OKI Semiconductor

This version: Dec. 2001
Previous version: Sep. 1999

MSM7715

Multi-Function Telecommunication LSI

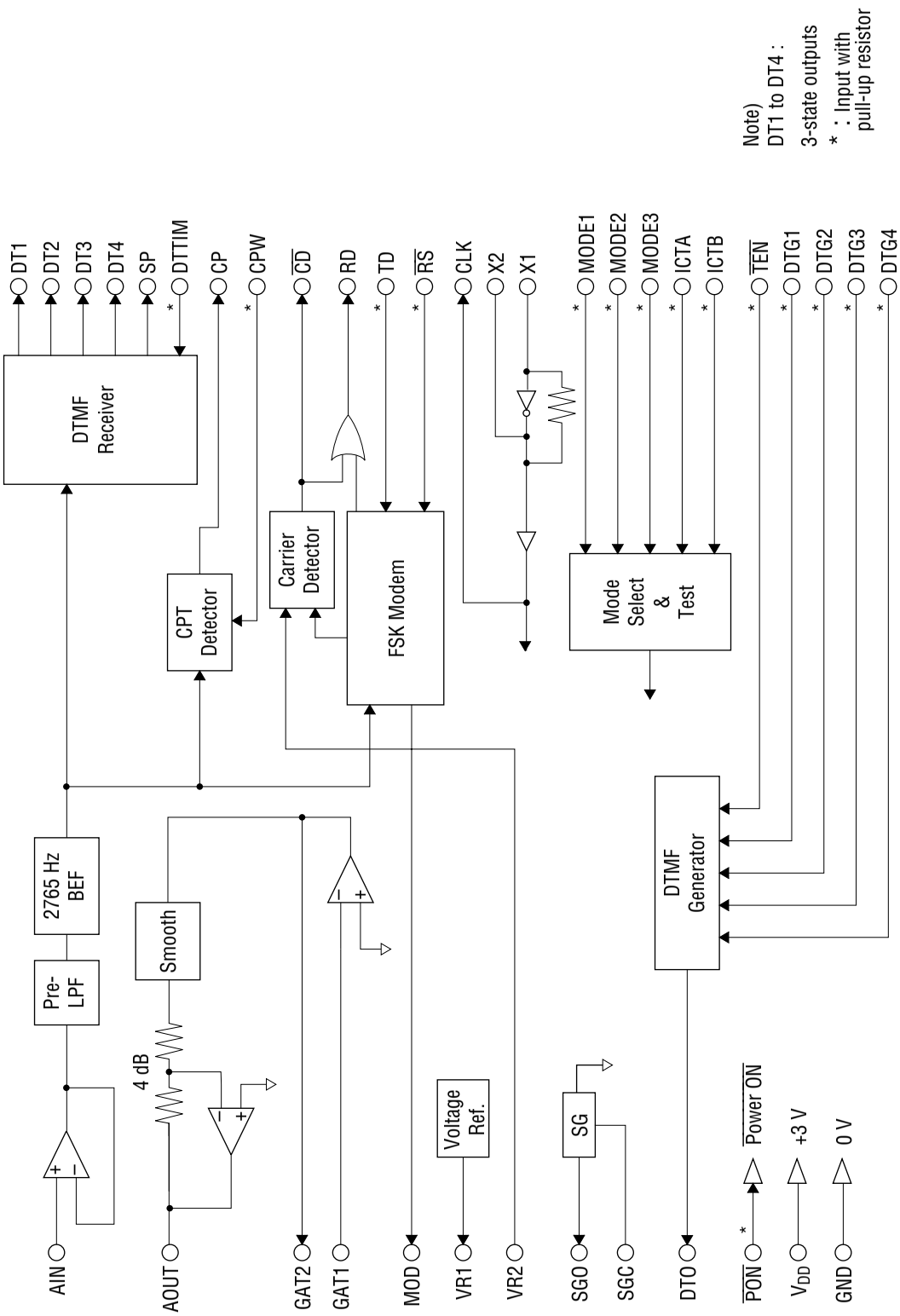
GENERAL DESCRIPTION

The MSM7715 is a signal transmitting and receiving LSI device for applications such as telemeters. The MSM7715 uses a no-ringing communication mode. Built-in functions includes a 300 bps full-duplex modem complying with ITU-T V.21, a DTMF signal (PB signal) generator and receiver, and a call progress tone (CPT) detector. The answer tone (1650 Hz) generation can be accomplished with the built-in modem.
A meter terminal can be configured using this transmitting and receiving device along with the meter, NCU, and controller.

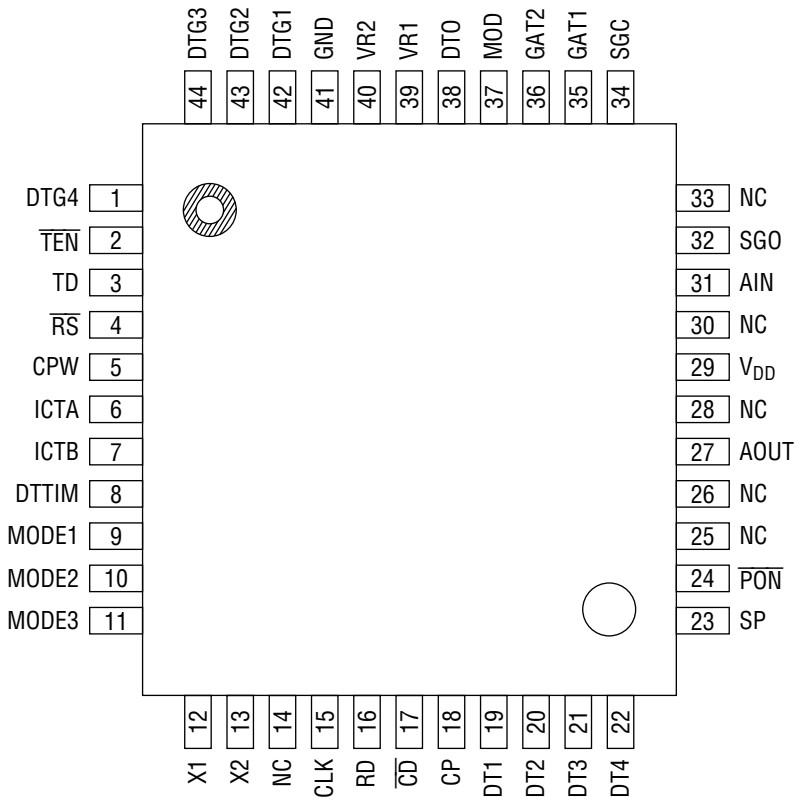
FEATURES

- 3 V power supply. (Voltage range is 2.5 V to 3.6 V.)
- Selectable modes, including DTMF signal sending mode, DTMF signal receiving mode, and V.21 modem answer/originate mode.
- For DTMF signal reception, support for normal detection mode or high-speed detection mode.
- For call progress tone detection, support for rectangular wave output or detection output.
- DTMF signal receiving output, which is in a 3-state mode, is able to be connected externally with the DTMF signal sending 4-bit input.
- Analog loopback test and remote digital loopback test supported.
- Dedicated pins for modem sending/receiving data, carrier detection, sending request, and call progress tone detection.
- Independent external adjustment of the output levels of the modem and DTMF transmit signals.
- External adjustment of the carrier detection level.
- Internal 3.579545 MHz crystal oscillation circuit.
- Power-down mode
- Package:
  44-pin plastic QFP (QFP44-P-910-0.80-2K) (Product name : MSM7715GS-2K)

