Similarity of Seventh Chords and Keys/Scales Defined by the Numbers of Chord Notes Belonging to Specific Keys/Scales

7th Chord	C-E-G-B	C-E-G-Bb	C-Eb-G-Bb	C-Eb-Gb-Bb	C-Eb-Gb-A
F# [d#]	*	*	* *	***	* *
B [g#]	* *	* *	* *	***	**
E [c#]	* *	*	*	**	**
A [f#]	* *	*		*	**
D [b]	***	**	*	*	**
G [e]	****	***	* *	* *	* **
C [a]	****	***	* *	*	* *
F [d]	***	****	* **	* *	* *
Bb [g]	* *	* **	****	** *	** *
Eb [c]	* *	* **	****	** *	**
Ab [f]	* *	* **	****	** *	**
Db [bb]	*	* *	** *	****	***

Note. The numbers of chord notes belonging to a specific key/scale are equal to the numbers of '*' (0, 1, 2, 4). For example, all 4 notes of 7th chord C-E-G-Bb belong only to F maj. (d min.). Thus, this C7 chord can be used as a "pivot chord" to modulate from C maj. to F maj.: C-E-G → C-E-G-Bb → C-F-A.

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Modulation with Triad Pivot Chords

Triads of the12 Major and 12 Relative Minor Keys

G-	**D-**	**A-**	**E-**	**B-**	**F**	**C**	**G**	**D**	**A**	**E**	**B**	**F+**
(e-)	**(b-)**	**(f)**	**(c)**	**(g)**	**(d)**	**(a)**	**(e)**	**(b)**	**(f+)**	**(c+)**	**(g+)**	**(d+)**
C-	Cd	Cm	Cm	Cm	**C**	**C**	**C**	C+d	C+m	C+m	C+m	**C+**
D-	**D-**	**D-**	Dd	Dm	Dm	Dm	**D**	**D**	**D**	D+d	D+m	D+m
E-m	E-m	**E-**	**E-**	**E-**	Ed	Em	Em	Em	**E**	**E**	**E**	E+d
Fd	Fm	Fm	Fm	**F**	**F**	**F**	F+d	F+m	F+m	F+m	**F+**	**F+**
G-	**G-**	Gd	Gm	Gm	Gm	**G**	**G**	**G**	G+d	G+m	G+m	G+m
A-d	**A-**	**A-**	**A-**	Ad	Am	Am	Am	**A**	**A**	**A**	A+d	A+m
B-m	B-m	B-m	**B-**	**B-**	**B-**	Bd	Bm	Bm	Bm	**B**	**B**	**B**

The seven key-/ scale-inherent triads are shown under their respective key name. The keys are ordered by the circle of 5ths, from left to right, and each column contains three major chords, three minor chords and one diminished chord. The chords shared by two keys can be used as pivot chords for smooth modulations. The seven rows of the table are using the “note order” C, D, E, F, G, A, B. **Three major triads are shared by three consecutive keys in the circle of 5ths (in a row), and three minor triads are shared by three consecutive keys in the circle of 5ths (in a row). These triads can serve as pivot chords.** To smoothy transition from a key to another key that is “far away,” based on the circle-of-5ths order, one has to perform multiple key-to-key modulations to achieve an overall smooth modulation, e.g., one can modulate F → G → A → B → F+.

Note. Triad representation is based on the following notation:

[C-, Cd, Cm, C, C+d, C+m, C+] = [C-E-G-, CE-G-, CE-G, CEG, C+EG, C+EG+, C+E+G+],

[D-, Dd, Dm, D, D+d, D+m] = [D-FA-, DFA-, DFA, DF+A, D+F+A, D+F+A+],

[E-m, E-, Ed, Em, E, E+d] = [E-G-B-, E-GB-, EGB-, EGB, EG+B, E+G+B],

[Fd, Fm, F, F+d, F+m, F+] = [FA-C-, FA-C, FAC, F+AC, F+AC+, F+A+C+],

[G-, Gd, Gm, G, G+d, G+m]. = [G-B-D-, GB-D-, GB-D, GBD, G+BD, G+BD+],

[A-d, A-, Ad, Am, A, A+d, A+m] = [A-C-E-, A-CE-, ACE-, ACE, AC+E, A+C+E, A+C+E+],

[B-m, B-, Bd, Bm, B] = [B-D-F, B-DF, BDF, BDF+, BD+F+].

Note. We use the following compact notation: C- = Cb, Cd = C dim, Cm = C min, C = C maj, C+d = C# dim, C+m = C# min, C+ = C+ maj.
Note. We keep in mind these identities: C+ = D-, D+ = E-, F+ = G-, G+ = A-, A+ = B- and C- = B, E+= F.

Note. **Enharmonic modulation** can be performed with various seventh chords serving as pivots. Modulation via seventh chords makes possible the smooth transition from a key to another kay that is “far away” in the circle of 5ths. For example, the **fully diminished 7th chord** has an interval structure (three stacked minor thirds) that can be viewed as a chord belonging to several different keys. Thus, on can perform smooth transitions between distant keys. Example: Fully diminished chord interval structure: 1-b3-b5-bb7 = 1-b3-b5-6. These are possible **resolutions** based on **voice leading** principles:
Root position: 0-3-6-9 = CE-G-B-- = CE-G-A, resolution: CFA, CFA-,
1st inversion: 3-6-9-0 = E-G-B--C = E-G-AC, resolution: FA-C, E-GC,
2nd inversion: 6-9-0-3 = G-B--CE- = G-ACE-, resolution: GCE, GCE-,
3rd inversion: 9-0-3-6 = B--CE-G- = ACE-G-, resolution: B-DF, B-D-F.

Many 7th chords and their resolutions enable smooth modulations.

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Note. More examples of resolving 7th chords on C (root position, 1st, 2nd and 3rd inversions) to possible resolving triads are the following:

- CEGB → EGC; EGBC → EGC; GBCE → GCE; BCEG → CEG, GCE;
- CEGB- → CFA; EGB-C → FAC; GB-CE → ACF; B-CEG →ACF;
- CE-GB- → DFB-; E-GB-C → DFB-, FB-D; GB-CE- → FB-D; B -CE-G → B-DF;
- CE-G-B- → DFB-; E-G-B-C → FB-D; G-B-CE- → FB-D; B-CE-G- → B-DF, DFB-;
- CE-G-B-- → DFB-; E-G-B—C → DFB-, FB-D; G-B--CE- → FB-D; B--CE-G- → B-DF

  Note. The chord CE-G-B-- represents semi-tone steps 0, 3, 6, 9. It is "symmetric": E-G-B--C = (3,6,9,0); G-B--CE- = (6,9,0,3); B--CE-G- = (9,0,3,6). Possible resolutions of the fully diminished 7th chord in its root position and three inversions cane thus be triads in B- major, D- major, E major and G major (when considering the fourth note of these 7th chords as leading tone defining the resolution keys and triads):

  CE-G-B-- → DFB-, B-DF, FB-D; E-G-B--C → FA-D-, D-FA-, A-D-F;

  G-B--CE- → G+BE, EG+B, BEG+; B--CE-G- → BDG, GBD, DGB.

  Using the B-, D-, E and G minor keys and triads for resolution is also possible:

  CE-G-B-- → D-FB-, B-D-F, FB-D-; E-G-B--C → F-A-D-, D-F-A-, A-D-F-;

  G-B--CE- → GBE, EGB, BEG; B--CE-G- → B-DG, GB-D, DGB-.