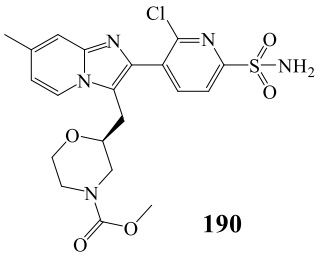

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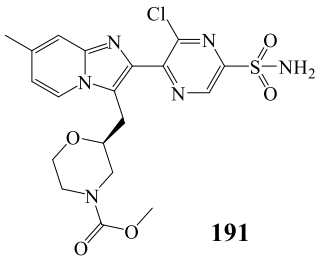

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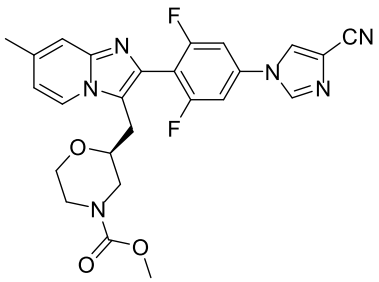
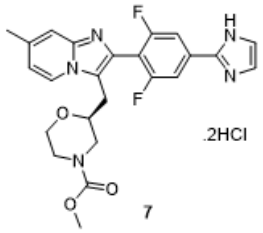


192 ; and

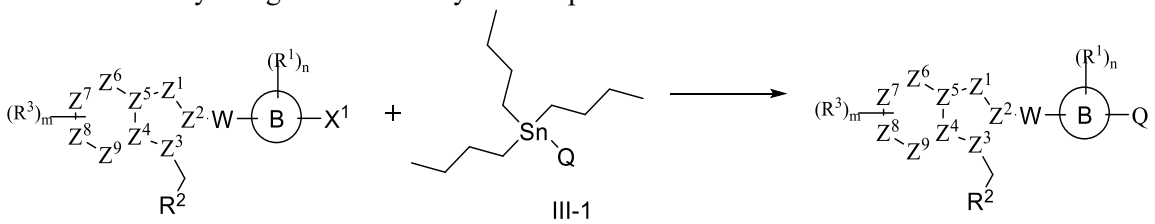
the pharmaceutically acceptable salt of the heterocyclic compound of the formula I is the following compound:



7 .

14. A preparation method of the heterocyclic compound of formula I according to any one of claims 1 to 13, wherein the preparation method is Scheme I, Scheme II, Scheme III, Scheme IV, Scheme V, Scheme VI, Scheme VII or Scheme VIII, wherein

Scheme I comprises the following step: performing Stille coupling reaction as shown below on a compound of formula II-1 and an organic tin reagent of formula III-1 in an organic solvent in the presence of a catalyst to give the heterocyclic compound of formula I:

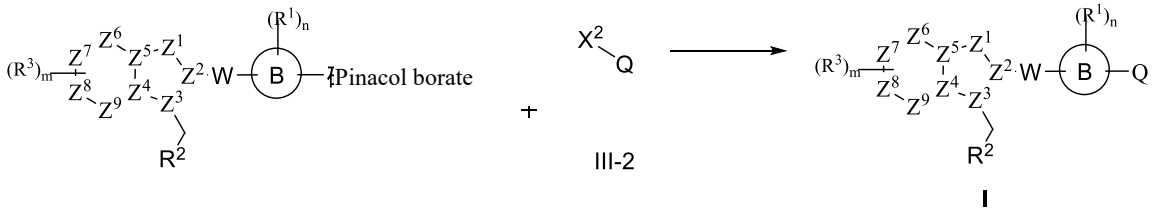


II-1 III-1 I

;

wherein X^1 is Br or Cl;

Scheme II comprises the following step: performing Suzuki coupling reaction as shown below on a compound of formula II-2 and a compound of formula III-2 in a solvent in the presence of a catalyst and a basic reagent to give the heterocyclic compound of formula I:

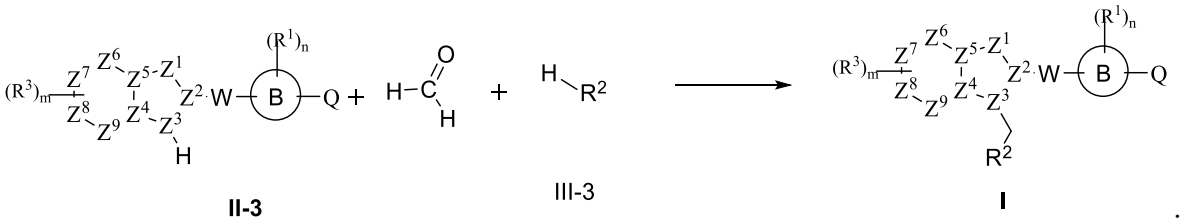


II-2 III-2 I

;

wherein X^2 is Br or Cl;

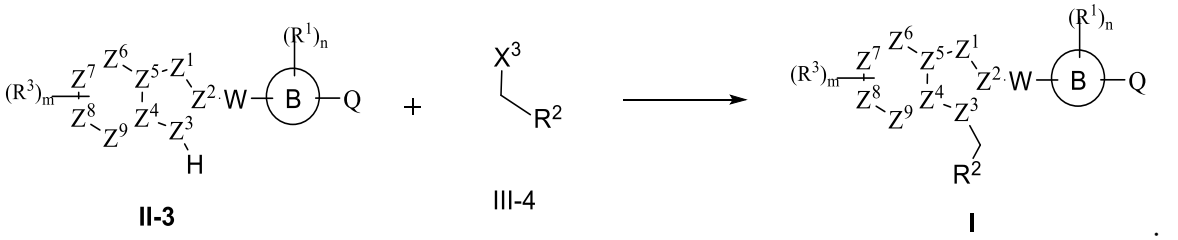
Scheme III comprises the following step: performing the reaction as shown below on a compound of formula II-3, a compound of formula III-3 and formaldehyde in an organic solvent to give the heterocyclic compound of formula I:



II-3 III-3 I

;

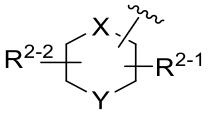
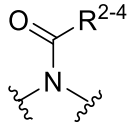
Scheme IV comprises the following step: performing the reaction as shown below on a compound of formula II-3 and a compound of formula III-4 in an organic solvent to give the heterocyclic compound of formula I:

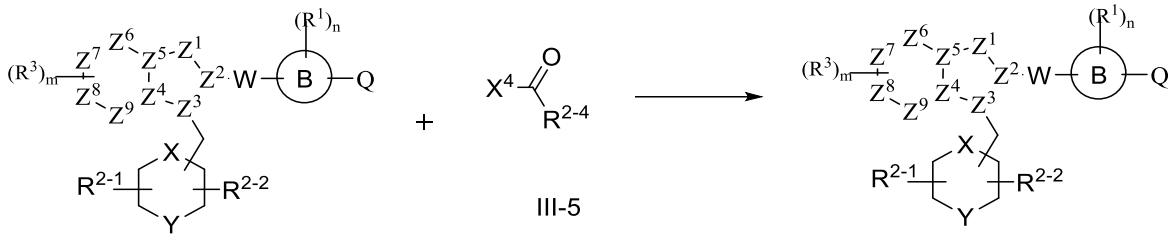


II-3 III-4 I

;

wherein X^3 is a leaving group;