BLOCK DIAGRAM



PIN CONFIGURATION (TOP VIEW)



44-Pin Plastic QFP

NC : No connect pin

PIN DESCRIPTION

Name	Pin No.	I/O	Description
DTG4	1	I*	Input for specifying the DTMF code to be sent.
$\overline{TEN}$	2	I*	Input for controlling output of the DTMF signal. (Transmit enable) DTG1 to DTG4 are latched at the falling edge of $\overline{TEN}$ and the DTMF signal is output when "0" is input. See Fig. 2.
TD	3	I*	Input for data to be sent to the modem. Input the data string at a speed of 300 bps or lower.
$\overline{RS}$	4	I*	Input for controlling the modem sending output. (Request to send) The sending signal is output when "0" is input.
CPW	5	I*	Input for selecting the output waveform from the call progress tone detector. When "1" is input, a rectangular wave that is synchronized with the input signal is output from the CP. When "0" is input, presence of detected signal is output from the CP pin. See Fig.3.
ICTA	6	I*	Inputs for testing. Leave them open or connect them to V_{DD}.
ICTB	7		
DTTIM	8	I*	Input pin for controlling the detection timing of the DTMF receiver. When "0" is input, the high-speed detection mode is selected.
MODE1	9	I*	Input for selecting the operation mode. See Table 1.
MODE2	10		
MODE3	11		
X1	12	I	Input and output connected to the crystal oscillator. See "Oscillation Circuit" in the Functional Description.
X2	13	O	
CLK	15	O	3.579545 MHz clock output
RD	16	O	Output for serial data received by the modem. It is held in the marked state ("1") when the carrier detector (CD) does not make detection.
$\overline{CD}$	17	O	Output for the carrier detector. "0" means detection, while "1" means non-detection.
CP	18	O	Output for call progress tone (CPT) detection. When the CPT is detected, the waveform selected by the CPW pin is output. See Fig. 3.
DT1	19	O	Outputs for the code of the received DTMF signal. In a mode other than the DTMF receiving mode, these pins are in a high-impedance state.
DT2	20		
DT3	21		
DT4	22		
SP	23	O	Output for presenting the DTMF signal receiving data. "1" means that the DTMF signal is being received. Latch DT1 to DT4 at the rising edge of SP. See Fig. 1.
$\overline{PON}$	24	I*	Input for controlling power-on. When "1" is input, all lines of this device enter the power down state, and then the operation of each funciton stops and the receiver timer is reset.
AOUT	27	O	Analog signal output. The DTMF signal or modem sending signal is output.

Name	Pin No.	I/O	Description
V_{DD}	29	—	Power supply. Supply +2.5V to 3.6V.
AIN	31	I	Input for the analog receiving signal.
SGO	32	O	Output for the signal ground voltage. The output voltage is 1/2 V_{DD}. Connect a capacitor of 0.1 μF or more between SGO and GND.
SGC	34	—	Pin for connecting the capacitor of the signal ground voltage generating circuit. Connect a capacitor of 1 μF or more between SGC and GND.
GAT1	35	I	Input for the sending output level-adjusting amplifier.
GAT2	36	O	Output for the sending output level-adjusting amplifier.
MOD	37	O	Output for the sending modem signal.
DTO	38	O	Output for the DTMF signal.
VR1	39	O	Output for the reference voltage generating circuit. The potential difference between VR1 and SGO is approximately +0.75 V.
VR2	40	I	Input for external adjustment of the modem's carrier detection level.
GND	41	—	Ground.
DTG1	42	I*	Inputs for specifying the DTMF code to be sent. Data is latched at the falling edge of $\overline{TEN}$.
DTG2	43		
DTG3	44		

Note: Digital inputs that are pulled up internally by a high resistance.

ABSOLUTE MAXIMUM RATINGS

Parameter	Symbol	Condition	Rating	Unit
Power Supply Voltage	V_{DD}	Ta = 25°C With respect to GND	–0.3 to +7	V
Input Voltage	V_I		–0.3 to V_{DD} + 0.3	V
Storage Temperature	T_{STG}	—	–65 to +150	°C

RECOMMENDED OPERATING CONDITIONS

Parameter		Symbol	Condition	Min.	Typ.	Max.	Unit
Power Supply Voltage		V_{DD}	—	2.5	3.0	3.6	V
Operating Temperature Range		T_{op}	—	–40	—	+85	°C
Input Voltage		V_{IH}	—	0.8 V_{DD}	—	V_{DD}	V
		V_{IL}		0	—	0.2 V_{DD}	
Input Clock Frequency		f_{CLK}	Against 3.579545 MHz	–0.1	—	+0.1	%
X1/X2 Load Capacitance		C1, C2	—	—	12	—	pF
SGC Bypass Capacitance		C3	—	—	1	—	μF
SGO Bypass Capacitance		C6	—	0.1	—	—	
V_{DD} Bypass Capacitance		C5	—	10	—	—	
Crystal	Oscillation Frequency	—	—	—	3.579545	—	MHz
	Frequency Deviation	—	At 25°C ±5°C	–100	—	+100	ppm
	Temperature Characteristics	—	At –40°C to +85°C	–50	—	+50	
	Equivalent Series Resistance	—	*1	—	—	90	Ω
	Load Capacitance	—	*1	—	16	—	pF

*1 If the crystal is characterized by a manufacturer, any value of the equivalent series resistance and load capacitance may be used when the frequency deviation is within the range specified herein.

ELECTRICAL CHARACTERISTICS

DC Characteristics

(V_{DD} = 2.5 V to 3.6 V, Ta = –40°C to +85°C)

Parameter	Symbol	Condition		Min.	Typ.	Max.	Unit
Power Supply Current	I_{DD1}	$\overline{PON}$ = "0"	Modem mode	—	3	6	mA
	I_{DD2}		DTMF mode	—	2.4	5	
	I_{DDS}	$\overline{PON}$ = "1"	Power-down	—	1	20	µA
Input Current *1	I_{IH}	$V_{IH} = V_{DD}$		–10	—	+10	
	I_{IL}	V_{IL} = 0 V		–50	–10	+10	
Output Voltage *2	V_{OH1}	*2	I_{OH} = –100 µA	V_{DD} – 0.1	—	V_{DD}	V
	V_{OL1}		I_{OL} = 100 µA	0	—	0.1	
	V_{OH2}	CLK	I_{OH} = –100 µA	0.9 V_{DD}	—	V_{DD}	
	V_{OL2}	$C_L \leq 10$ pF	I_{OL} = 100 µA	0	—	0.1 V_{DD}	

Notes: *1 The following pins have an internal pull-up resistor. : DTG1 to DTG4, $\overline{TEN}$, TD, $\overline{RS}$, CPW, ICTA, ICTB, DTTIM, MODE1 to MODE3, and $\overline{PON}$

