MOTOROLA TWO TONE & FOUR TONE PAGING

MOTOROLA GENERAL ENCODING PLAN TABLE 1		
FIRST DIGIT OF PAGER CODE	GROUP FROM WHICH TONE A IS SELECTED	GROUP FROM WHICH TONE B IS SELECTED
1	1	1
2	2	2
3	1	2
4	4	4
5	5	5
6	2	1
7	4	5
8	5	4
9	2	4
0	4	2
A	3	3

MOTOROLA QUICK CALL 1 TWO PLUS TWO OR CODE TYPE "Y"					
A SERIES		B SERIES		Z SERIES	
CODE	FREQ	CODE	FREQ	CODE	FREQ
DA	398.1	DB	412.1	DZ	384.6
EA	441.6	EB	457.1	EZ	426.6
FA	489.8	FB	507.0	FZ	473.2
GA	543.3	GB	562.3	GZ	524.8
HA	602.6	HB	623.7	HZ	582.1
JA	668.3	JB	691.8	JZ	645.7
KA	741.3	KB	767.4	KZ	716.7
LA	822.2	LB	851.1	LZ	794.3
MA	912.0	MB	944.1	MZ	881.0
CA	358.9	CB	371.5	CZ	346.7
NA	1011.6	NB	1047.1	NZ	977.2
PA	1122.1	PB	1161.4	PZ	1084.0

MOTOROLA TABLE 3 EXTENDED CODE PLAN																					
FIRST DIGIT	CAP CODE																				
	B	C	D	E	F	G	H	J	K	L	M	N	P	Q	R	S	T	U	V	W	Y
1	11	11	11	11	11	11	11	11	11	11	23	23	23	24	24	25	34	34	35	46	AA
2	22	22	22	22	13	13	13	14	14	15	22	22	22	22	22	22	43	43	53	64	BB
3	33	12	12	12	33	33	33	41	41	51	33	33	33	42	42	52	33	33	33	56	ZZ
4	12	44	15	21	44	31	31	44	44	16	44	32	32	44	44	26	44	44	36	44	AB
5	13	14	55	16	31	55	16	55	16	55	32	55	26	55	26	55	55	36	55	55	AZ
6	21	21	21	66	14	15	66	15	66	66	24	25	66	25	66	66	35	66	66	66	BA
7	31	41	51	61	41	51	61	45	61	61	42	52	62	45	62	62	45	63	63	45	ZA
8	23	24	25	26	34	35	36	54	46	56	34	35	36	54	46	56	54	46	56	54	BZ
9	32	42	52	62	43	53	63	51	64	65	43	53	63	52	64	65	53	64	65	65	ZB
OPTIONAL DIAGONAL TONES: 569.1, 979.9 Hz																					

MOTOROLA QUICK CALL 2 ONE PLUS ONE																
TONE No.	REED GROUP 1		REED GROUP 2		REED GROUP 3		REED GROUP 4		REED GROUP 5		REED GROUP 6		REED GROUP 10		REED GROUP 11	
	Reed Code	Freq Hz	Reed Code	Freq Hz	Reed Code	Freq Hz	Reed Code	Freq Hz	Reed Code	Freq Hz	Reed Code	Freq Hz	Reed Code	Freq Hz	Reed Code	Freq Hz
1	111	349.0	121	600.9	138	288.5	141	339.6	151	584.8	191	1153.4	171	1513.5	201	1989.0
2	112	368.5	122	634.5	108	296.5	142	358.6	152	617.4	192	1185.2	172	1555.2	202	2043.8
3	113	389.0	123	669.9	139	304.7	143	378.6	153	651.9	193	1217.8	173	1598.0	203	2094.5
4	114	410.8	124	707.3	109	313.0	144	399.8	154	688.3	194	1251.4	174	1642.0	204	2155.6
5	115	433.7	125	746.8	160	953.7	145	422.1	155	726.8	195	1285.8	175	1687.2	205	2212.2
6	116	457.9	126	788.5	130	979.9	146	445.7	156	767.4	196	1321.2	176	1733.7	206	2271.7
7	117	483.5	127	832.5	161	1006.9	147	470.5	157	810.2	197	1357.6	177	1781.5	207	2334.6
8	118	510.5	128	879.0	131	1034.7	148	496.8	158	855.5	198	1395.0	178	1830.5	208	2401.0
9	119	539.0	129	928.1	162	1063.2	149	524.6	159	903.2	199	1433.4	179	1881.0	209	2468.2
0	110	330.5	120	569.1	189	1092.4	140	321.7	150	553.9	190	1122.5	170	1472.9	200	1930.2

