MSM6808/6818

SPLIT FILTER LSI FOR MODEM FUNCTION IN THE CELLULAR MOBILE PHONE

GENERAL DESCRIPTION

The MSM6808 and MSM6818 perform the split filtering functions in the modem part of the cellular mobile phone.

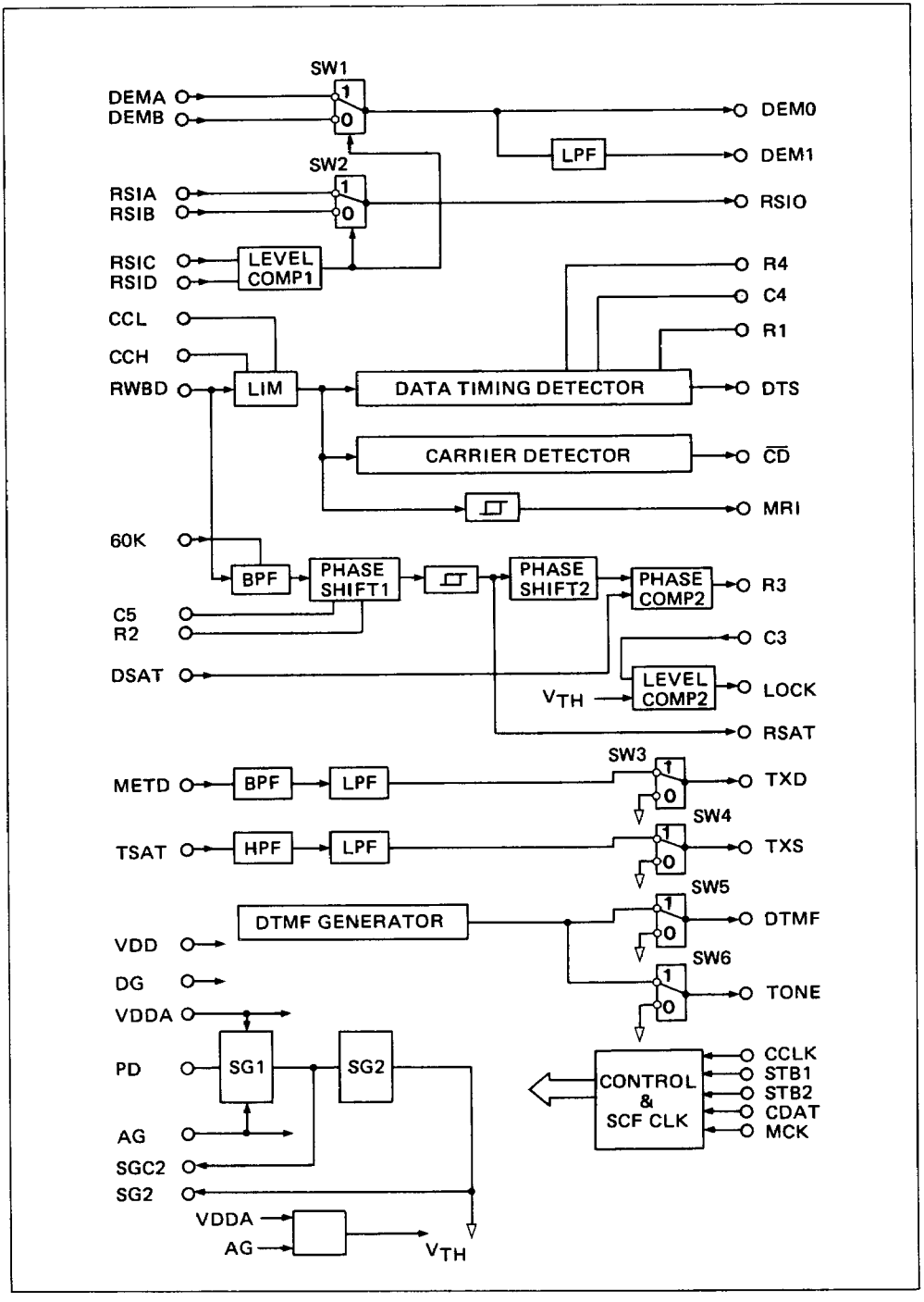
Each of the MSM6808 and MSM6818 consists of a Received Wide Band Data (RWBD) detecter, a MODEM DATA Signal (MODEM DATA) transmitter, a Supervisary Audio Tone (SAT) receiver, a SAT transmitter, and a DTMF signal transmitter and is fabricated by OKI's low power consumption CMOS silicon gate technology.

In combination with the MSM74017, MSM6808 can realize a 10K bps SPL modem for AMPS (Advanced Mobile Phone Service) system. MSM6818 can realize a 8K bps SPL modem for TACS (Total Access Communications System) system.