*2 RD, $\overline{CD}$, CP, DT1 to DT4, and SP

AC Characteristics (DTMF)

(V_{DD} = 2.5 V to 3.6 V, Ta = –40°C to +85°C)

Parameter	Symbol	Condition		Min.	Typ.	Max.	Unit
Transmit Level	V_{DTTL}	AOUT, R1 = R3	Low-group tone	–16.5	–14.5	–12.5	dBm
	V_{DTTH}		High-group tone	–15.5	–13.5	–11.5	*1
Transmit Signal Level Relative Value	V_{DTDF}	High-group tone/low-group tone		0	1	2	dB
Transmit Frequency Deviation	f_{DDT}	With respect to the nominal frequency		–1.5	—	+1.5	%
Transmit Signal Distortion Rate	THD_{DT}	Harmonics/Fundamental frequency		—	—	–23	dB
DTG1 to DTG4 Input Data Setup Time	t_{SDT}	See Fig. 2.		250	—	—	ns
DTG1 to DTG4 Input Data Hold Time	t_{HDT}	See Fig. 2.		250	—	—	
Receive Detect Level	V_{DETDT}	For each single tone		–46	—	–10	dBm
Receive Reject Level	V_{REJDT}	For each single tone		—	—	–60	*1
Receive Frequency Detect Band	f_{DETDT}	With respect to the nominal frequency		—	—	±1.5	%
Receive Frequency Reject Band	f_{REJDT}	With respect to the nominal frequency		±3.8	—	—	
Allowable Receive Level Difference	V_{TWIST}	High-group tone/low-group tone		–6	—	+6	dB
Allowable Receive Noise Level ratio	$V_{N/S}$	Noise (0.3 kHz to 3.4 kHz) level/tone level		—	–12	—	
Dial Tone Reject Ratio	V_{REJ400}	380 Hz to 420 Hz		37	—	—	
Signal Repetition Time	t_{C1}	See Fig. 1	DTTIM = "1"	120	—	—	ms
	t_{C2}		DTTIM = "0"	70	—	—	
Tone Time for Detect	t_{S1}		DTTIM = "1"	49	—	—	
	t_{S2}		DTTIM = "0"	34	—	—	
Tone Time for No Detect	t_{I1}		DTTIM = "1"	—	—	24	
	t_{I2}		DTTIM = "0"	—	—	9	
Output Delay Time	t_{G11}	Normal condition *2	DTTIM = "1"	30	45	57	
	t_{G12}		DTTIM = "0"	20	32	42	
	t_{G21}	Just after mode change *3	DTTIM = "1"	30	48	77	
	t_{G22}		DTTIM = "0"	20	35	62	
Interdigit Pause Time	t_{P1}		DTTIM = "1"	30	—	—	
	t_{P2}		DTTIM = "0"	21	—	—	
Acceptable Drop Out Time	t_{B1}		DTTIM = "1"	—	—	10	
	t_{B2}		DTTIM = "0"	—	—	3	
SP Delay Time	t_{SP1}		DTTIM = "1"	6	8	10	
	t_{SP2}		DTTIM = "0"	1	1.7	3	
Output Trailing Edge Delay Time	t_{D1}	t_S > 80 ms	DTTIM = "1"	21	29	35	
	t_{D2}	t_S > 44 ms	DTTIM = "0"	15	21	27	

Note: *1 0 dBm = 0.775 Vrms (For all AC characteristics)
*2 "Normal condition" means that a DTMF signal appears after more than 20 ms after setting DTMF receive mode.
*3 "Just after mode change" means that there is an input signal when the mode is changed from DTMF transmit mode to DTMF receive mode. If there is an input signal when power is turned on, see "DTMF mode setting procedure after power on or after releasing power down mode".

AC Characteristics (Modem)

(V_{DD} = 2.5 V to 3.6 V, Ta = –40°C to +85°C)

Parameter	Symbol	Condition		Min.	Typ.	Max.	Unit
Modem Transmit Level	V_{AOM}	Measured at AOUT pin, R1 = R2		–11	–9	–7	dBm
Signal Level Relative Value	V_{DM}	Mark signal/space signal		–1.5	0	+1.5	dB
Modem Transmit Carrier Frequency	f_{OM}	Originate mode	Mark, TD = "1"	976	980	984	Hz
	f_{OS}		Space, TD = "0"	1176	1180	1184	
	f_{AM}	Answer mode	Mark, TD = "1"	1646	1650	1654	
	f_{AS}		Space, TD = "0"	1846	1850	1854	
Transmit Signal Output Deray Time	t_{ADD}	TD → AOUT		—	3.5	—	ms
Modem Receive Signal Level	V_{AIM}	Measured at AIN. FSK modulation signal		–48 *1	—	–6	dBm
Carrier Detection (CD) Signal Level	V_{ON}	Answer mode : 1080 Hz	OFF→ON	—	–44	–42	
	V_{OFF}	Originate mode : 1750 Hz	ON→OFF	–48	–46	—	
CD Level Hysteresis	V_{HYS}	VR2 open at AIN pin		—	2	—	dB
CD Delay Time	t_{CDD1}	OFF → –6 dBm		—	8	—	ms
	t_{CDD2}	OFF → –40 dBm		5	14	22	
CD Hold Time	t_{CDH1}	–6 dBm → OFF		20	31	40	
	t_{CDH2}	–40 dBm → OFF		—	23	—	
Demodulated Data Bias Distortion	D_{BS}	300 bps,1 : 1 pattern		—	—	±10	%
NRTS Signal Versus Modem Receive Signal Allowable Level Ratio	V_{NR}	V_{NRTS}/V receive modem signal NRTS : 2765 Hz ±30 Hz		—	—	–2	dB
Receive data output Delay Time	t_{RDD}	AIN → RD		—	5	—	ms

*1 When the carrier detector does not detect ($\overline{CD}$="1"), RD is fixed to "1".

AC Characteristics (Call progress tone detector)

(V_{DD} = 2.5 V to 3.6 V, Ta = –40°C to +85°C)

Parameter	Symbol	Condition	Min.	Typ.	Max.	Unit
CPT Detect Level	V_{DETCP}	400 Hz	–40	—	–6	dBm
CPT Non-Detect Level	V_{REJCP}	400 Hz	—	—	–60	dBm
CPT Detect Frequency	f_{DETCP}	See Fig. 3.	380	—	420	Hz
CPT Non-Detect Frequency	f_{REJCP}	See Fig. 3.	500	—	—	Hz
			—	—	300	
CPT Detect Delay Time	t_{DELCP}	—	—	20	—	ms
CPT Detect Hold Time	t_{HOLCP}	—	—	15	—	ms

AC Characteristics

(V_{DD} = 2.5 V to 3.6 V, Ta = –40°C to +85°C)

