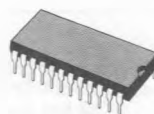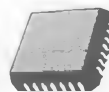# SGS-THOMSON
MICROELECTRONICS

TS7514

PROGRAMMABLE V.23 MODEM WITH DTMF

- PROGRAMMABLE MODES :
  - Modem 75 bps transmit, 1200 bps receive
  - Modem 1200 bps transmit, 75 bps receive
  - DTMF dialing
  - Call status tone detection
  - Auxiliary analog transmit input
  - Analog test loopback
- PROGRAMMABLE FUNCTIONS :
  - Transmission level
  - Hysteresis and detection level
  - Filters (reception and transmission)
  - Line monitoring and buzzer
  - DTMF frequencies
- FIXED COMPROMISE LINE EQUALIZER
- AUTOMATIC BIAS ADJUSTMENT
- INTEGRATED DUPLEXER
- STANDARD LOW COST CRYSTAL (3.579 MHZ)
- TAX TONE REJECTION
- POWER-UP INITIALIZATION OF REGISTERS
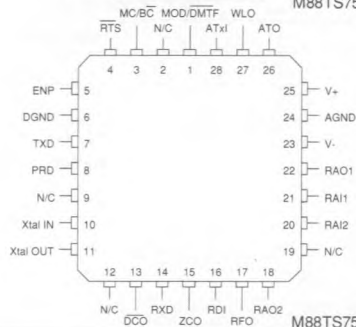- OPERATES FROM ± 5 VOLTS

P
DIP24
(Plastic Package)

FN
PLCC28
(Plastic Package)

PIN CONNECTIONS

MOD/$\overline{DTMF}$	1		24	ATxl
MC/$\overline{BC}$	2		23	WLO
$\overline{RTS}$	3		22	ATO
ENP	4		21	V+
DGND	5		20	AGND
TxD	6		19	V-
PRD	7		18	RAO1
Xtal IN	8		17	RAI1
Xtal OUT	9		16	RAI2
$\overline{DCD}$	10		15	RAO2
RxD	11		14	RFO
ZCO	12		13	RDI

M88TS7514-01

Pins (PLCC28):
$\overline{RTS}$ 4, N/C 3, MC/$\overline{BC}$ 2, MOD/$\overline{DTMF}$ 1, ATxl 28, WLO 27, ATO 26

- ENP 5 — 25 V+
- DGND 6 — 24 AGND
- TXD 7 — 23 V-
- PRD 8 — 22 RAO1
- N/C 9 — 21 RAI1
- Xtal IN 10 — 20 RAI2
- Xtal OUT 11 — 19 N/C

Bottom pins: N/C 12, $\overline{DCO}$ 13, RXD 14, ZCO 15, RDI 16, RFO 17, RAO2 18
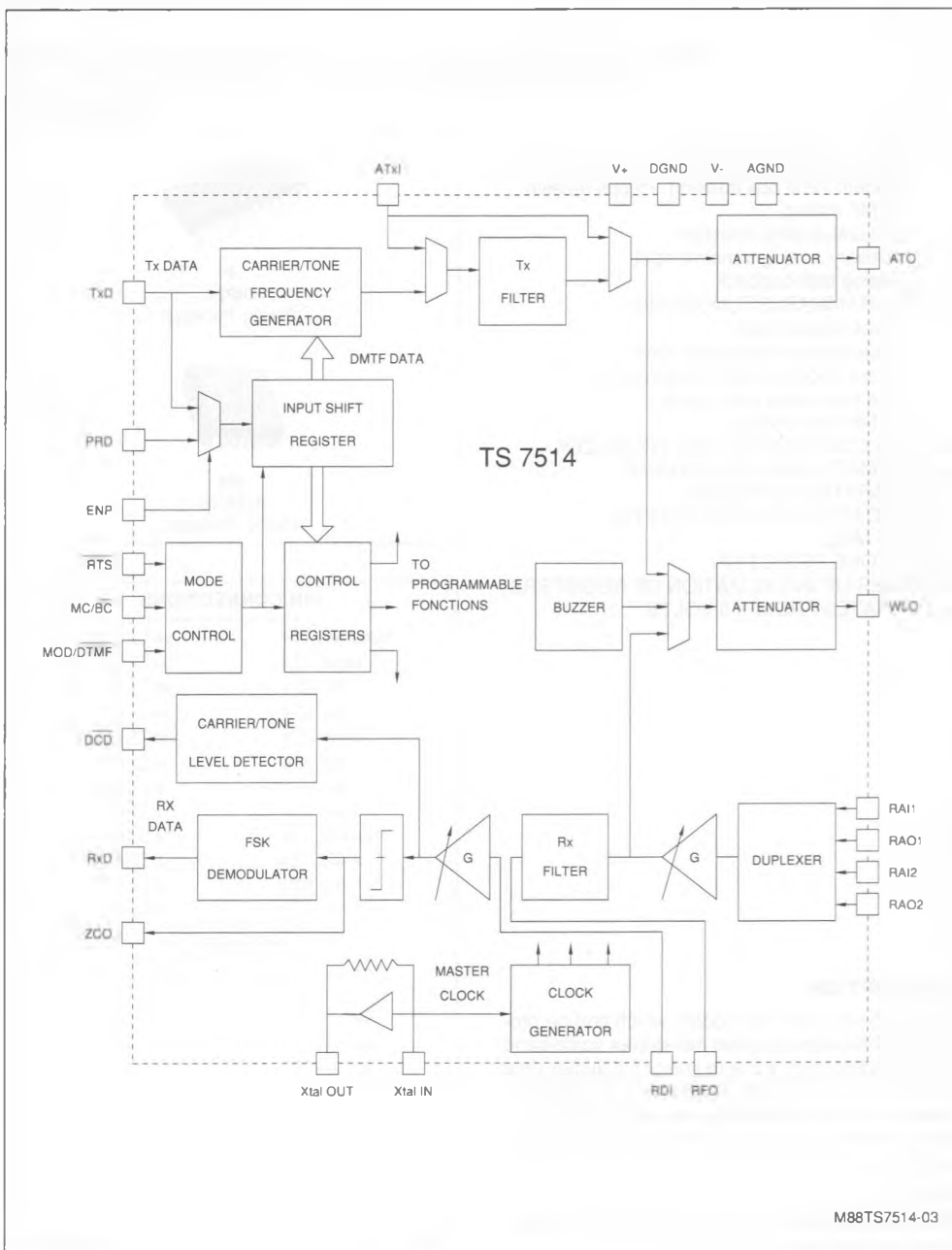
M88TS7514-02