Scheme V comprises the following step: performing amidation reaction as shown below on a compound of formula I, wherein R^2 is  and Y is -NH-, and a compound of formula III-5 in an organic solvent in the presence of a basic reagent to give the heterocyclic compound of formula I, wherein Y is  :

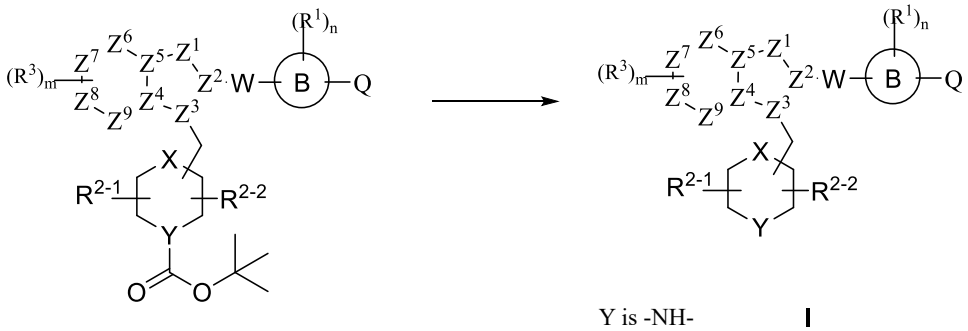


Y is -NH- **I** **III-5** **I** Y is

;

wherein X^4 is halogen;

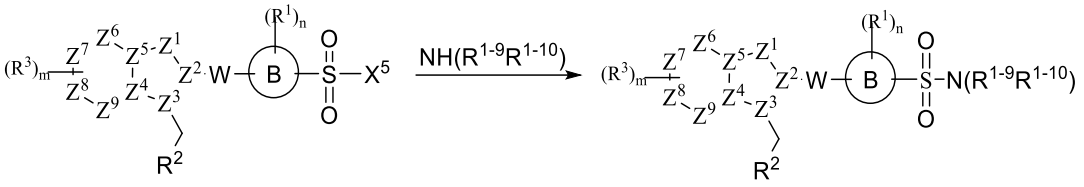
Scheme VI comprises the following step: performing deprotection reaction as shown below on a compound of formula II-4 and a compound of formula III-5 in an organic solvent in the presence of an acid to give the heterocyclic compound of formula I:



Y is -NH- **II-4** Y is -NH- **I**

wherein Y is -NH-;

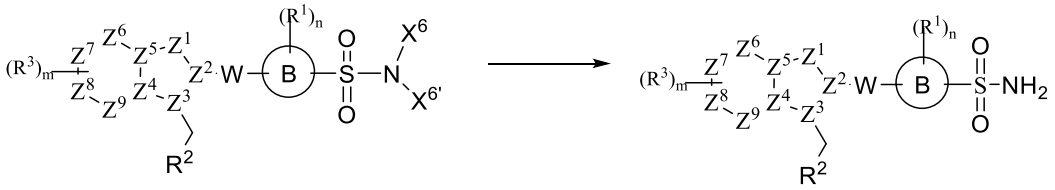
Scheme VII comprises the following step: performing substitution reaction as shown below on a compound of formula II-5 and $NH(R^{1-9}R^{1-10})$ in an organic solvent to give the heterocyclic compound of formula I, wherein Q is $-S(=O)_2-N(R^{1-9}R^{1-10})$:

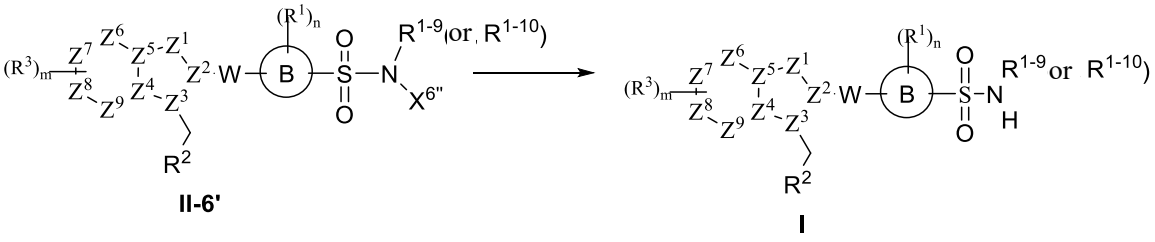


;

wherein X^5 is Br or Cl;

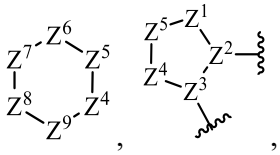
Scheme VIII comprises the following step: performing deprotection reaction as shown below on a compound of formula II-6 or formula II-6' in an organic solvent in the presence of an acid to give the heterocyclic compound of formula I:



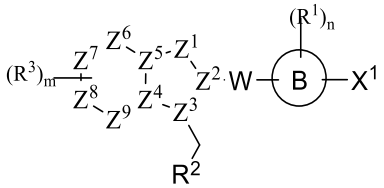


;

wherein X^6, $X^{6'}$ and $X^{6''}$ are N protecting groups; and

the  , ,  , R^3, R^2, R^1, W, X, Y, R^{2-1}, R^{2-2}, n and m have the definitions as defined in any one of claims 1 to 16.

15. A compound of formula II-1, II-2, II-3, II-4, II-5, II-6 or II-6':



II-1

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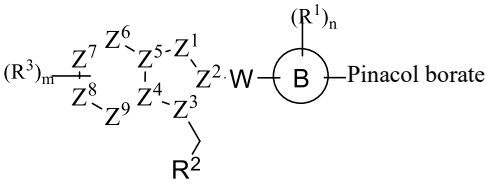

II-2

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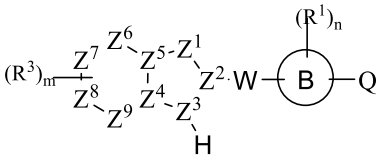

II-3

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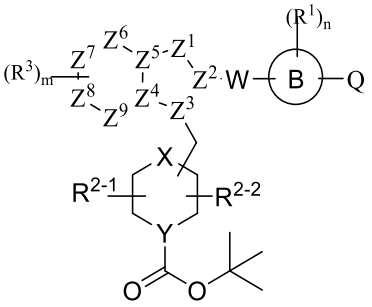