Parameter	Symbol	Condition		Min.	Typ.	Max.	Unit
Transmit Signal Output Level	V_{AOUT}	AOUT		—	—	1.1	Vp-p
Output Load Resistance	R_{LX}	MOD, DTO, GAT2		20	—	—	kΩ
	R_{LVR1}	Resistor between VR1 and SGO		40	—	—	
	R_{LAO}	AOUT		30	—	—	
Output Impedance	R_{OX}	AOUT, MOD, DTO, GAT2, VR1, SGO		—	100	—	Ω
Input Impedance	R_{AI}	GAT1, AIN		—	10	—	MΩ
Output DC Potential	V_{SG}	SGO		V_{DD}/2–0.1	V_{DD}/2	V_{DD}/2+0.1	V
	V_{DCAO}	AOUT		—	V_{DD}/2	—	
	V_{REF}	Potential difference between VR1 and SGO		0.7	0.75	0.8	
Out-of-band Output Noise	V_{S1}	Measured at AOUT R1= 30 kΩ C4 = 680 pF	4 kHz to 8 kHz	—	—	–45	dBm
	V_{S2}		8 kHz to 12 kHz	—	—	–65	
	V_{S3}		every 4 kHz bandwidth of 12 kHz or more	—	–70	–60	

TIMING DIAGRAM

When DTMF is received

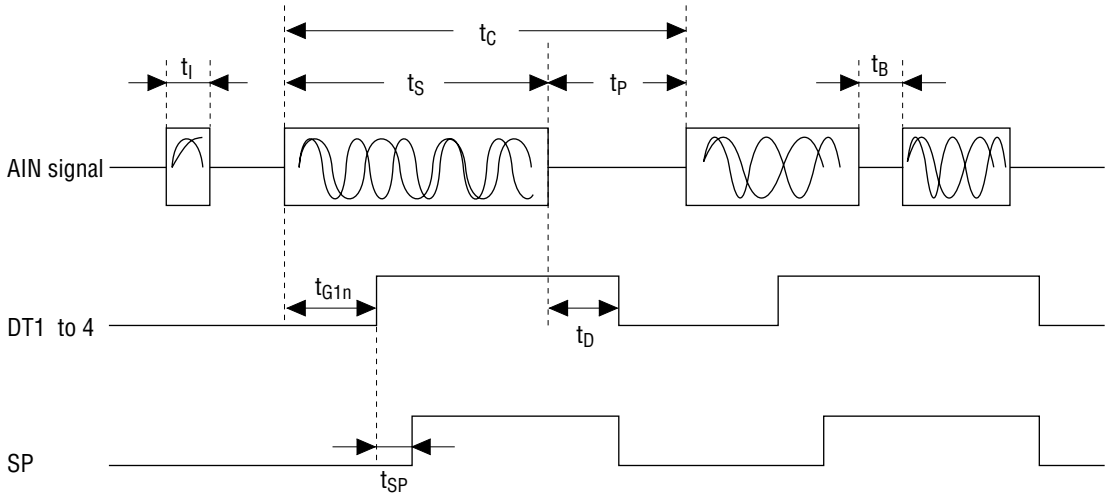


Figure 1 DTMF Receive Timing

t_S : Tone time for detect
When the input signal duration is t_S or more, receiving is normally done.

t_I : Tone time for no detect
When the input signal duration is t_I or less, this input signal is ignored and DT1 to DT4 and SP is not output.

t_P : Interdigit pause time
When there is no input signal for t_P or more, DT1 to DT4 and SP are reset.

t_B : Acceptable drop out time
DT1 to DT4 and SP are not reset even though a no-signal state for t_B or less (momentary no-signal) occurs during signal receiving. The t_B is applicable while the received signals are output. (SP="1")

t_{SP} : SP delay time
Against the DT1 to DT4 output, SP is output after a delay of t_{SP}. Therefore, latch DT1 to DT4 at the rising edge of SP.

t_C : Signal repetition time
For normal receiving, set the signal repetition time to t_C or more.

t_{G1n} : Output delay time (n: 1 or 2)
Against the appearance of the input signal, DT1 to DT4 are outputs after a delay of t_{G1n}.

t_D : Output trailing edge delay time
Against the stop of the input signal, DT1 to DT4 and SP stop outputting after a delay of t_D.