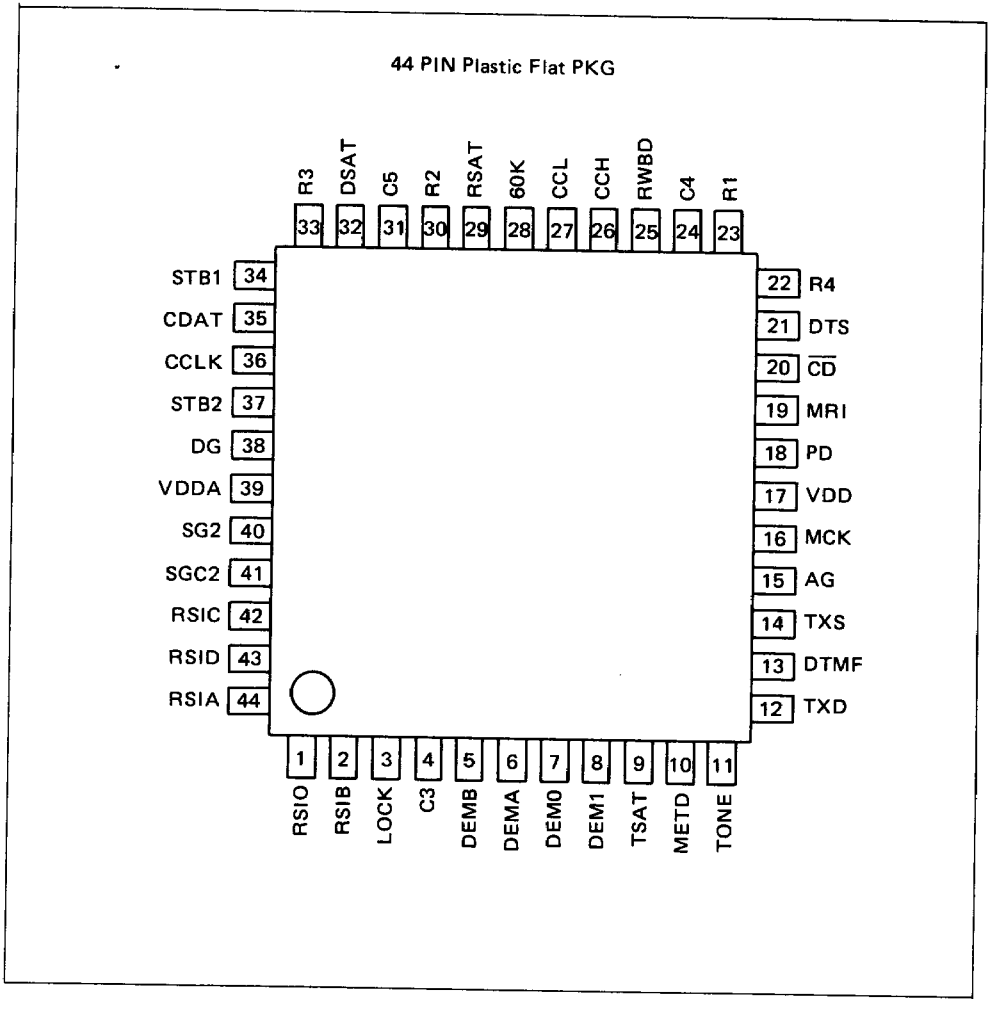
FEATURES

- Built-in timing re-generating circuit for received data.
- Built-in Switched Capaciter Filters for SAT and MODEM data.
- Built-in Anti-Aliasing filters and Smoothing Filters.
- DTMF generator circuit on chip.
- Received signal level comparator for diversity system.
- Microcomputer interface serial control data.
- Power supply: +5 V.
- Low power consumption: 40 mW (typ).
- 44-pin plastic FLAT package.

BLOCK DIAGRAM



PIN CONFIGURATION



PIN DESCRIPTION

Pin Name	Pin No.	I/O	Function
RSIO	1	O	Received signal Strength Output. The larger DC level applied to RSIA and RSIB is put out of RSIO.
RSIB	2	I	Received signal Strength Input (B). DC levels are applied to RSIA and RSIB pins.
LOCK	3	O	SAT (Supervisory Audio Tone) Lock. The LOCK determines whether RSAT (Received SAT) and TSAT (Transmitting SAT) are synchronized or not. The LOCK is set at logical 1, when the phase of DSAT exceeds +270° compared with that of the RSAT signal.
C3	4	I	Form LPF by connecting a resistor and a capacitor between R3 and C3. See Figure 7.
DEMB	5	I	Demodulated signal input (B). The DEMB pin is enabled if RSIC<RSID.
DEMA	6	I	Demodulated signal input (A). The DEMA pin is enabled if RSIC>RSID.
DEM0	7	O	Demodulated signal output (0). Connect this pin to DEM0 of MSM6807.
DEM1	8	O	Demodulated signal output (1). Connect this pin to RWBD.
TSAT	9	I	Transmitting SAT signal. The phase of TSAT should be more than +270° compared with that of the RSAT output signal. The TSAT signal is same as the DSAT signal.
METD	10	I	Transmitting Manchester Encoded Data.
TONE	11	O	DTMF SIDETONE output. Connect this pin to TONE of MSM6807.
TXD	12	O	Transmitting Data. Digital data applied to METD becomes sinusoidal wave signals coming through filters.
DTMF	13	O	Dual Tone Multi Frequency. Each DTMF signal consists of two sinusoidal waves, one from a low group (697, 770, 852, 941 Hz) and the other from a high group (1209, 1336, 1477, 1633, 2016 Hz).

Pin Name	Pin No.	I/O	Function
DTMF	13	O	The level has +6 dB/oct. pre-emphasis characteristics. CCLK, STB2 and CDAT control the frequency, selection of dual tone or single tone. See Table 2.
TXS	14	O	Transmitting SAT. The digital signal input to TSAT becomes sinusoidal wave through a band limited filter.
AG	15	–	Analog Ground. This pin should be common with the DG at the point which is as close as possible to the system ground.
MCK	16	I	Master Clock. Use a 1 MHz (±0.01%) MCK.
VDD	17	–	Power supply pin for the digital circuit. +5V shall be applied.
PD	18	I	Power Down function enable pin. The PD signal selects power on or off; logical 0 enables the power down mode. In the power down mode, transmitting function, SAT function and DTMF output function are suspended.
MRI	19	O	Output for the Manchester Encoded data derived from RWBD input data. See Figure 6.
$\overline{CD}$	20	O	Carrier Detection. The carrier detector detects dotting pattern (1010101010) input to the RWBD. When the frequency of input signal to MSM6808 is approx. 5 kHz, the $\overline{CD}$ of MSM6808 becomes logical 0, while $\overline{CD}$ is logical 1 for any other frequencies. When the frequency of input signal to MSM6818 is approx. 4 kHz, the $\overline{CD}$ of MSM6818 becomes logical 0, while $\overline{CD}$ is logical 1 for any other frequencies.
DTS	21	O	Derived Timing Signal. Output for the timing clock derived from the RWBD input data. When a 5 kHz data is input to the RWBD of MSM6808, a 10 kHz signal is obtained. When a 4 kHz data is input to the RWBD of MSM6818, a 8 kHz signal is obtained.
R4	22	–	DTS sensitivity adjustment. An external resistor R9 shall be connected between R4 and SG2.