Y is -NH-

II-4

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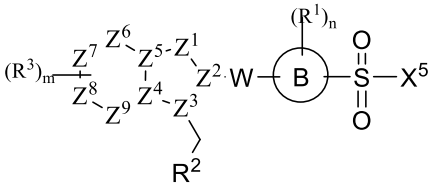

II-5

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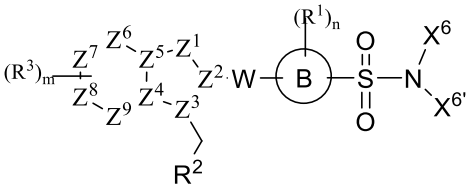
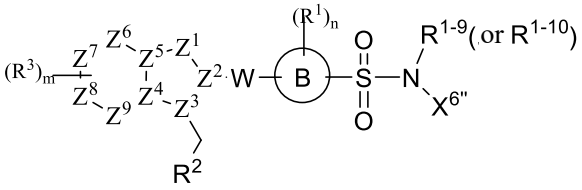


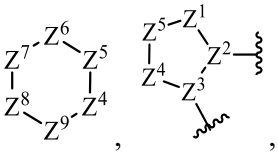
II-6

, or

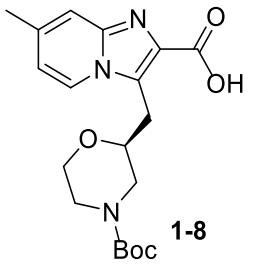


II-6'

;

wherein the  , ,  , R^3, R^2, R^1, W, X, Y, R^{2-1}, R^{2-2}, n and m have the definitions as defined in any one of claims 1 to 13, and X^1, X^5, X^6, $X^{6'}$ and $X^{6''}$ have the definitions as defined in claim 14.

16. Compounds as shown below:



1-8

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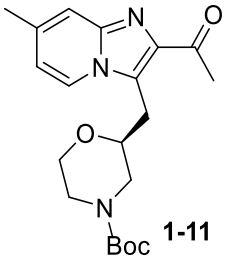

1-11

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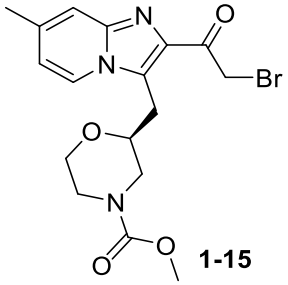

1-15

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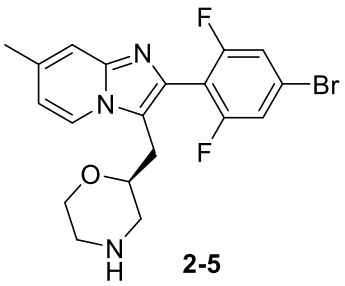

2-5

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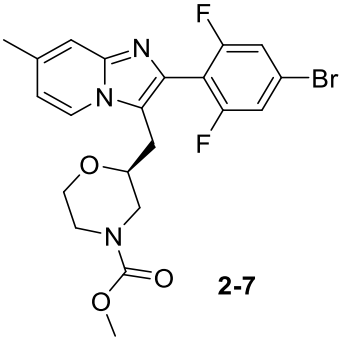

2-7

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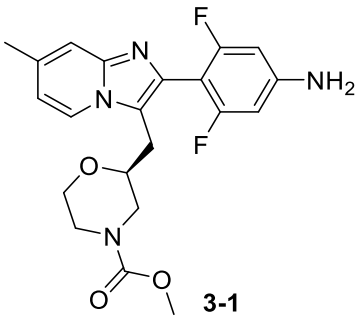

3-1

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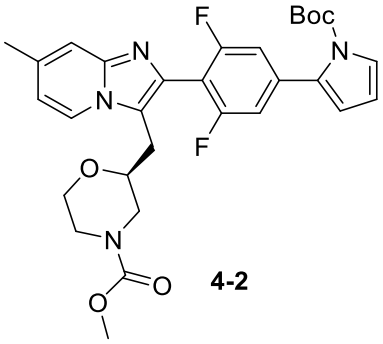

4-2

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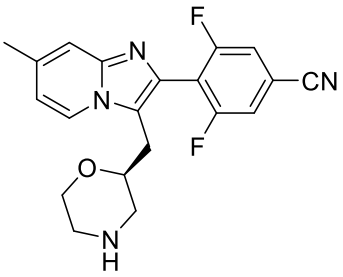

6-4

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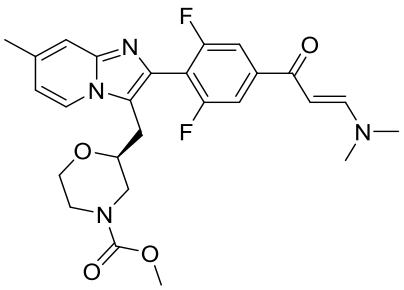

15-1

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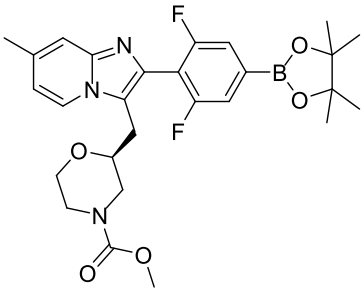

17-2

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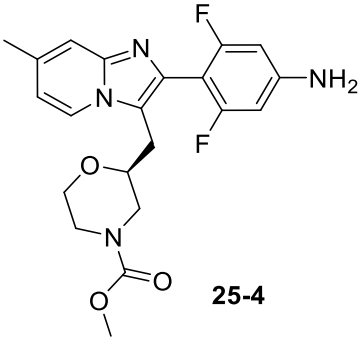

25-4

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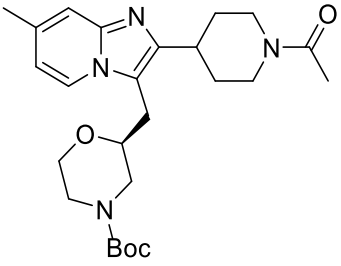

30-6

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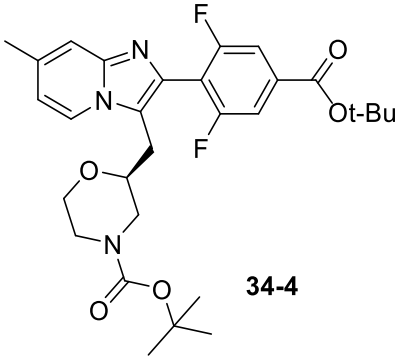

34-4

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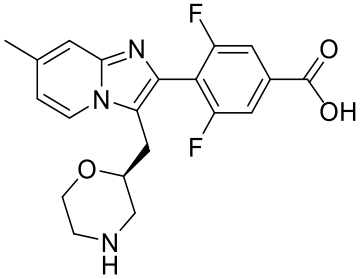