When the DTMF tone is sent

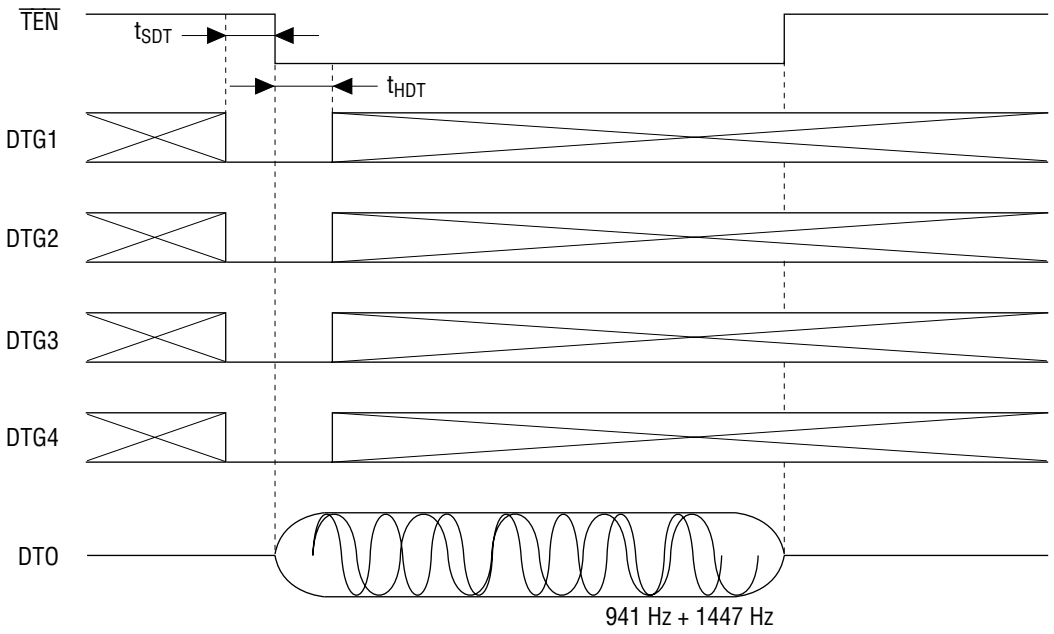


Figure 2 DTMF Transmit Timing

When the call progress tone (CPT) is detected

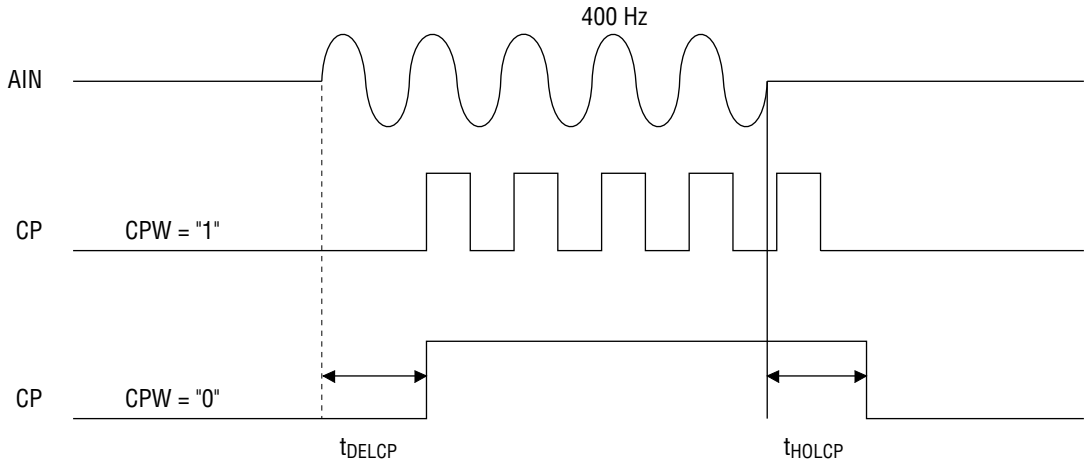


Figure 3 Call Progress Tone Detect Timing

FUNCTIONAL DESCRIPTION

Oscillation circuit

Connect a 3.579545 MHz crystal resonator between X1 and X2. If the load capacitance of the crystal resonator is 16 pF, connect a 12 pF capacitor between X1 and GND and between X2 and GND.
When an external clock is used, input the external clock to X2 via a 200 pF capacitor and leave X1 open.

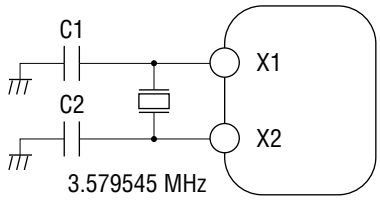


Figure 4 Connection of the Crystal Resonator

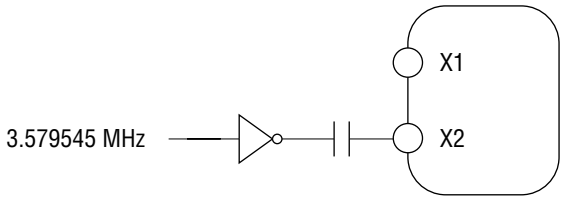


Figure 5 Connection of the External Clock

Signal ground

Connect a capacitor of 1 µF between SGC and GND. Do not connect anything other than this capacitor to the SGC pin.
SGO outputs 1/2 V_{DD} and can also be used as the reference voltage for the peripheral circuit. A capacitor of 0.1 µF or more should be connected between SGO and GND.

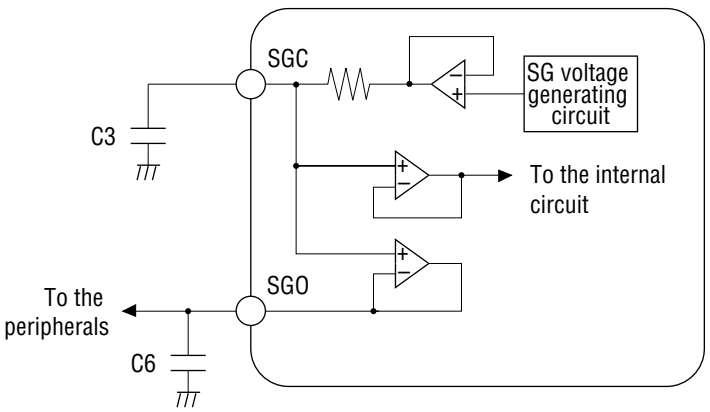


Figure 6 Signal Ground

Digital input pin

The digital input pin contains a pull-up resistor. Therefore, supply the V_{IH} voltage (V_{DD}) to this pin or open this pin to input "1". To input "0", supply the V_{IL} voltage (GND) to this pin.
Upon power down ($\overline{PON}$ = "1"), this pull-up goes into a high-impedance state. Therefore, current is not affected upon power down even though the V_{IL} voltage remains connected to the digital input pin.

Operation mode selection

By setting the MODE1 to MODE3 pins, an operation mode can be selected (see Table 1). The call progress tone detector (CPT DET.) can be operated in the DTMF signal transmit mode and modem mode. However, since the carrier detector is also used for the call progress tone detector, only rectangular waveform output is available in modem mode. Set CPW = "1" when activating the call progress tone detector in a modem mode.

Table 1 Operation Mode Table

MODE			Operation Mode				Functional Block				
							DTMF GEN.	DTMF REC.	FSK MODEM	CPT DET.	
3	2	1								CPW = "1"	CPW = "0"
0	0	0	DTMF mode		DTMF signal transmit		*			*	*
0	0	1			DTMF signal receive			*			
0	1	0	Modem mode	Normal operation	Originate (O)				*	*	
0	1	1			Answer (A)				*	*	
1	0	0		Test mode	Analog loopback (ALB)	O			*	*	
1	0	1				A			*	*	
1	1	0			Remote digital loopback (RDLB)	O			*	*	
1	1	1				A			*	*	

* means active.

Note: The carrier detecor may malfunction within 40 ms after the operating mode is changed from the DTMF or power down mode to the modem mode.
Therefore, ignore an output signal from $\overline{CD}$ and RD during this period of time.

DTMF mode setting procedure after power-on or after releasing power-down mode

(1) Put power-on or release power-down mode.
(2) Set DTMF signal transmit mode. $\overline{PON}$="0", $\overline{TEN}$="1"
(3) Wait more than 20 ms, V_{DD} must be more than 2.5 V after this wait time.
(4-1) In the case of DTMF receive, set DTMF signal to receive mode.
(4-2) In the case of DTMF transmit, it is possible control transmit enable ($\overline{TEN}$).

Modem mode setting procedure after power-on

(1) Power on.
(2) Set $\overline{PON}$="1", $\overline{TEN}$="1" and $\overline{RS}$="1". Set mode to be used.
(3) More than 200 µs after V_{DD} becomes more than 2 V, set $\overline{PON}$="0".
(4) Wait more than 20 ms. V_{DD} must be more than 2.5 V after this wait time.
(5) It is possible to control transmit output. Ignore an output signal from $\overline{CD}$ and RD of more than 40 ms which includes the wait time of term (4).

Modem signal flow

Figure 7 shows the signal flow during normal modem operation.

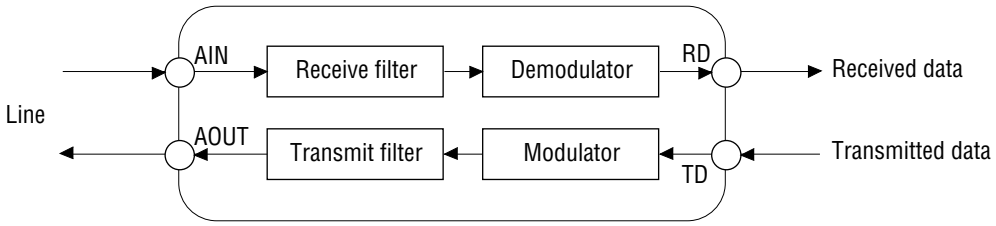


Figure 7 Signal Flow in Normal Operation

The MSM7715 uses the analog loopback test (ALB) mode and remote digital loopback test (RDLB) mode as the modem testing functions. In these test modes, the signal flow shown in Figure 8 is used. O (originate)/A (answer) in the test mode is the expression based on the modulator side. In ALB mode, the transmit analog signal is input to the demodulator and can be monitored as RD. In RDLB mode, the modem is configured as the remote modem in the RDL test mode.
Data from the other modem that requested for RDL is returned to the other modem as a result of echo-back.