<table>
<tr><th>Pin Name</th><th>Pin No.</th><th>I/O</th><th>Function</th></tr>
<tr><td>R1</td><td>23</td><td>–</td><td>DTS phase adjustment.
An external resistor R8 shall be connected between R1 and SG2.</td></tr>
<tr><td>C4</td><td>24</td><td>–</td><td>DTS phase adjustment.
If phase cannot be sufficiently adjusted, connect an external capacitor between C4 and R1.
C4 pin shall be left open when it is not used.</td></tr>
<tr><td>RWBD</td><td>25</td><td>I</td><td>Received Wide Band Data input pin.
Received data and SAT signal are input to this pin.
This pin shall be connected to DEM1 directly.</td></tr>
<tr><td>CCH</td><td>26</td><td>–</td><td rowspan="2">An external resistor and capacitor shall be connected between CCL and CCH.
See Figure 7.</td></tr>
<tr><td>CCL</td><td>27</td><td>–</td></tr>
<tr><td>60K</td><td>28</td><td>I</td><td>The 60K signal controls the center frequency of the BPF (RWBD block).
According to the SAT frequency input to RWBD, the frequency of control signal input to the 60K pin changes as below.
<table>
<tr><th colspan="2">SAT (WRBD)</th><th colspan="2">RS10</th><th colspan="2">Center Frequency (BPF)</th></tr>
<tr><td>5970</td><td rowspan="3">Hz</td><td>59.7</td><td rowspan="3">kHz</td><td>5970</td><td rowspan="3">Hz</td></tr>
<tr><td>6000</td><td>60.0</td><td>6000</td></tr>
<tr><td>6030</td><td>60.3</td><td>6030</td></tr>
</table>
Normally the 60K control signal is made by the digital PLL.</td></tr>
<tr><td>RSAT</td><td>29</td><td>O</td><td>Received SAT.
The RSAT output signal is applied to the external digital PLL.
The phase of RSAT through the PLL exceeds +270°.</td></tr>
<tr><td>R2</td><td>30</td><td>–</td><td>Received SAT signal phase adjustment.
An external resistor R7 shall be connected between R2 and SG2.</td></tr>
<tr><td>C5</td><td>31</td><td>–</td><td>Received SAT signal phase adjustment.
An external capacitor C22 shall be connected between C5 and R2.</td></tr>
<tr><td>DSAT</td><td>32</td><td>I</td><td>Data SAT.
The "PHASE COMP2" judges the difference of the phase between RSAT and DSAT.
The phase of DSAT (equals to TSAT) should be exceeded +270° compared with RSAT.
In other cases, RSAT and TSAT is not locked.
See "BLOCK DIAGRAM".</td></tr>
</table>

Pin Name	Pin No.	I/O	Function
R3	33	—	Refer to the description of pin 4.
STB1	34	I	Strobe 1. Refer to the description of CDAT.
CDAT	35	I	Serial Control Data. The CDAT and STB1 signal control the internal switches. DTMF frequency is selected by CDAT and STB2. See Table 1.
CCLK	36	I	Control timing clock. See Table 1.
STB2	37	I	Strobe 2. Refer to the description of CDAT.
DG	38	—	Digital Ground. This pin should be common with the AG at the point which is as close as.possible to the system ground.
VDDA	39	—	Power supply pin for the analog circuit. +5V shall be applied.
SG2	40	Power	SG2 is built-in analog ground. This voltage is nearly $\frac{VDDA}{2}$ V, so the analog line interface must be implemented by AC-coupling except in the case of connecting with MSM6807. To make its impedance lower, it is necessary to be AC grounded for AG via a bypass capacitor of more than 2.2 μF.
SGC2	41	Power	This is voltage reference for SG and is obtained by two-equal resistors division among VDDA and AG. It is necessary to be AC grounded for AG via a bypass capacitor of more than 2.2 μF so as to keep SG2 silent.
RSIC	42	I	Received signal Strength input (C). The rectified signal of the RSIA input signal is applied to this pin through external LPF. See "APPLICATION".
RSID	43	I	Received signal Strength input (D). Same as RSIC, the rectified signal of the RSIB is applied to this pin through LPF. The DC levels of RSIC and RSID determine the status of SW1, SW2. See Table 1.
RSIA	44	I	Received signal Strength input (A). DC levels are applied to RSIA and RSIB.