34-5

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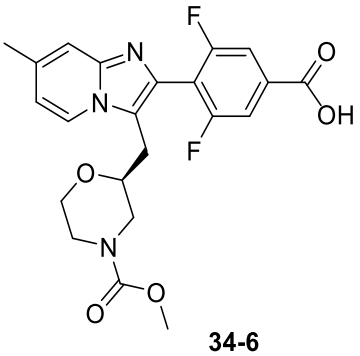

34-6

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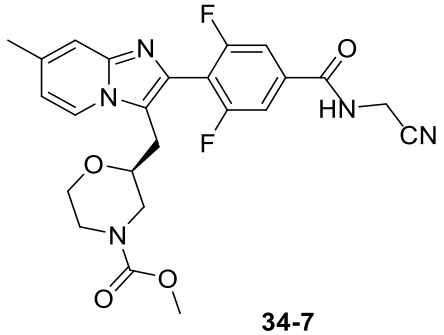

34-7

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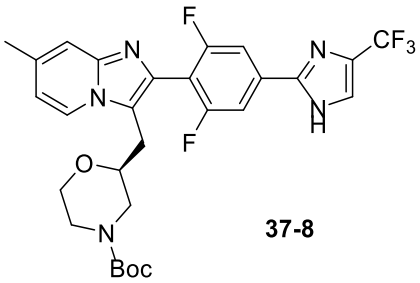

37-8

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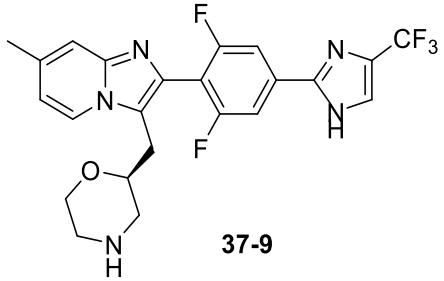

37-9

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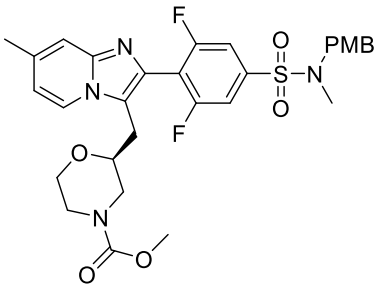

43-7

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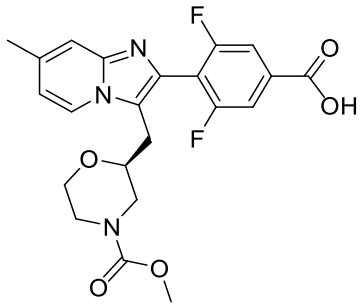

49-6

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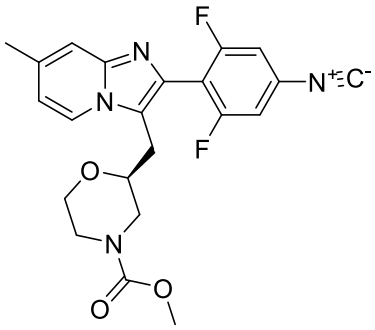

51-2

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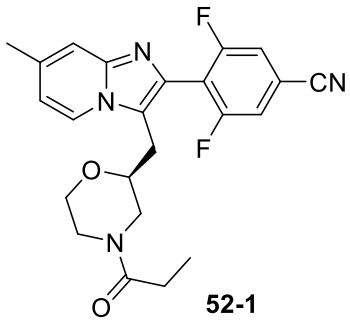

52-1

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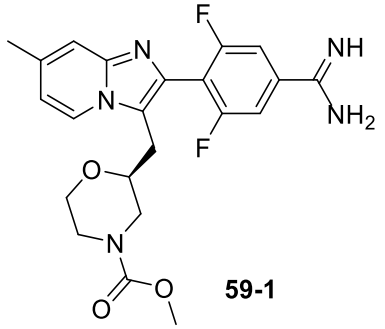

59-1

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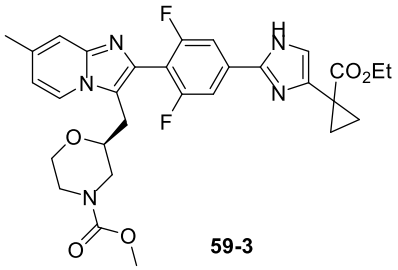

59-3

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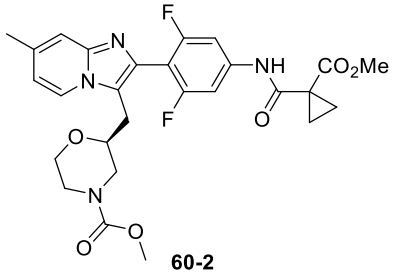

60-2

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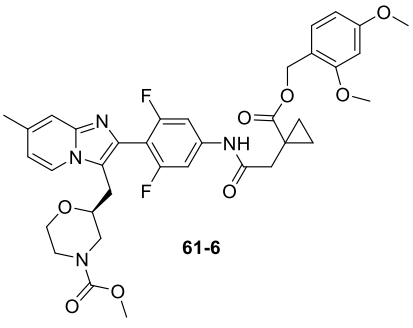

61-6

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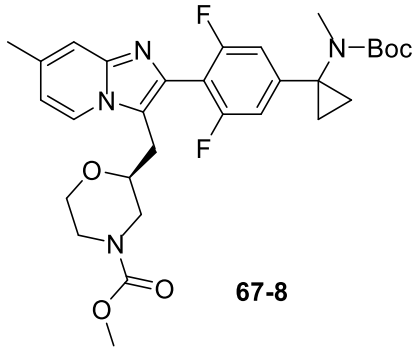

67-8

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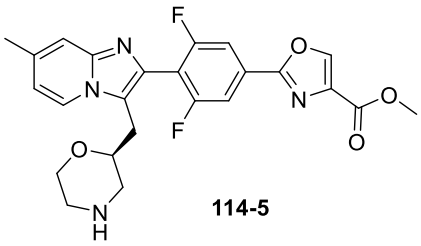

114-5

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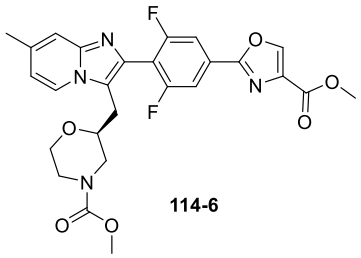

114-6

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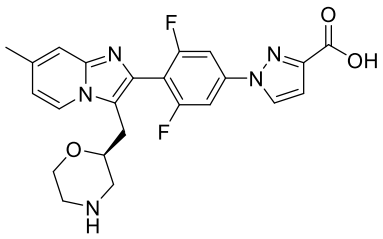

125-1

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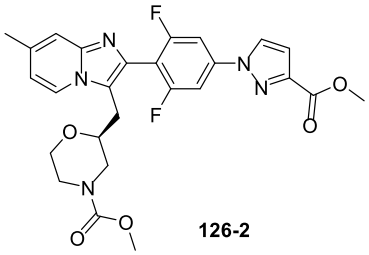