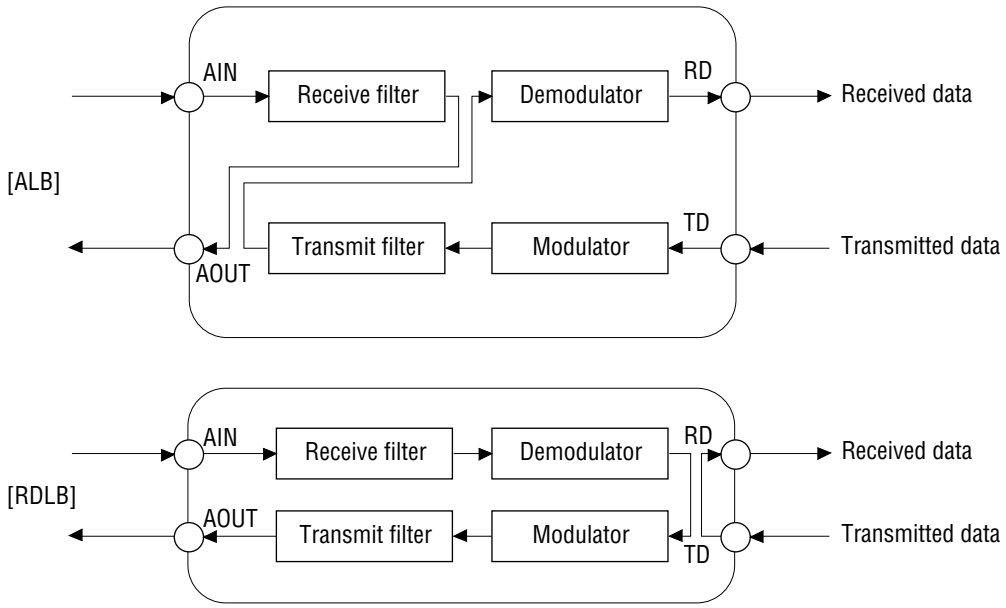


Figure 8 Signal Flow in Test Mode

DTMF signal code

Sixteen types of DTMF transmit signals can be set by using DTG1 to DTG4. Also, sixteen types of DTMF receive signals can be monitored by using DT1 to DT4. Table 2 shows the DTMF signal codes.

Table 2 DTMF Signal Codes

Button	Low-group signal (Hz)				High-group signal (Hz)				DT4 DTG4	DT3 DTG3	DT2 DTG2	DT1 DTG1
	697	770	852	941	1209	1336	1477	1633				
1	*				*				0	0	0	1
2	*					*			0	0	1	0
3	*						*		0	0	1	1
4		*			*				0	1	0	0
5		*				*			0	1	0	1
6		*					*		0	1	1	0
7			*		*				0	1	1	1
8			*			*			1	0	0	0
9			*				*		1	0	0	1
0				*		*			1	0	1	0
*				*	*				1	0	1	1
#				*			*		1	1	0	0
A	*							*	1	1	0	1
B		*						*	1	1	1	0
C			*					*	1	1	1	1
D				*				*	0	0	0	0

Microcontroller interface

By externally connecting DT1 to DT4 and DTG1 to DTG4 respectively, a 4-bit bus can be configured (Fig 9).
In DTMF signal transmit mode, DT1 to DT4 enter a high-impedance state and this 4-bit line is used to set the DTMF code against DTG1 to DTG4. The bus data is latched at the falling edge of $\overline{\text{TEN}}$.
In DTMF signal receive mode, DT1 to DT4 enter an output state. The 4-bit bus line is used as the output of the DTMF code from DT1 to DT4 to the microcontroller. Latch this bus data at the rising edge of SP.
In modem mode, DT1 to DT4 enter a high-impedance state. This 4-bit bus line is pulled up by the pull-up resistor in DTG1 to DTG4.
In power-down mode ($\overline{\text{PON}}$ = "1"), DT1 to DT4 enter a high-impedance state. Since the pull-up resistors in DTG1 to DTG4 also enter a high-impedance state, potential of this 4-bit bus line becomes unstable from the MSM7715.