GENERAL ELECTRIC

GE Type 99 Table 1			
Group	A	B	C
Tone #	Freq	Freq	Freq
1	592.5	607.5	712.5
2	757.5	787.5	772.5
3	802.5	832.5	817.5
4	847.5	877.5	862.5
5	892.5	922.5	907.5
6	937.5	967.5	952.5
7	547.5	517.5	532.5
8	727.5	562.5	577.5
9	637.5	697.5	622.5
0	682.5	652.5	667.5
Dia	742.5 Hz		

GE Type 99 Table 2		
100's Digit	Tone Reed Groups For	
	1st Tone	2nd Tone
0	A	A
1	B	A
2	B	B
3	A	B
4	C	C
5	C	A
6	C	B
7	A	C
8	B	C

GE Trunking Frequencies			
Code	Freq	Code	Freq
01	604.2	18	1304.0
02	631.5	19	1362.1
03	662.3	20	1423.5
04	693.0	21	1488.4
05	727.1	22	1556.7
06	761.3	23	1628.3
07	795.4	24	1717.1
08	832.9	25	1795.6
09	870.5	26	1877.5
10	911.5	27	2051.6
11	952.4	28	2143.8
12	996.8	29	2239.4
13	1041.2	30	2341.8
14	1089.0	31	2447.6
15	1140.2	32	2556.9
16	1191.4	33	2672.9
17	1246.0	34	2792.4

AVIATION

AVCALL 2 + 2	
TONE	FREQUENCY
A	312.6
B	346.7
C	384.6
D	426.6
E	473.2
F	524.8
G	582.1
H	645.7
J	716.1
K	794.3
L	881.0
M	977.2
P	1083.9
Q	1202.3
R	1333.5
S	1479.1

BRAMCO, LEDEX/RCA

BRAMCO, LEDEX & RCA EQUIVALENCE TO MOTOROLA & GENERAL ELECTRIC	
MOTOROLA	BRAMCO, LEDEX/RCA
Series A	Group A
Series B	Group B
Series Z	Group Z
Group 1	Group D & E
Group 2	Group F
Group 4	Group C & G
Group 5	Group H
GE TYPE 99	BRAMCO, LEDEX/RCA
Group A	Group J

REACH

REACH TWO-TONE SEQUENTIAL – FAST OR SLOW		
1ST DIGIT OF CODE	GROUP FOR 1ST TONE (2ND DIGIT)	GROUP FOR 2ND TONE (3RD DIGIT)
1	A	C
***2**	C	A
3	B	D
***4**	D	B
5	A	D
***6**	D	A
7	A	E
***8**	E	A
9	B	E
***0**	E	B

REACH TWO TONE & SINGLE TONE PAGING FREQUENCIES														
TWO TONE & SINGLE TONE														
TONE #	GROUP A		GROUP B		GROUP C		GROUP D		GROUP E		SINGLE TONE ONLY			
	Chnl	Freq	Chnl	Freq	Chnl	Freq	Chnl	Freq	Chnl	Freq	Chnl	Freq	Chnl	Freq
1	11	2704	21	1912	26	1608	36	1137	46	804	01	3824	56	568
2	12	2612	22	1847	27	1553	37	1093	47	776	02	3694	57	549
3	13	2523	23	1784	28	1500	38	1061	48	750	03	3568	58	530
4	14	2437	24	1723	29	1449	39	1025	49	725	04	3446	59	512
5	15	2354	25	1664	30	1400	40	990	50	700	05	3329	60	495
6	16	2274	26	1606	31	1352	41	956	51	676	06	3215		
7	17	2196	27	1553	32	1306	42	923	52	653	07	3106		
8	18	2121	28	1500	33	1261	43	892	53	631	08	3000		
9	19	2049	29	1449	34	1219	44	862	54	609	09	2898		
0	20	1980	30	1400	35	1177	45	832	55	588	10	2799		