126-2

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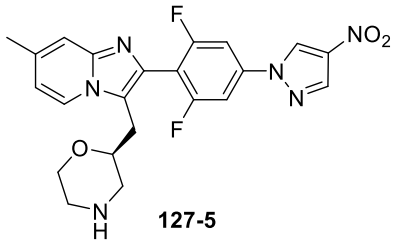

127-5

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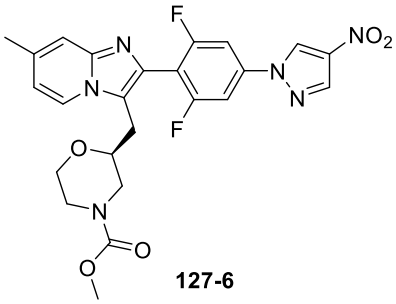

127-6

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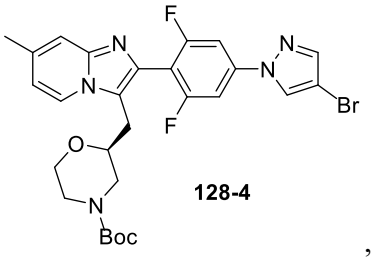

128-4

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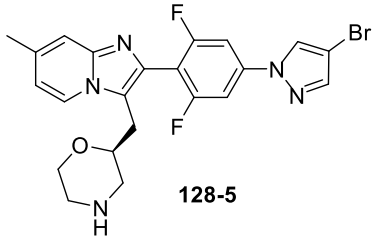

128-5

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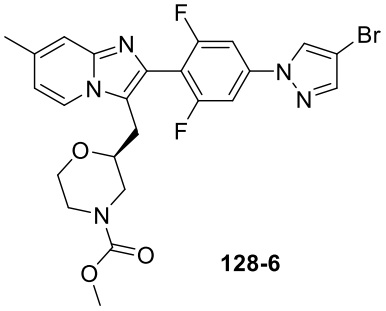

128-6

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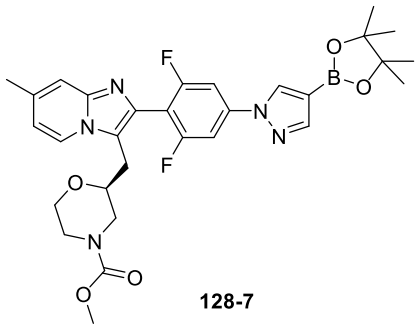

128-7

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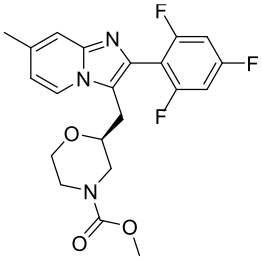

134-7

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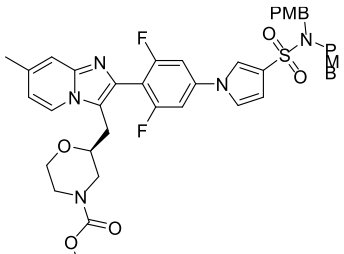

134-8

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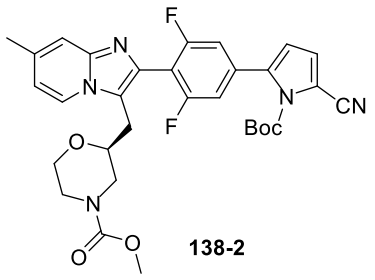
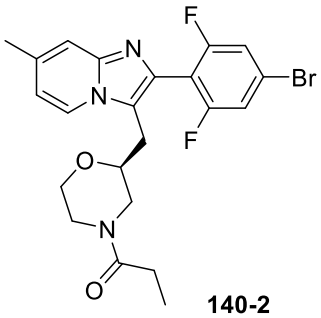
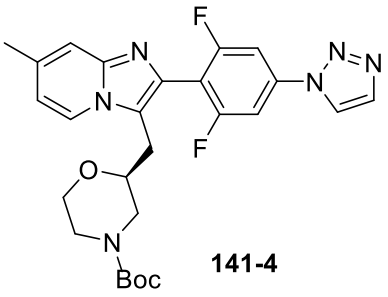