ELECTRICAL CHARACTERISTICS

Absolute Maximum Ratings

Parameter	Symbol	Condition	Min	Type	Max	Unit
Power Supply Voltage	V_{DD} V_{DDA}	T_a = +25°C With respect to AG or DG	-0.3	–	7	V
Analog Input Voltage*1	V_{IA}		-0.3	–	V_{DDA} +0.3	
Digital Input Voltage*2	V_{ID}		-0.3	–	V_{DD} +0.3	
Operating Temperature	T_{op}		-40	–	85	°C
Storage Temperature	T_{stg}		-55	–	125	

*1 DEMA, DEMB, RSIA, RSIB, RWBD
*2 RSIC, RSID, RS10, DSAT, METD, TSAT, STB1, STB2, CDAT, MCK, CCLK

Recommended Operating Conditions

Parameter	Symbol	Condition	Min	Typ	Max	Unit
Power supply Voltage	V_{DD} V_{DDA}	With respect to AG or DG	4.75	5.0	5.25	V
Operating Temperature	T_{op}		-30	–	70	°C
Master Clock Frequency	f_{MCK}		0.9999	1	1.0001	MHz

DC AND DIGITAL INTERFACE CHARACTERISTICS

V_{DDA}, V_{DD} = 5V ±5%, T_a = -30 ~ 70°C

Parameter	Symbol	Condition	Min	Typ	Max	Unit	Note
Power Dissipation (standby)	I_{DD}	–	–	10	15	mA	–
	I_{DDS}		–	6	9		
Input Leak Current	I_{IL}	V_I = 0V	-10	–	10	μA	MCK STB1 STB2 CCLK CDAT
	I_{IH}	V_I = V_{DD}	-10	–	10		
Input Voltage	V_{IL}	–	0	–	0.3 V_{DD}		
	V_{IH}		0.7 V_{DD}	–	V_{DD}		
Output Voltage	V_{OL}	I_{OL} = -1.6 mA	–	–	0.3 V_{DD}	–	DTS MRI $\overline{CD}$ RSAT
	V_{OH}	I_{OH} = 400 μA	0.7 V_{DD}	–	–		

ANALOG INTERFACE CHARACTERISTICS

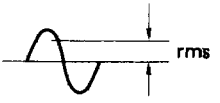
V_{DDA}, V_{DD} = 5V ±5%, T_a = -30 ~ 70°C

Parameter	Symbol	Condition	Min	Typ	Max	Unit	Note
Input Impedance*1	R_{AIN}	–	100	–	–	kΩ	–

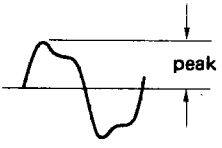
*1 RSIC, RSID, RWBD, METD, TSAT, DSAT

Definition of Units

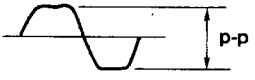
dBV_{rms} : 20*logV, where V denotes the root mean square value of the signal voltage.



dBVp : 20*logV, where V denotes the peak value of of the signal voltage.



Vp-p : Peak-peak value of the signal voltage.



DEM, RSSI CHARACTERISTICS

V_{DDA}, V_{DD} = 5V ±5%, T_a = -30 ~ 70°C

Parameter	Symbol	Condition		Min	Typ	Max	Unit	Note
DEM0 Output Level	V_{ODEM0}	Vi (DEM) = -14.2 dBVrms fi = 1 kHz		–	-11.2	–	dBVrms	+3dB
DEM1 Output Level	V_{ODEM1}			–	2.2	–	Vp-p	+12dB
RSIO Output Level	V_{ORSIL}	V_I=0V	RL≧100K	–	0	–	V	–
	V_{ORSIH}	V_I=3.15V		–	3.15	–		
RSSI Hysteresis	V_{HYS}	–		–	30	–	mV	RSIC RSID
DEM1 LPF Cut-off frequency	f_{CDEM}	At the point 2dB lower		20	–	–	kHz	–
DEM1 Undesired Wave Leakage	–	DEMA, DEMB silent		–	–	-50	dBVrms	–

RWBD SAT

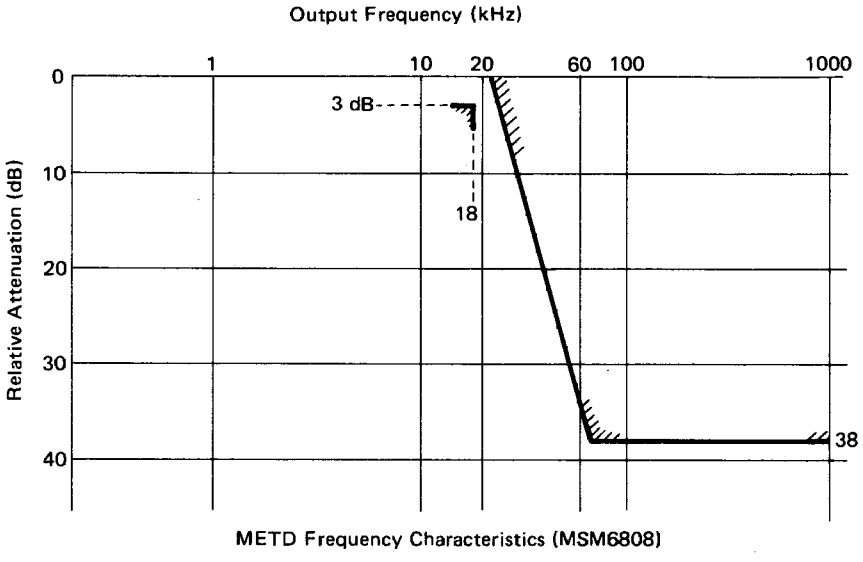
V_{DDA}, V_{DD} = 5V ±5%, T_a = -30 ~ 70°C