REACH 11TH ROOT OF 2 (5 & 6 TONE)		
TONE #	HIGH FREQ	LOW FREQ
0	2400	1200
1	2253	1127
2	2116	1058
3	1987	993
4	1865	933
5	1751	876
6	1644	822
7	1544	772
8	1450	725
9	1361	681
Tone Width (ms)	40±5	40±5

FIVE, SIX, SEVEN TONE

Sequential Single Frequency Codes & Timings															
Tone Number	Code Digit	European Tone Frequencies in Hz												Motorola	
		ZVEI1	ZVEI2	ZVEI3	PZVEI	DZVEI	PDZVEI	CCIR1	CCIR2	PCCIR	EEA	Euro Signal	NATEL	EIA	MODAT
Tone 0	0	2400	2400	2200	2400	2200	2200	1981	1981	1981	1981	979.8	1633	600	637.5
Tone 1	1	1060	1060	970	1060	970	970	1124	1124	1124	1124	903.1	631	741	787.5
Tone 2	2	1160	1160	1060	1160	1060	1060	1197	1197	1197	1197	832.5	697	882	937.5
Tone 3	3	1270	1270	1160	1270	1160	1160	1275	1275	1275	1275	767.4	770	1023	1087.5
Tone 4	4	1400	1400	1270	1400	1270	1270	1358	1358	1358	1358	707.4	852	1164	1237.5
Tone 5	5	1530	1530	1400	1530	1400	1400	1446	1446	1446	1446	652.0	941	1305	1387.5
Tone 6	6	1670	1670	1530	1670	1530	1530	1540	1540	1540	1540	601.0	1040	1446	1537.5
Tone 7	7	1830	1830	1670	1830	1670	1670	1640	1640	1640	1640	554.0	1209	1587	1687.5
Tone 8	8	2000	2000	1830	2000	1830	1830	1747	1747	1747	1747	510.7	1336	1728	1837.5
Tone 9	9	2200	2200	2000	2200	2000	2000	1860	1860	1860	1860	470.8	1477	1869	1987.5
Group Tone	A	2800	885	885	970	825/885	825	2400	2400	1050	1055	---	1995	2151	
	B	810	810		810	740	886	930	930	930	930		571	2433	
Reset Tone	C	970	740		2800	2600	2600	2247	2247	2400	2400		2205	2010	
	D	885	680		885	885	856	991	991	991	991		2437	2292	
Repeat Tone	E	2600	970	2400	2600	2400	2400	2110	2110	2110	2110	1062.9	1805	459	487.5
	F	680	2600		680	680		1055	1055		2247		2694	1091	
Tone Width (ms)		70±15	70±15	70±15	70±15	70±15	70±15	100±10	70±15	100±10	40±4	100	70	33±.5	40±5
Seq Length (ms)		350	350	350	350	350	350	500	350	500	200	600-700	350	165	280
Max intertone time (ms)		15	15	15	15	15	15	7.5	7.5	7.5	4			0	
Min gap before/ between seq (ms)		140	140	140	140	140	140	290	290	290	100			33	
Encoder tolerance		±1.5%	±1.5%	±1.5%	±1.5%	±1.5%	±1.5%	±8Hz	±8Hz	±8Hz	±1%			±.1%	
Must decode BW		±1.5%	±1.5%	±1.5%	±1.5%	±1.5%	±1.5%	±1%	±1%	±1%	±1%			±16Hz	
Must reject BW		±4.5%	±4.5%	±4.5%	±4.5%	±4.5%	±4.5%	±3%	±3%	±3%	±3%			NS	

CAUTION: The A,B,C,D,E,F tones above have been modified by some manufacturers for competitive or system needs. DZVEI is 825 Hz for the Group Tone or "A" Tone, however, several manufacturers use 885 Hz. The 0-9 tones, group tones, & repeat tones are standards.