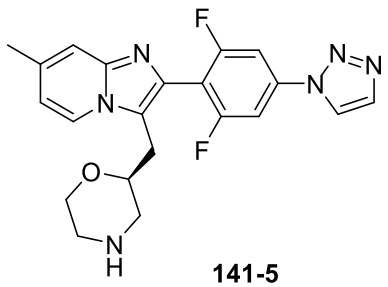
138-2 ,



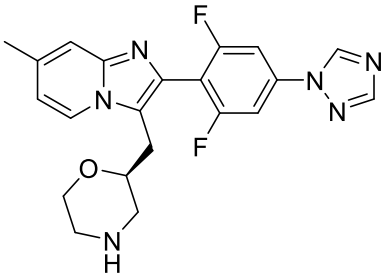
140-2 ,



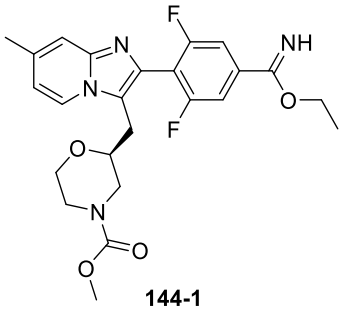
141-4 ,



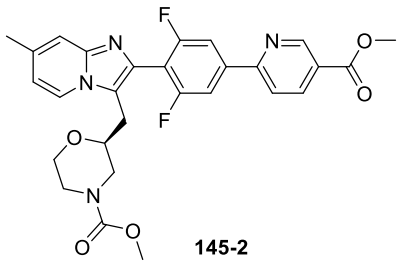
141-5 ,



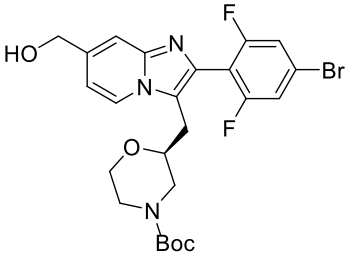
142-4 ,



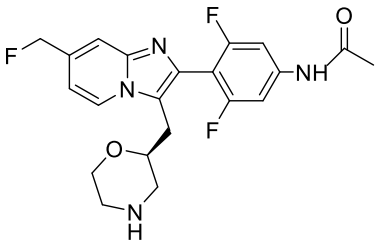
144-1 ,



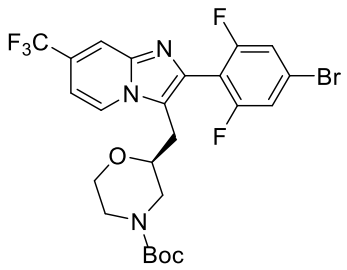
145-2 ,



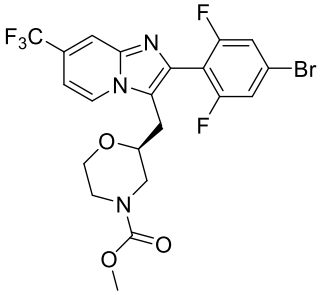
150-2 ,



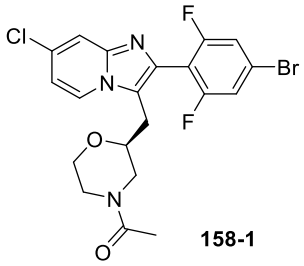
150-5 ,



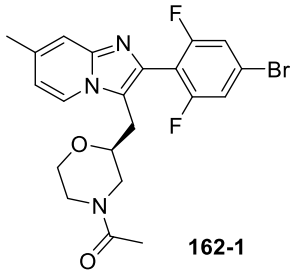
153-2 ,



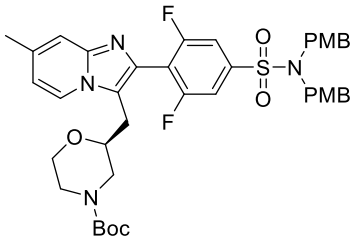
153-4 ,



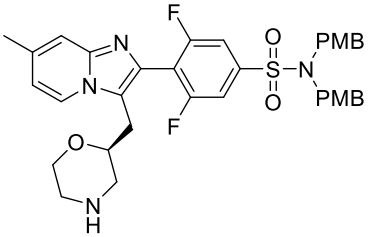
158-1 ,



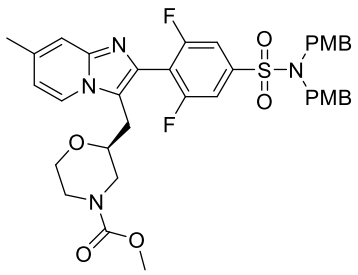
162-1 ,



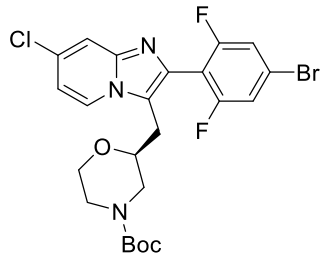
171-5 ,



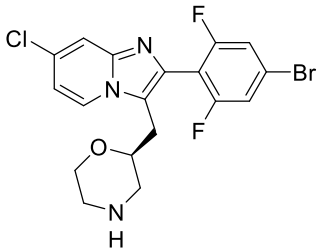
171-6 ,



171-7 ,



172-3 ,



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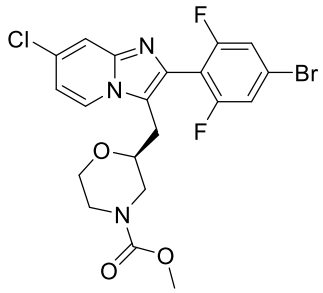

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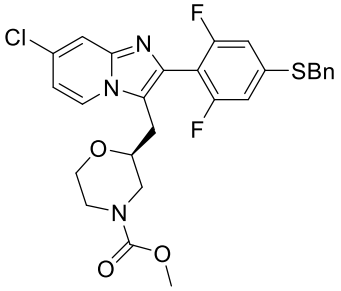

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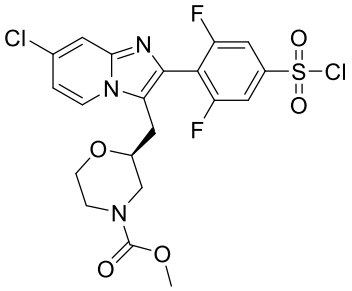

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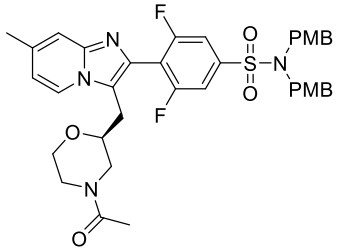

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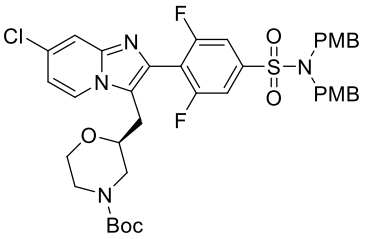
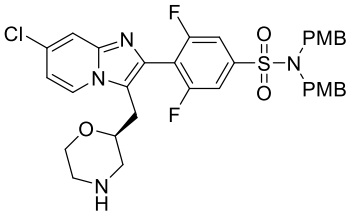
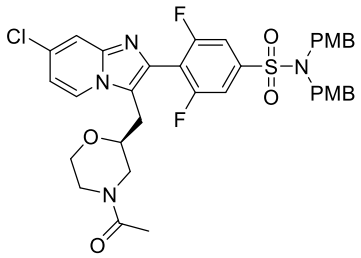


174-1 ,



174-2 ,



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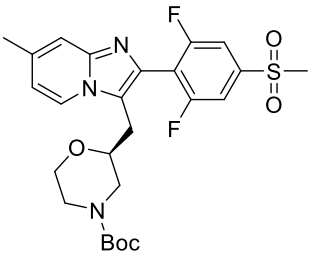
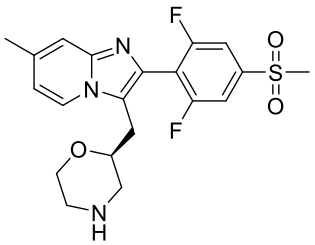
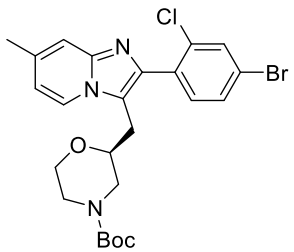


175-1 ,



175-2 ,



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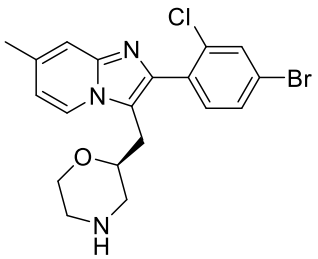

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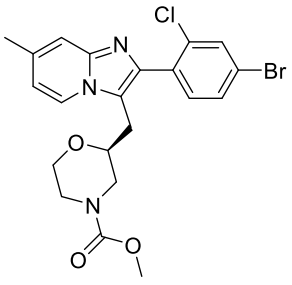

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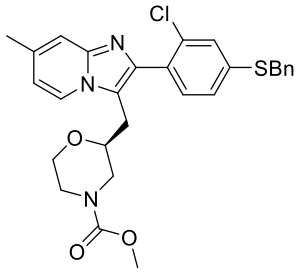

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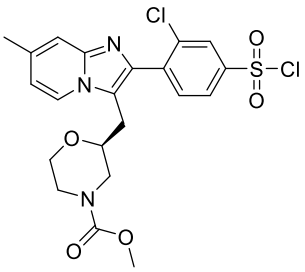