Parameter		Symbol	Condition			Min	Typ	Max	Unit	Note
DTS Output Duty Ratio		DR_{DTS}	Vi (RWBD) = 2.3Vp-p fi = 5 kHz			–	50	–	%	f_{DTS} = kHz
$\overline{CD}$	Sensitivity	FS_{CD1}	Vi(RWBD) =2.3Vp-p	MSM6808	MSM6818					
				fi = 3.5k±100Hz	fi = 2.8k±100Hz	–	V_{DD}	–	V	–
		FS_{CD2}		5k ± 100Hz	4k ± 100Hz	–	DG	–		
		FS_{CD3}		6.5k±100Hz	5.2k±100Hz	–	V_{DD}	–		
	Response	t_{D1}	Figure 5			–	–	2	ms	
		t_{D2}				2	–	–		
MRI/DTS Delay Time		t_d	R9 = 10 Ω R8 = 175 kΩ C4 open			–	21	–	μs	Figure 6
RSAT Sensitivity		V_{RSAT}	fi = 5970 Hz 6000 6030			-20	–	–	dBV-rms	

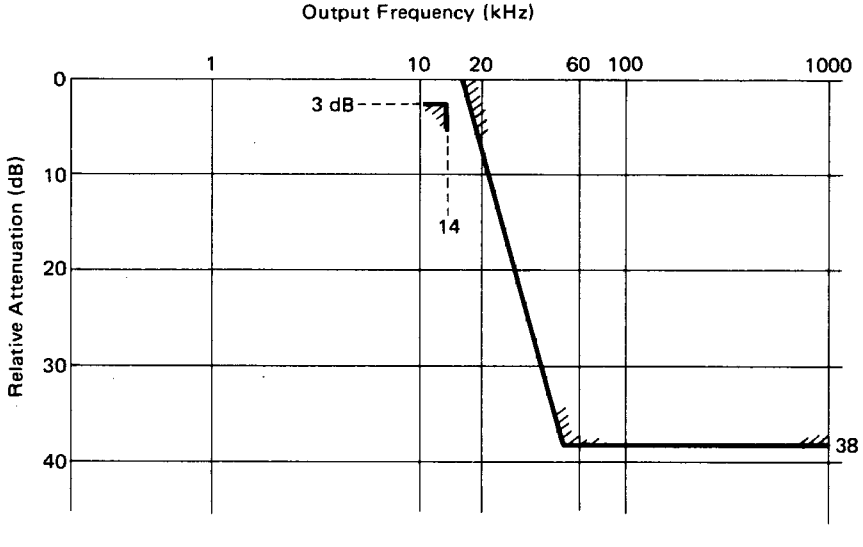
TX-AUDIO (TXD/TXS/DTMF) CHARACTERISTICS

V_{DDA}, V_{DD} = 5V ±5%, T_a = -30 ~ 70°C

Parameter	Symbol	Condition	Min	Typ	Max	Unit	Note
METD Output Level	V_{OTXD}	V_{IL} = 0 V, V_{IH} = V_{DD} fi = 10 kHz (MSM6808) fi = 8 kHz (MSM6818) square wave (50%)	–	-8.2	–	dBVp	SW3 = "1"
METD Frequency Characteristics	–	V_{IL} = 0 V, V_{IH} = V_{DD} square wave (50%)	Figure 1			–	–
TXS Output Level	V_{OTXS}	V_{IL} = 0 V, V_{IH} = V_{DD} square wave (50%) fi = 6 kHz	–	-23.2	–	dBVrms	SW4="1"
TSAT Frequency Characteristics	–	V_{IL} = 0 V, V_{IH} = V_{DD} square wave (50%)	Figure 2			–	–
DTMF Output Level	V_{OL1}	f0 = 697 Hz	–	-19.3	–	dBVrms	Emphasis (6dB/oct) Figure 3 MCK=1MHz
	V_{OL2}	770	–	-18.4	–		
	V_{OL3}	852	–	-17.6	–		
	V_{OL4}	941	–	-16.7	–		
	V_{OH1}	f0 = 1209 Hz	–	-14.5	–		
	V_{OH2}	1336	–	-13.6	–		
	V_{OH3}	1477	–	-12.8	–		
	V_{OH4}	1633	–	-11.9	–		
Sounder Output Level	V_{OTONE}	f0 = 2016 Hz	–	-25	–	dBVrms	SW6="1"
DTMF Side Tone Output Level	V_{ODST}	697, 1633 Hz Pair	–	-22	–	dBVrms	
DTMF Distortion	D_{DTMF}	–	–	–	10	%	–
DTMF Output Frequency Error	ΔF_{DTMF}	MCK = 1 MHz	-1.5	–	+1.5	%	–
TONE Undesired Wave Leakage	–	TXD/TXS/DTMF	–	–	-61	dBVrms	SW3="0" SW4="0" SW5="0"
Out-band Noise Level	–	TX-AUDIO RX-AUDIO	Figure 4			–	–



METD Frequency Characteristics (MSM6808)



METD Frequency Characteristic (MSM6818)