EEA	Electronic Engineering Association, United Kingdom, Five Tone.
CCIR	Comite Consultatif International de Radio, Five Tone. Can also employ 40ms tones.
ZVEI/DZVEI/DDZVEI	Zentralverband der Electrotechnische Industrie, West Germany, Five Tone. Depressed ZVEI and Double Depressed ZVEI: Modified forms of ZVEI with lower frequencies due to use in narrow band systems.
NATEL	Scandinavian National Telephone
Eurosignal	Six Tone Sequential High Power AM paging for CEPT countries, Six to Seven Tone.
EIA	Electronics Industries Association, United States. Motorola Metropage. Can use 690 ms preamble plus 45 ms gap followed by 5 tones for battery save.
MODAT	Motorola Seven Tone ANI Status System.
REACH	Eleventh root of two spacing. Two to Five Tone Selective call, ANI, Status. Digit sequence is High, Low, High, Low, High: first digit High, second Low, third High, etc.

PLECTRON

Plectron Format Tones									
282.2	366.0	474.8	615.8	799.0	1036	1344	1743	2260	2932
294.7	382.3	495.8	643.0	834.0	1082	1403	1820	2361	3062
307.8	399.2	517.8	672.0	871.0	1130	1465	1901	2465	3197
321.4	416.9	540.7	701.0	910.0	1180	1530	1985	2575	3339
335.6	435.3	564.7	732.0	950.0	1232	1598	2073	2688	3487
350.5	454.6	589.7	765.0	992.0	1287	1669	2164	2807	
Plectron Does Not Employ Code Groups - Random Selection Only									

TONE SQUELCH

RS-220-A EIA Standard CTCSS Tone Frequencies						Non-Standard CTCSS Splits
EIA Code Group A		EIA Code Group B		EIA Code Group C		
Motorola Reed Code	Freq (Hz)	Motorola Reed Code	Freq (Hz)	Motorola Reed Code	Freq (Hz)	Freq (Hz)
XZ	67.0	XA	71.9	WA	74.4	69.4
XB	77.0	YZ	82.5	SP	79.7	97.4
YB	88.5	ZA	94.8	YA	85.4	159.8
1Z	100.0	1A	103.5	ZZ	91.5	165.5
1B	107.2	2Z	110.9	Special Non EIA		171.3
2A	114.8	2B	118.8			177.3
3Z	123.0	3A	127.3			183.5
3B	131.8	4Z	136.5			189.9
4A	141.3	4B	146.2	ZB	97.4	196.6
5Z	151.4	5A	156.7	Midian Shut-Off Code		199.5
5B	162.2	6Z	167.9			206.5
6A	173.8	6B	179.9			229.1
7Z	186.2	7A	192.8			254.1
M1	203.5	M2	210.7			Use caution when using these non-standard codes. Older equipment operating on either side may be falsed.
M3	218.1	M4	225.7	—	259.1	
—	233.6	—	241.8			
—	250.3					

BURST

Standard Burst Tone Frequencies	
1600	2150
1650	2200
1700	2250
1750	2300
1800	2350
1850	2400
1900	2450
1950	2500
2000	2550
2100	
Other Burst Frequencies can exist from 600 to 3150 Hz in 50 or 25 Hz increments.	

DIGITAL SQUELCH

Digital Coded Squelch Codes							
Standard 83 Codes Used in the DCS Scheme							
Low Series	100 Series	200 Series	300 Series	400 Series	500 Series	600 Series	700 Series
023	114	205	306	411	503	606	703
025	115	223	311	412	506	612	712
026	116	226	315	413	516	624	723
031	125	243	331	423	532	627	731
032	131	244	343	431	546	631	732
043	132	245	346	432	565	632	734
047	134	251	351	445		654	743
051	143	261	364	464		662	754
054	152	263	365	465		664	
065	155	265	371	466			
071	156	271	DCS employs a fixed octal digit 4 as the 1st digit, followed by three octal digits shown in the table above. Code words are 23 bit-long strings: 12 bits of octal code, followed by 11 bits of CRC. Each bit is 7.5 ms, adding up to 172.5 ms per word. While it might appear that 512 codes are possible, only 83 exist, because a code word that is misaligned when serially shifted into the decoder can match a different code word.					
072	162						
073	165						
074	172						
	174						
Turn off Code is 200 milliseconds of 134 Hertz							