176-6

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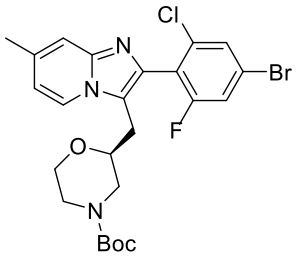

177-3

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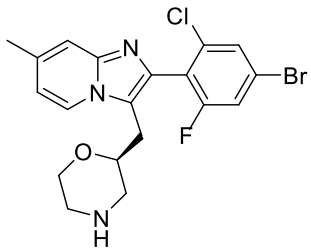

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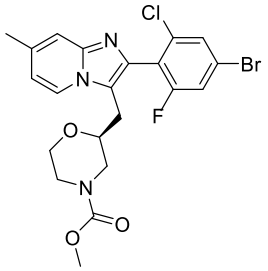

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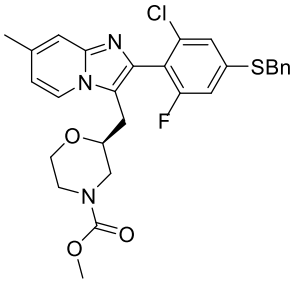

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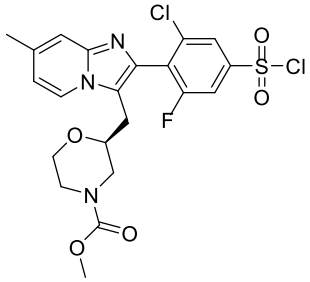

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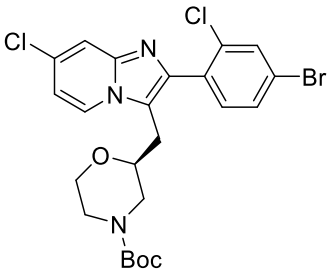

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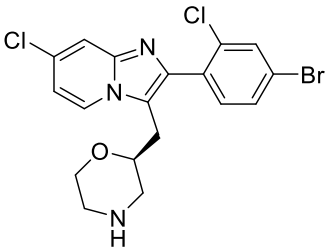

178-3

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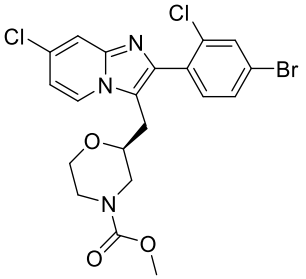

178-4

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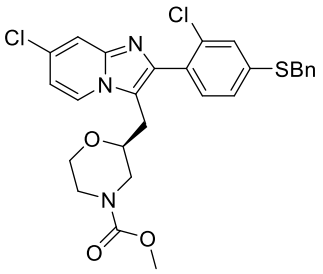

178-5

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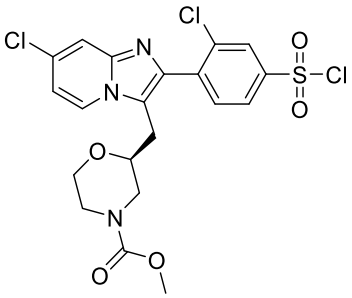

178-6

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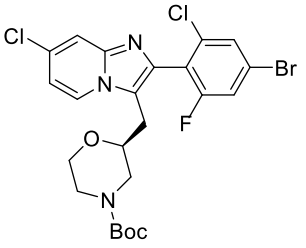

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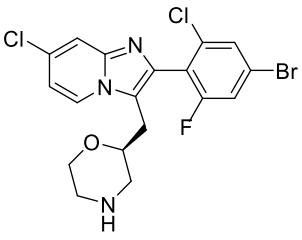

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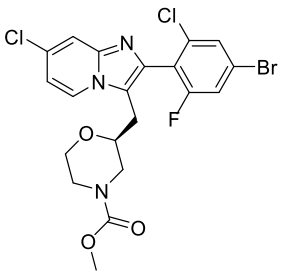

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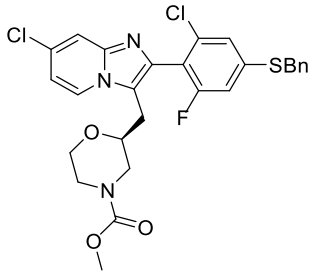

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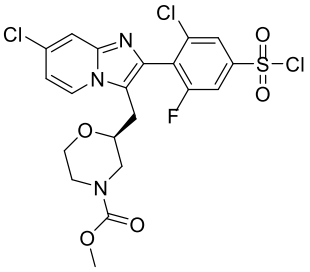

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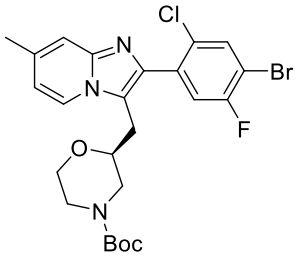

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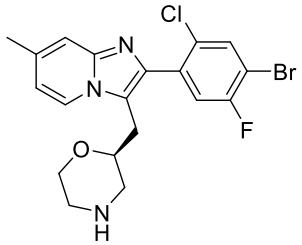

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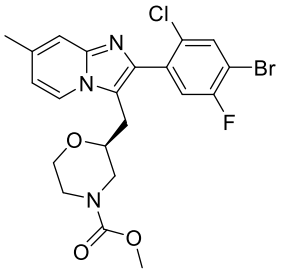

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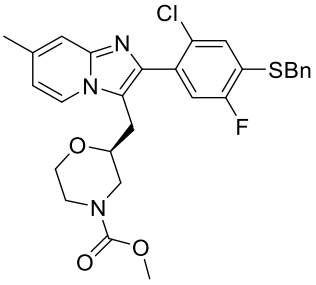

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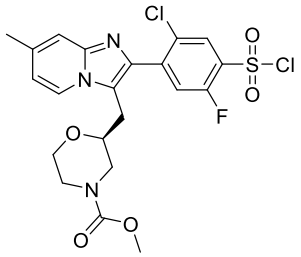

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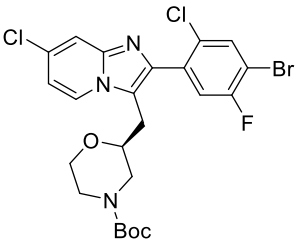

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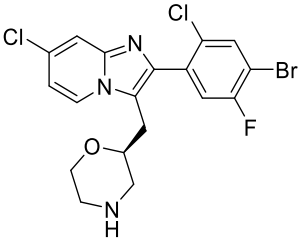

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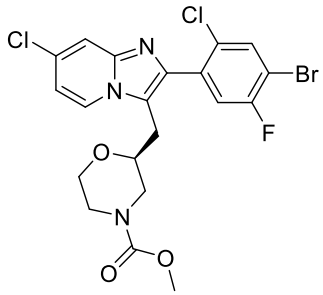