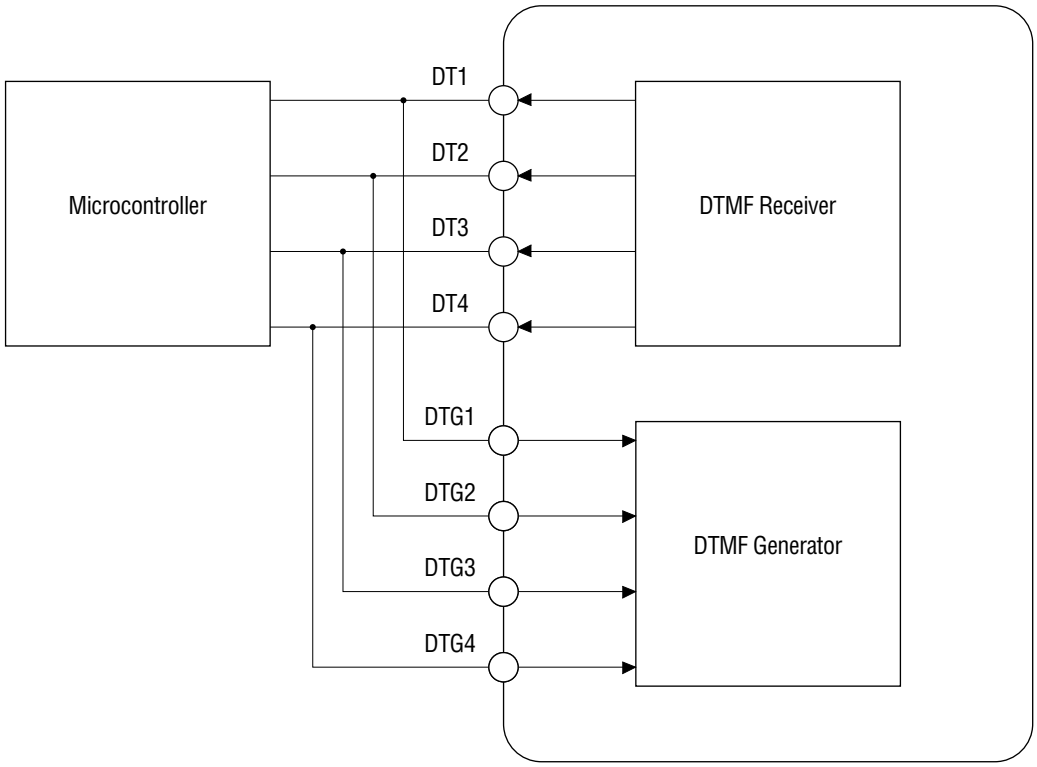


Figure 9 Microcontroller Interface Example

Setting the transmit signal level

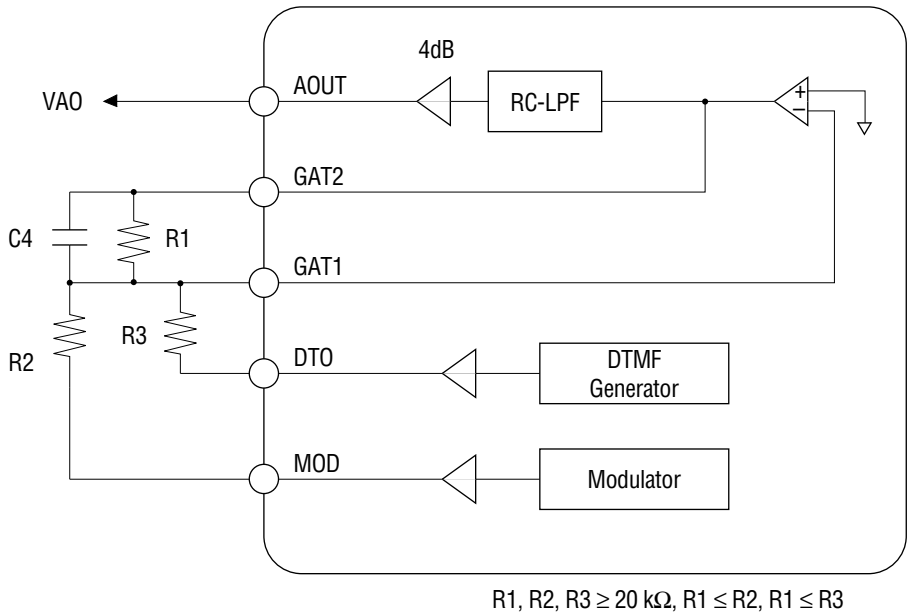


Figure 10 Setting the Transmit Signal Level

The modem's modulated analog signal and DTMF signal are not transmitted at the same time. The signal to be transmitted is determined by the selected operation mode. This device provides the pins for individual setting of transmit signal levels.

V_{AOM}: Level of the modem signal at the AOUT pin when R1 = R2 (dBm)
V_{AODT}: Level of the DTMF signal at the AOUT pin when R1 = R3 (dBm)

When external resistors (R1, R2, R3) are changed, the signal level at AOUT is as follows:

V_{AO} (modem) = $20 \times \log (R1/R2) + V_{AOM}$
V_{AO} (DTMF) = $20 \times \log (R1/R3) + V_{AODT}$

However, to avoid distorted output, R1 ≤ R2 and R1 ≤ R3 are needed. In circuit design, R1 = R2 or R1 = R3 with 5% tolerance is permitted.
C4 is a component in the first order LPF for suppressing the out-of-band output noise. Select a value C4 in such a way that cutoff frequency F_C determined by R1 and C4 will be approximately 8 kHz.

$C4 = 1/ (2\pi \times R1 \times F_C)$

External adjustment of the carrier detection level

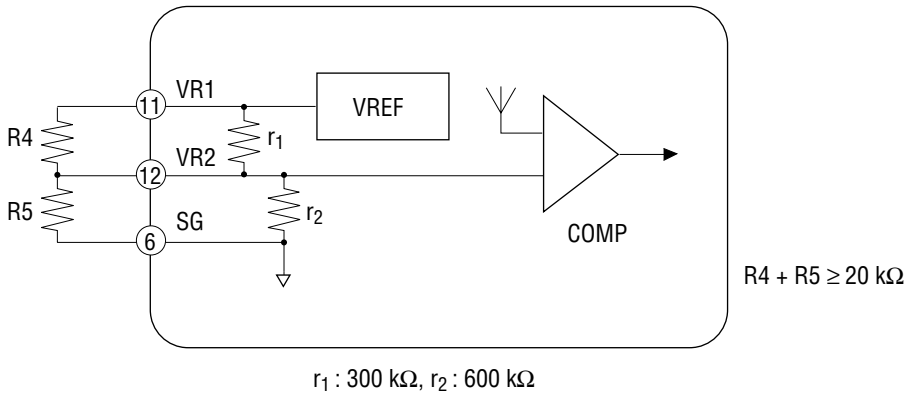


Figure 11 External Adjustment of the Carrier Detection Level

The carrier detection level is determined by the resistance ratio between the MSM7715's internal resistors r1 and r2, unless external resistors R4 and R5 are connected.
By connecting external resistors R4 and R5, the detection level can be adjusted. However, the width of hysteresis cannot be changed.

$Ra = R4 \times r_1/(R4 + r_1)$, Parallel-connected resistance of R4 and r_1
$Rb = R5 \times r_2/(R5 + r_2)$, Parallel-connected resistance of R5 and r_2
$V_{ON} = 20 \times \log (Rb/(Ra + Rb)) - 40.5$ (dBm)
$V_{OFF} = 20 \times \log (Rb/(Ra + Rb)) - 42.5$ (dBm)

Caution: r_1 and r_2 may vary in similar proportions over a 0.5 to 2.0 × range, due to the lot variation and temperature variation.

Analog Interface

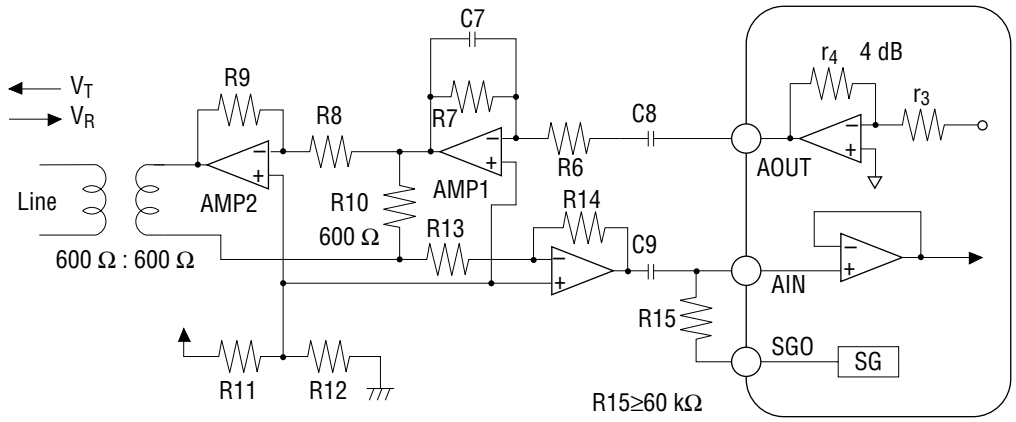


Figure 12 Analog Interface Circuit Example

When R1 = R2 in the modem mode, the AOUT output level is at its maximum value of about –9 dBm. When R1 = R3 in DTMF mode, the AOUT output level is at its maximum value of –11 dBm (sum of the low group and high group). To increase the transmit output level in the line to a high level, use an external amplifier (AMP1).

The receive signal levels can be adjusted by the values of R13 and R14.