PAGING TIMINGS

ONE, TWO & TWO TONE TIMING SEQUENCE				
FORMAT	**CALL SEQUENCE**	**1ST TONE**	**GAP**	**2ND TONE**
BURST TONE	Open Squelch	100 – 500 ms		
MOTOROLA 2 + 2 QUICK CALL 1 SERIES Y	Individual Call	1 sec	200 ms	1 sec
	Group Call	4 sec of tone 2 & 3		
MOTOROLA 1 + 1 QUICK CALL 2	Individual Call Tone & Voice	1 sec	0	3 sec
	Group Call	0	0	8 sec
	Tone Only	.4 sec	0	.8 sec
	Tone Only Battery Save	2.7 sec	0	.8 sec
REACH TWO TONE	Reach Slow	2 sec	25 ms	.7 sec
	Reach Fast	150 ms	25 ms	150 ms
	Reach Group Call Two Tone	5 sec	0	0
REACH SINGLE TONE	Reach Single Tone	1.5 sec	0	0
	Reach Single Tone Battery Save	3.5 sec	0	0
PLECTRON	Single Tone	3 sec		
	Plectron Fast Duotone	.75 sec	0	.25 sec
	Plectron Slow Duotone	3 sec	0	.25 sec
AVCALL 2 + 2	Unit Call	1.25 sec	.2 sec	1 sec
GENERAL ELECTRIC	General Electric Type 99	1 sec	0	1.5 sec
	Four Tone GE Trunk	40 ms each, no gap 1st tone is collect tone and is 90 ms times number of channels		
NEC	Group Call			
A	6 sec	1 sec	.25 sec	3 sec
B	6 sec	1 sec	0	3 sec
C	4 sec	1 sec	0	1 sec
D	3 sec	.4 sec	0	.4 sec
L	3 sec	.5 sec	0	.5 sec
M	4 sec	.4 sec	0	.8 sec

TONE REMOTE

STANDARD TONE REMOTE FREQUENCIES	RELATIVE LEVELS	TONE DURATION
High Level 2175 Hz Guard Tone	10 dBm	120 ms
1950 Hz Transmit F1 Function Tone	0 dBm	40 ms
1850 Hz Transmit F2 Function Tone	0 dBm	40 ms
2050 Hz CTCSS Monitor Function Tone	0 dBm	40 ms
Low Level Guard Tone	-20 dBm	Continuous
Voice Peaks	0 – 5 dBm	--

ADDITIONAL TONE REMOTE FREQUENCIES & MULTIPLE FUNCTION USES			
Tone Freq	**Function**	**Function**	**Function**
1750 Hz	Receiver 2	Mute	
1650 Hz	Receiver 2	Mute	
1550 Hz	Maximum Squelch	Repeater off	PL on
1450 Hz	Minimum Squelch	Repeater on	PL off
1350 Hz	Frequency 3	CTCSS 1 Select	Wild Card 1 On
1250 Hz	Frequency 4	CTCSS 2 Select	Wild Card 1 Off
1150 Hz		CTCSS 3 Select	Wild Card 2 On
1050 Hz		CTCSS 4 Select	Wild Card 2 Off
These functions employ the same relative levels and tone durations as used on the standard tone remote frequencies shown above: 0 dB, 40 ms			

TELEPHONE AND RADIO TELEPHONE

MAXIMUM LEVEL PER TONE OF A MULTI-TONE SYSTEM REFERENCED TO A CHANNEL'S MAXIMUM ALLOWABLE SINGLE TONE LEVEL			
Number of Tones	**dB Level**	**Number of Tones**	**dB Level**
1	0	13	-11.1
2	-3	14	-11.5
3	-4.8	15	-11.8
4	-6	16	-12
5	-7	17	-12.3
6	-7.8	18	-12.5
7	-8.5	19	-12.8
8	-9	20	-13
9	-9.5	21	-13.2
10	-10	22	-13.4
11	-10.4	23	-13.6
12	-10.8	24	-13.8

AUTOMATIC RADIO TELEPHONE SIGNALING TONES					
FUNCTION TONE	**IMTS**	**AMTS**	**IPTS**	**PMTS**	**SMART**
MARK IDLE	2000 Hz	1100 &/OR 1700 HZ	2000 Hz	—	2805 Hz BUSY
SEIZE TONE	1800 Hz	1500 Hz	—	—	—
BASE TO MOBILE DIAL	2000/1800	1500/1700	TWO TONE	DTMF	2805 Hz PULSE
RINGING	2000/1800	1500/1700	RINGS AFTER DECODE	RINGS AFTER DECODE	RINGS AFTER DECODE
CONNECT	1633 Hz	1477 Hz	—	—	1402.5 * 0-9
DISCONNECT	1336 Hz	1210 Hz	DTMF	DTMF	1402.5 POS DIS
MOBILE ANI	2150/1633	DTMF	DTMF	DTMF	1402.5 Hz DPSK
MOBILE TO BASE DIAL	2150/1633	DTMF	DTMF	DTMF	2805 Hz PULSE