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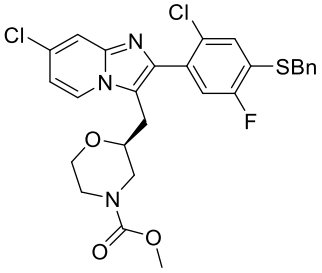

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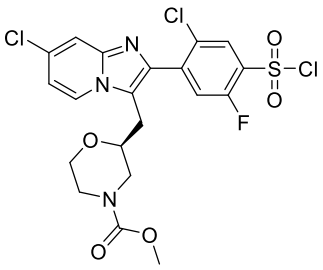
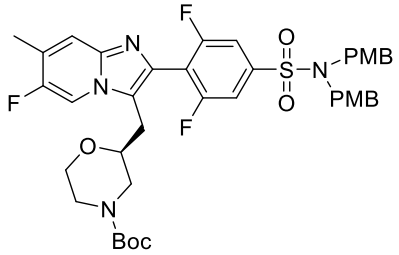
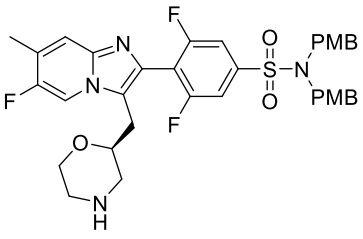


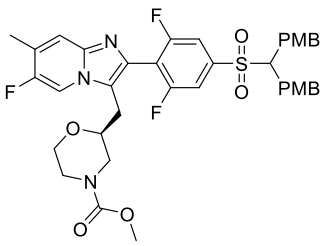
181-5 ,



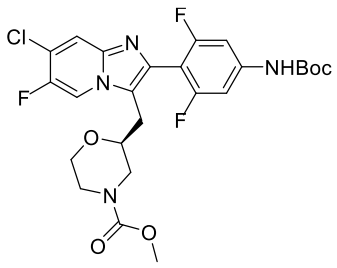
182-2 ,



182-3 ,



182-4 ,



183-3

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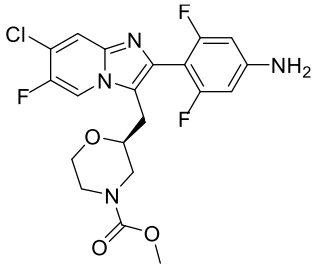

183-4

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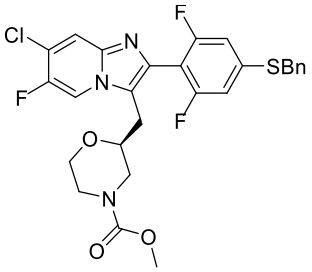

183-5

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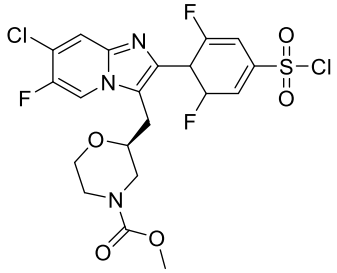

183-6

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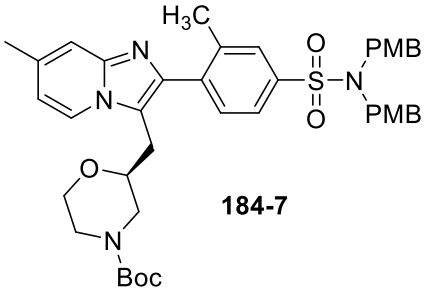

184-7

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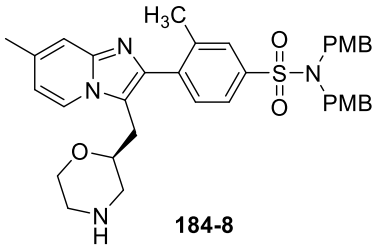

184-8

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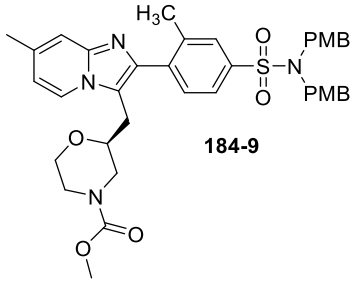

184-9

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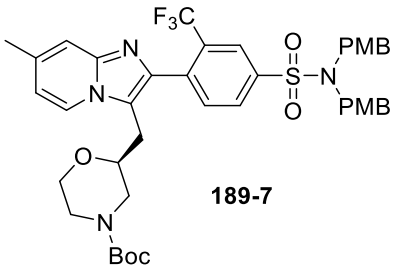

189-7

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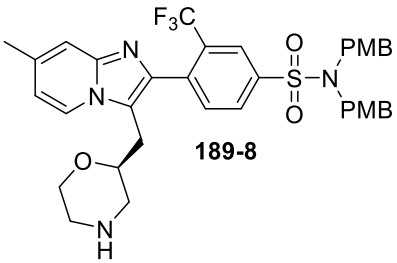

189-8

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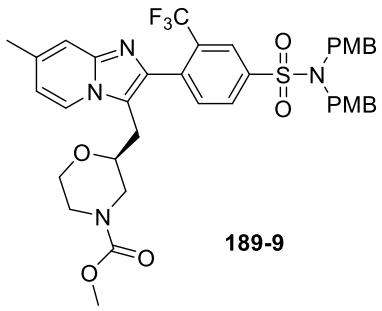

189-9

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17. A pharmaceutical composition comprising the heterocyclic compound of formula I or the pharmaceutically acceptable salt, the hydrate, the solvate, the stereoisomer, or the tautomer thereof according to any one of claims 1 to 11, or the compound according to claim 12 or 13, and at least one pharmaceutically acceptable excipient.

18. Use of the heterocyclic compound of formula I or the pharmaceutically acceptable salt, the hydrate, the solvate, the stereoisomer, or the tautomer thereof according to any one of claims 1 to 11, or the compound according to claim 12 or 13, or the pharmaceutical composition according to claim 17, in the manufacture of a P2X3 inhibitor or a medicament.

19. Use of the heterocyclic compound of formula I or the pharmaceutically acceptable salt, the hydrate, the solvate, the stereoisomer, or the tautomer thereof according to any one of claims 1 to 11, or

the compound according to claim 12 or 13, or the pharmaceutical composition according to claim 17, in the manufacture of a medicament for treating pains, urinary tract diseases or respiratory diseases.

20. The use according to claim 19, wherein the pains comprise: inflammatory pain, surgical pain, visceral pain, dental pain, premenstrual pain, central pain, pain resulting from burns, migraine or cluster headache; the urinary tract diseases comprise: urinary incontinence, overactive bladder, dysuria or cystitis; and the respiratory diseases comprise: respiratory disorders including idiopathic pulmonary fibrosis, chronic obstructive pulmonary disease, asthma, bronchospasm or chronic cough.