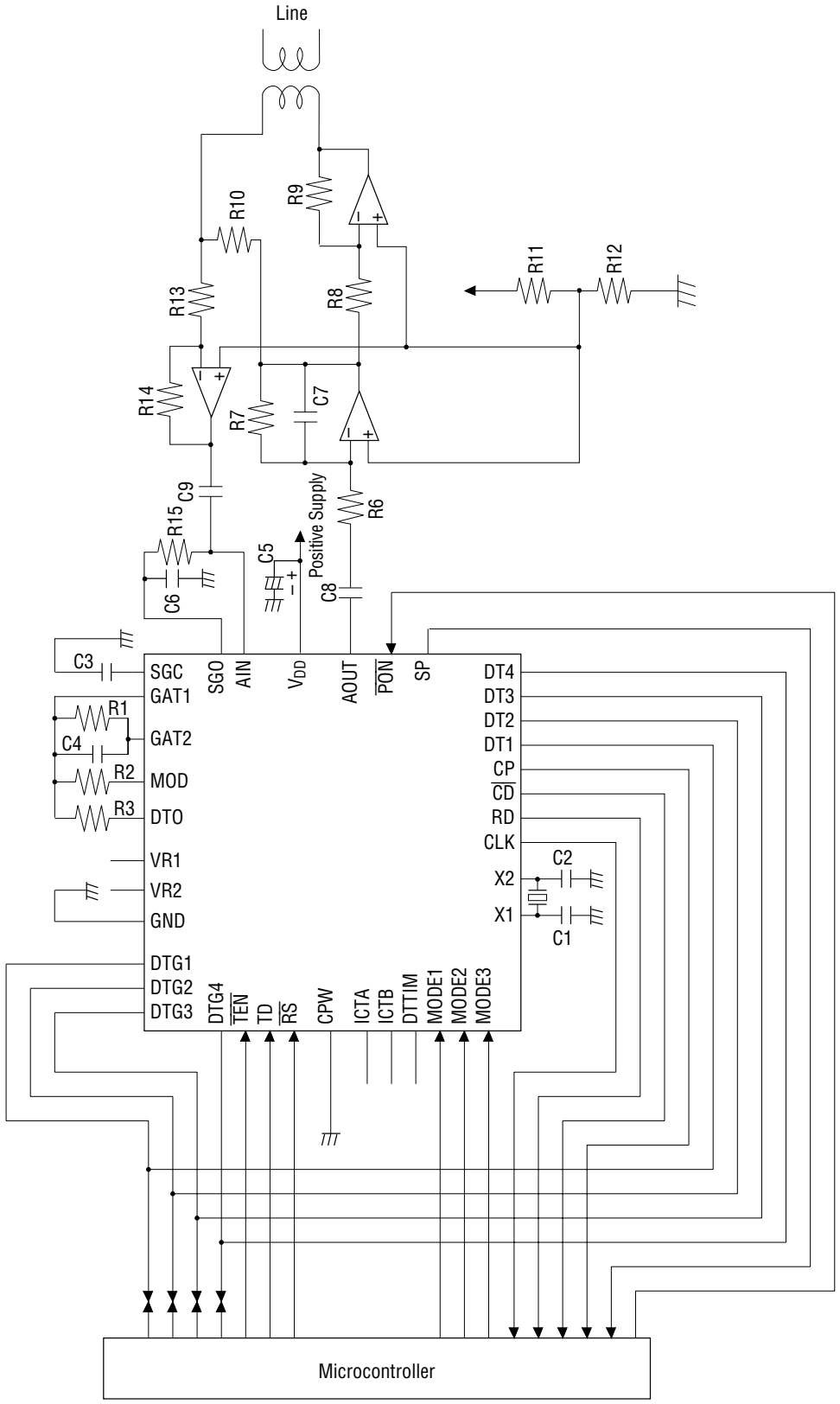
Clock noise of about –70 dBm will be generated from AOUT as out-of-band noise. (Clock noise has a frequency of 27.965 kHz and its odd harmonics.) The clock noise level is nearly always constant even if the output level of AOUT is lowered by varying the values of resistors R1 to R3 that are connected to GAT1, GAT2, DTO, and MOD. Therefore, to suppress this noise output to the line, build a LPF at the AMP1. Note, however, that setting the cutoff frequency of the LPF too low affects the output signal level.

Note that too large a time constant determined by the values of C9 and R15 allows the longer time required for reaching a stable DC level, which may result in the violation of specification for the DTMF signal receive output delay time.

Example: R15=100 kΩ, C9=0.022 μF.

Larger circuit-return levels of the transmit signal to the AIN pin can cause receive data errors. If the line impedance is equal to the R10 impedance, R8=R9 can not induce the circuit-return levels of the transmit signal to the AIN pin.
The peripheral circuits should be designed so that the circuit-return level, including variations of the line impedance, of the transmit signal to the AIN pin is –9 dBm or less.

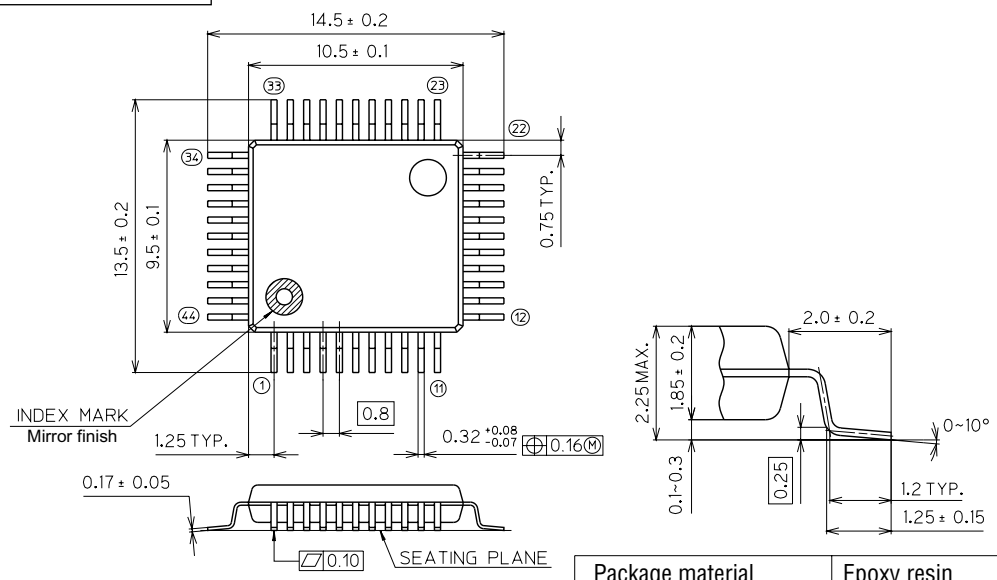
APPLICATION CIRCUIT



PACKAGE DIMENSIONS

(Unit : mm)

QFP44-P-910-0.80-2K



Package material	Epoxy resin
Lead frame material	42 alloy
Pin treatment	Solder plating (≥5 μm)
Package weight (g)	0.41 TYP.
Rev. No./Last Revised	4/Nov. 28, 1996

Oki Electric Industry Co., Ltd.

Notes for Mounting the Surface Mount Type Package

The SOP, QFP, TSOP, SOJ, QFJ (PLCC), SHP and BGA are surface mount type packages, which are very susceptible to heat in reflow mounting and humidity absorbed in storage.
Therefore, before you perform reflow mounting, contact Oki's responsible sales person for the product name, package name, pin number, package code and desired mounting conditions (reflow method, temperature and times).

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