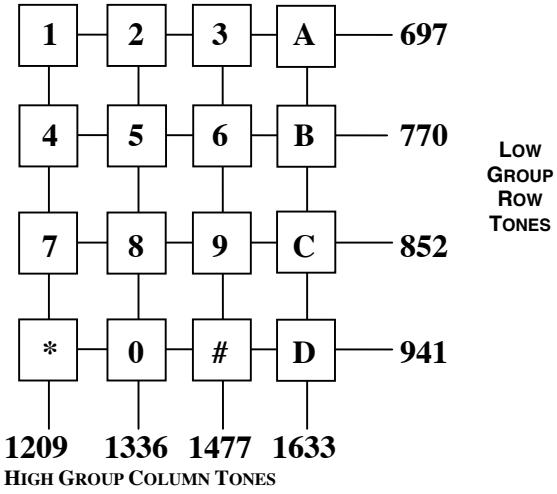
MANUAL RADIO TELEPHONE SYSTEMS			
FUNCTION TONE	**TELCO**	**RCC**	**AIRCRAFT**
BASE TO MOBILE DIAL	600/1500 Hz	2805 Hz PULSE OR TWO TONE SEQUENTIAL	600/1500 WITH CHANNEL ANSWER COMMAND
MOBILE TO BASE DIAL	1100/1500 OR VOICE	VOICE	VOICE
EMS HEAR SYSTEM	1500 Hz PULSE DIALING	(8-12 PPS) 10 PPS NOMINAL 60/40 ms BREAK MAKE RATIO	

TELEPHONE SIGNALING

TELCO NETWORK CALL PROGRESS TONES				
Tone Function	**Frequency (Hz) ±.5%**	**Cadence (secs) On time**	**Off time**	**Power per Freq at Exchange Point (dB mo)**
Dial	350 + 440	Continuous		-13
Busy	480 + 620	0.5	0.5	-24
Congestion (toll)	480 + 620	0.2	0.3	-24
Reorder (local)	480 + 620	0.3	0.2	-24
Ring back (normal)	480 + 440	2	4	-16
Ring back (PBX)	480 + 440	1	3	-16
Receiver off hook	1400 + 2060 + 2450 + 2600	0.1	0.1	0
Call waiting	440 —	One 500 ms burst		-13
High tone	480	Varies per usage		-16
Pre-emption tone	440 + 620	One 200/500 ms burst		-18
Confirmation	350 + 440	Three 100 ms burst		
Executive Override	440 —	One 3 sec burst		
Recall Dial	350 + 440	Three 100 ms burst then dial tone		

GROUP DELAY VARIATION VS. FREQUENCY OF CONDITIONED TRANSMISSION LINES		
Conditioned Voice Grade Channels	**Frequency Range (Hz)**	**Delay Variation (us)**
Basic (none)	800 – 2600	1750
C1	800 – 2600	1750
C2	600 – 2600	1500
C3	600 – 2600	260 – 300
C4	800 – 2800	500
C5	600 - 2600	300

TOUCH TONE® (DTMF) FREQUENCIES



MORSE

MORSE CODE			
A	•–	U	••–
B	– •••	V	•••–
C	– • – •	W	•– –
D	–••	X	–••–
E	•	Y	–•– –
F	••–•	Z	– –••
G	– –•	1	•– – – –
H	••••	2	••– – –
I	••	3	•••– –
J	•– – –	4	••••–
K	– •–	5	•••••
L	•–••	6	–••••
M	– –	7	– –•••
N	–•	8	– – –••
O	– – –	9	– – – –•
P	•– –•	0	– – – – –
Q	– –•–	.	•–•–•–
R	•–•	,	– –••– –
S	•••	?	••––••
T	–	ERR	•••••••