Figure 1

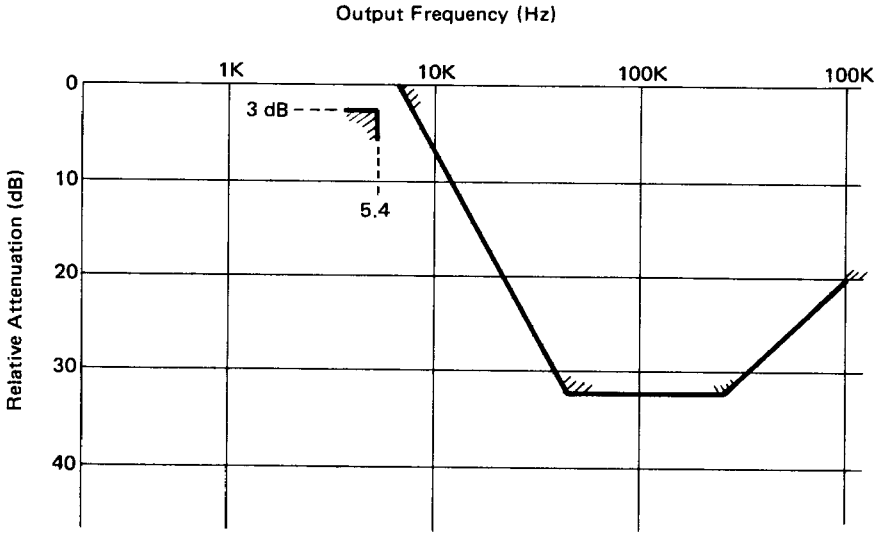


Figure 2 TSAT Frequency Characteristic

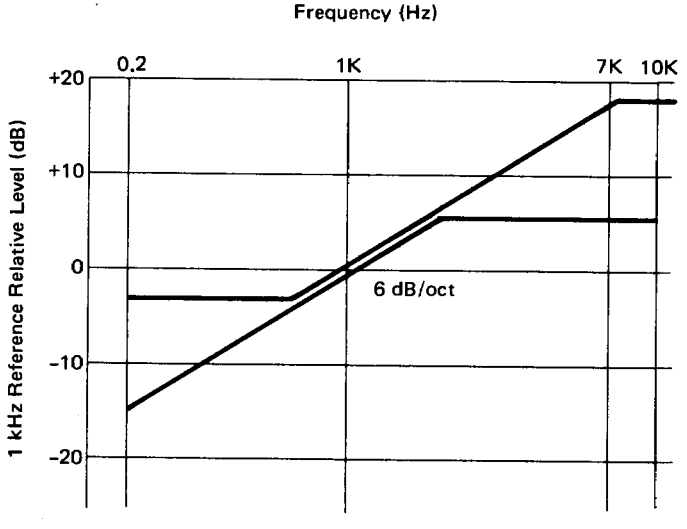


Figure 3 DTMF Emphasis Characteristic

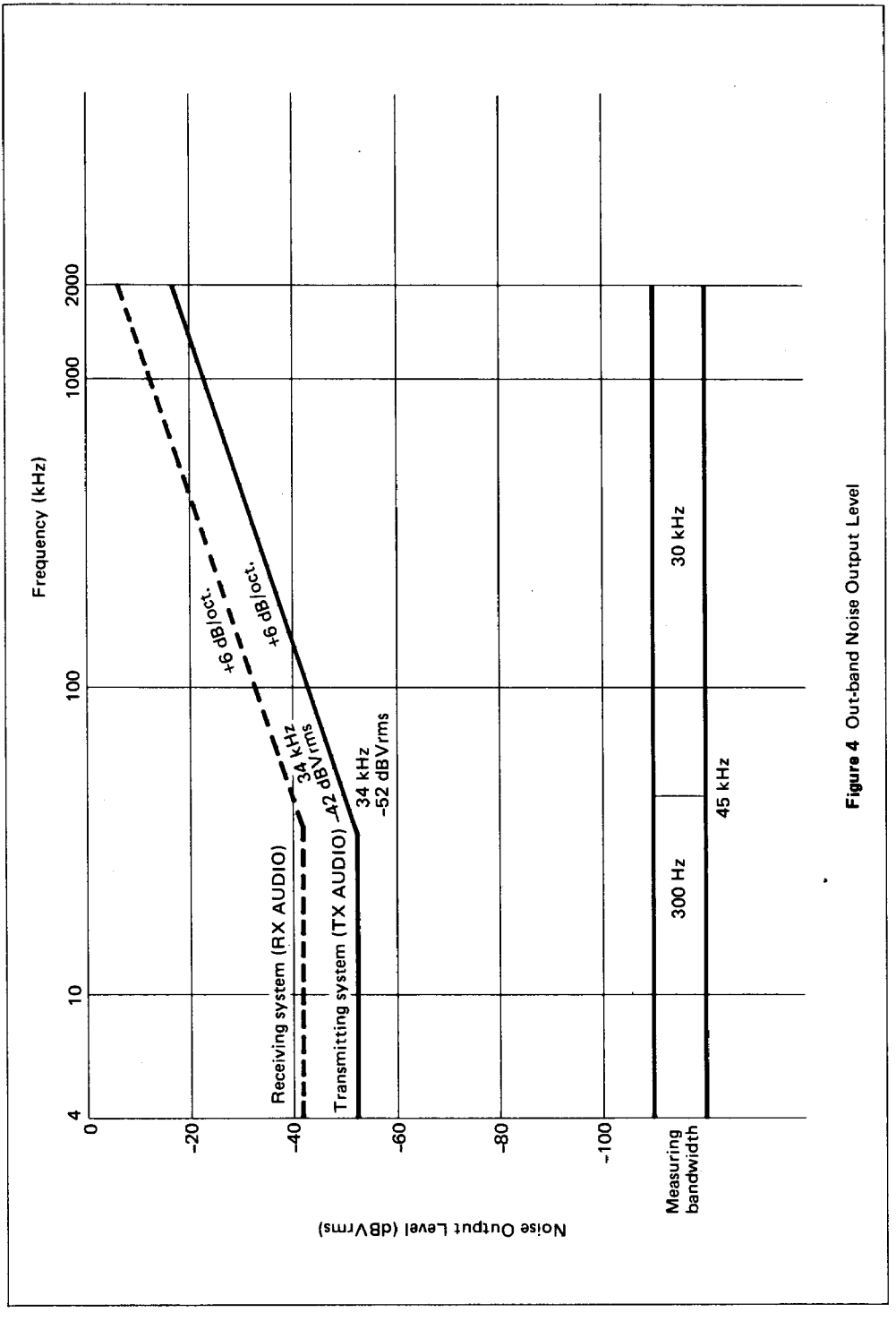


Figure 4 Out-band Noise Output Level

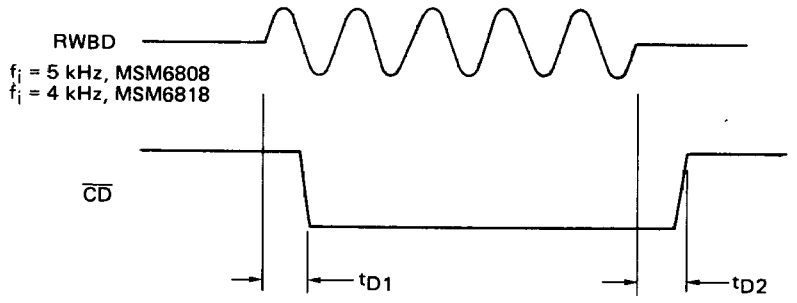
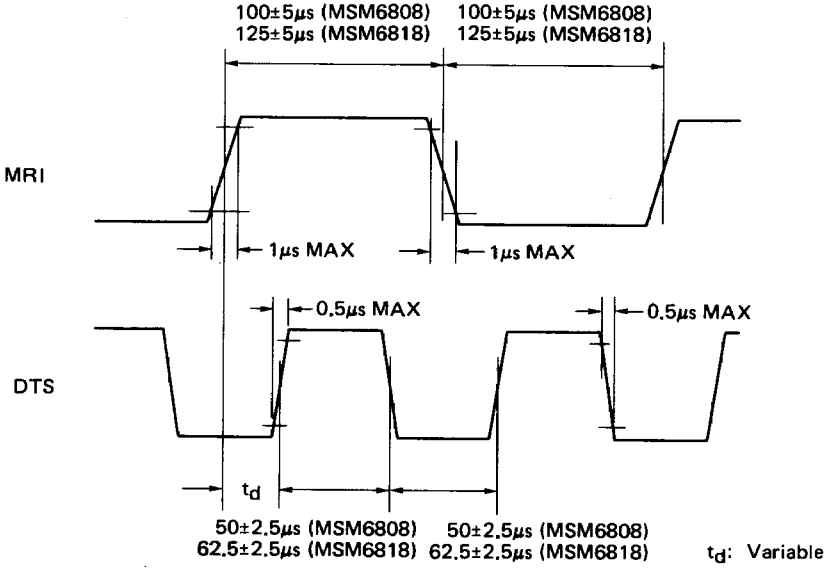


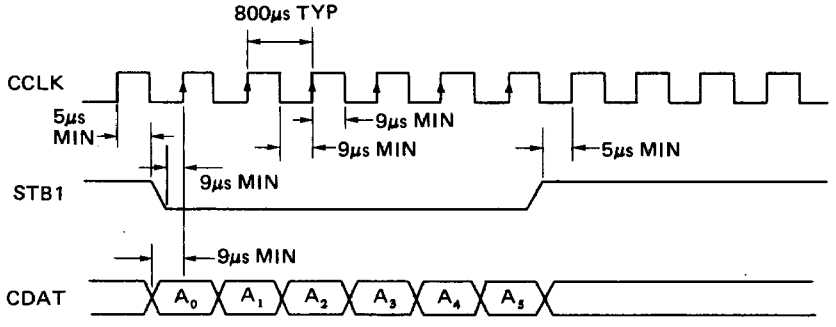
Figure 5 $\overline{CD}$



f_i (RWBD) = 5 kHz (MSM6808)
f_i (RWBD) = 4 kHz (MSM6818)

Figure 6 MRI/DTS

CONTROL PIN SPECIFICATIONS



Note: The CCLK is edge triggered.

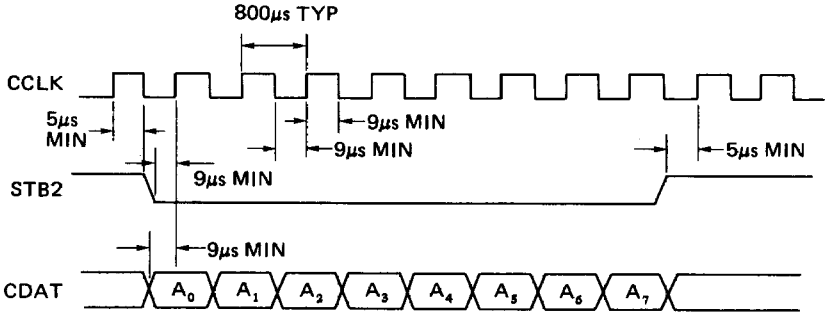
Symbol	Name	Switch Status
A_0	(DEMA, DEMB) (RSIA, RSIB) selection switch	
A_1	(DEMA, DEMB) (RSIA, RSIB) selection switch enable	
A_2	Data transmission enable	H: SW3 = "1", L: SW3 = "0"
A_3	SAT transponder enable	H: SW4 = "1", L: SW4 = "0"
A_4	DTMF transmission enable	H: SW5 = "1", L: SW5 = "0"
A_5	Side tone enable	H: SW6 = "1", L: SW6 = "0"

RSIC, RSID Input DC Level	Control Data A0	Control Data A1	Switch Status SW1	Switch Status SW2
RSIC > RSID	L	L	0	0
	L	H	1	1
	H	L	1	1
	H	H	1	1
RSIC < RSID	L	L	0	0
	L	H	0	0
	H	L	1	1
	H	H	0	0

Control data L: Logic Low Level
H: Logic High Level
Switch status "0", "1": Refer to the block diagram

See the block diagram

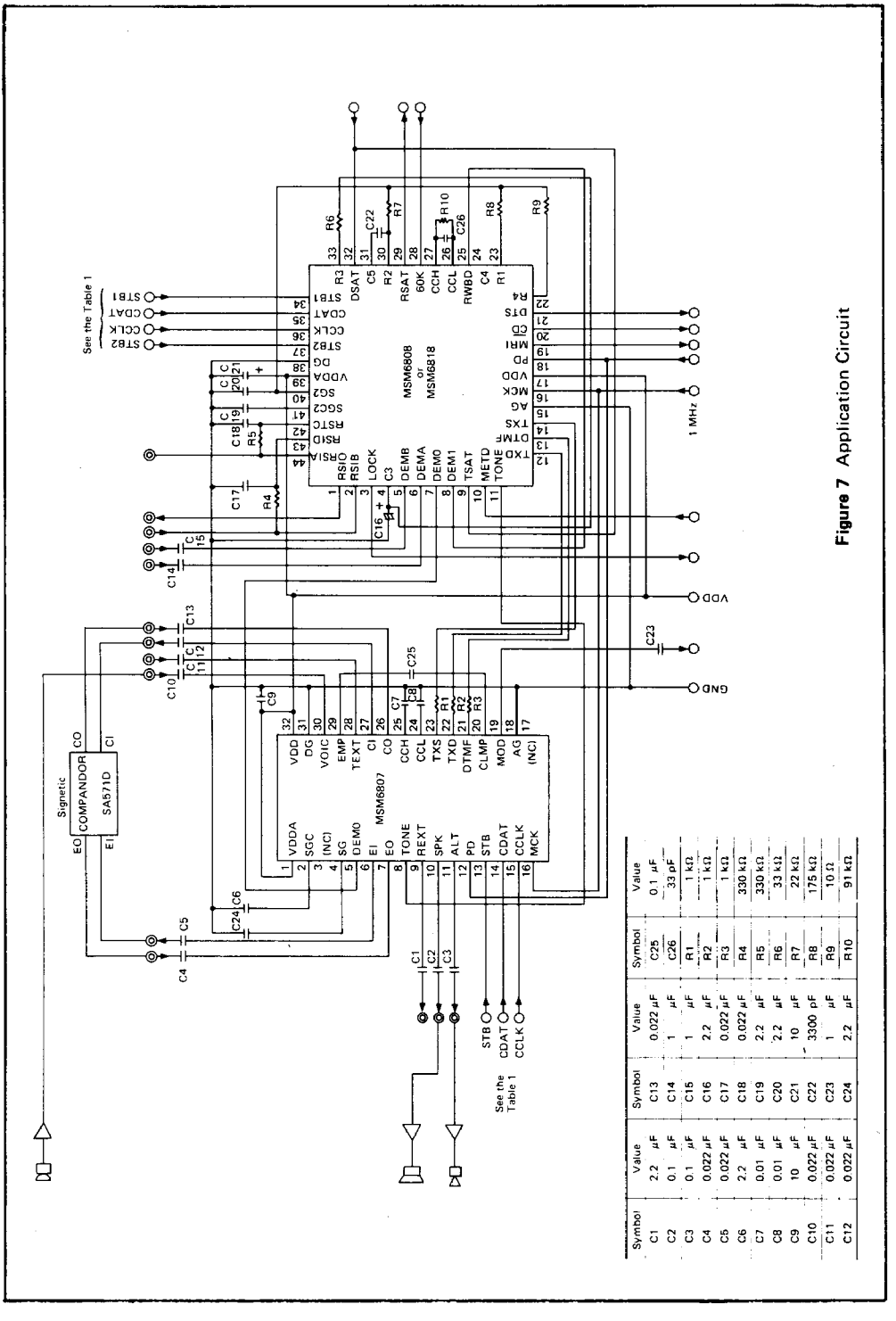
Table 1



The CCLK is edge triggered.

A_0	A_1	A_2	A_3	A_4	A_5	A_6	A_7	Low Tone Frequency (Hz)	High Tone Frequency (Hz)	Remarks
0	0	0	x	x	x	x	x	697		
0	0	1	x	x	x	x	x	770		
0	1	0	x	x	x	x	x	852		
0	1	1	x	x	x	x	x	941		
1	0	0	x	x	x	x	x			
1	0	1	x	x	x	x	x			A_6 = H: Low tone on
1	1	0	x	x	x	x	x			L: Low tone off
1	1	1	x	x	x	x	x			
x	x	x	0	0	0	x	x		1209	A_7 = H: High tone on
x	x	x	0	0	1	x	x		1336	
x	x	x	0	1	0	x	x		1477	L: High tone on
x	x	x	0	1	1	x	x		1633	
x	x	x	1	0	0	x	x		2016	
x	x	x	1	0	1	x	x			
x	x	x	1	1	0	x	x			
x	x	x	1	1	1	x	x			

Table 2



Symbol	Value	Symbol	Value	Symbol	Value
C1	2.2 μF	C13	0.022 μF	C25	0.1 μF
C2	0.1 μF	C14	1 μF	C26	33 pF
C3	0.1 μF	C15	1 μF	R1	1 kΩ
C4	0.022 μF	C16	2.2 μF	R2	1 kΩ
C5	0.022 μF	C17	0.022 μF	R3	1 kΩ
C6	2.2 μF	C18	0.022 μF	R4	330 kΩ
C7	0.01 μF	C19	2.2 μF	R5	330 kΩ
C8	0.01 μF	C20	2.2 μF	R6	33 kΩ
C9	10 μF	C21	10 μF	R7	22 kΩ
C10	0.022 μF	C22	3300 pF	R8	175 kΩ
C11	0.022 μF	C23	1 μF	R9	10 Ω
C12	0.022 μF	C24	2.2 μF	R10	91 kΩ

Figure 7 Application Circuit