DESCRIPTION

The TS7514 is an FSK modem which can be programmed for asynchronous half-duplex voice-band communications on a 2-wire line or full duplex on a 4-wire line. Its programming concept makes it the ideal component to design low-cost intelligent modems, featuring auto dialing and auto answering.

The TS7514 conforms to CCITT V.23 recommendation.

The chip incorporates DTMF dialing, line monitoring, tone and dialing detection.

ARCHITECTURE

Figure 1 : Simplified Block Diagram.

M88TS7514-03

PIN DESCRIPTION

Name	Pin n° P D I P	Pin n° P L C C	Description
MOD/DMTF	1	1	MODEM or DMTF Operating Mode Selection. Also controls write operations to control registers (if MOD/DMTF = 0 and MC/BC = 0).
MC/BC	2	3	Digital Control Input. In MODEM mode, it sets transmission mode to main or back channel. It also permits selection of dialing or control registers programming.
RTS	3	4	Request to Send. When RTS = 0, the circuit sends an analog signal to the ATO output. The signal depends on the operating mode selected. When RTS = 1. the signal sent to ATO is suppressed after its first zero crossing. When MOD/DMTF = 0 and MC/BC = 0, the RTS pin acts as a clock for serial data loading into the input register.
ENP	4	5	Serial Register Write Select Input. When ENP = 0, the serial register input is connected to TxD. When ENP = 1, the register input is connected to PRD.
DGND	5	6	Digital Ground = 0V. All digital signals are referenced to this pin.
TxD	6	7	Digital Input for Transmit or Control Data
PRD	7	8	Digital Input for Control Data. Selected through ENP
XtalIN	8	10	Crystal Oscillator Input. Can be tied to an external clock generator. F quartz = 3.579 MHz.
XtalOUT	9	11	Crystal Oscillator Output
DCD	10	13	Data Carrier Detect Output
RxD	11	14	Digital Receive Data Output
ZCO	12	15	Zero Crossing Rx Digital Output (ringing detection)
RDI	13	16	Analog Output for the Receive Signal after Filtering or Analog Input for the Amplifier-limiter.
RFO	14	17	Analog Receive Filter Output
RAO2	15	18	A2 Amplifier Output
RAI2	16	20	A2 Amplifier Inverting Input
RAI1	17	21	A1 Amplifier Inverting Input
RAO1	18	22	A1 Amplifier Output
V-	19	23	Negative Supply Voltage : – 5 V ± 5 %
AGND	20	24	Analog Ground = 0 V. Reference Pin for Analog Signals
V+	21	25	Positive Supply Voltage : + 5 V ± 5 %
ATO	22	26	Analog Transmit Output
WLO	23	27	Analog Output for Line Monitoring and Buzzer
ATxl	24	28	Direct Analog Input Transmit Filter

FUNCTIONAL DESCRIPTION

The TS7514 circuit is an FSK modem for half-duplex, voice-band asynchronous transmissions on a 2-wire line according to CCITT recommendation V.23 or full duplex on 4 wire-line.

The circuit features DTMF dialing, call status tone detection and line monitoring in both dialing and automatic answer modes. A signalling frequency is available at the line monitoring output (buzzer).

Ring detection is possible by using the signal detection function and bypassing the receive filter. The receive signal at ZCO output can be filtered in the associated microprocessor.

The TRANSMIT channel (Tx) includes :

- two programmable frequency generators
- one switched capacitor filter (SCF) with low-pass or bandpass configuration and its associated propagation delay corrector.
- one continuous time low-pass smoothing filter
- one attenuator, programmable from 0 to + 13 dB by 1 dB steps
- one programmable analog input

The RECEIVE channel (Rx) includes :

- two operational amplifiers for duplexer implementation
- one continuous time low-pass anti-aliasing filter
- one programmable gain amplifier
- one linear compromise equalizer
- one switched capacitor band pass filter (can be set to either main or back channel)
- one continuous time low pass smoothing filter
- one limiting amplifier
- one correlation demodulator
- one programmable level signal detector

Figure 2 : Internal Control Register.

The LINE MONITORING channel includes :

- one buzzer
- one 3-channel multiplexer to select beetwen
  - transmit channel monitoring
  - receive channel monitoring
  - buzzer
- one programmable attenuator

INTERNAL CONTROL

Power up initialization

The TS7514 includes power-up initialization of control registers. This system sets the ATO transmission output to an infinite attenuation position, leaving time for the microprocessor to set up the RPROG input on power up. Control registers are also initialized when V+ is lower than 3 V or V - greater than - 3 V.
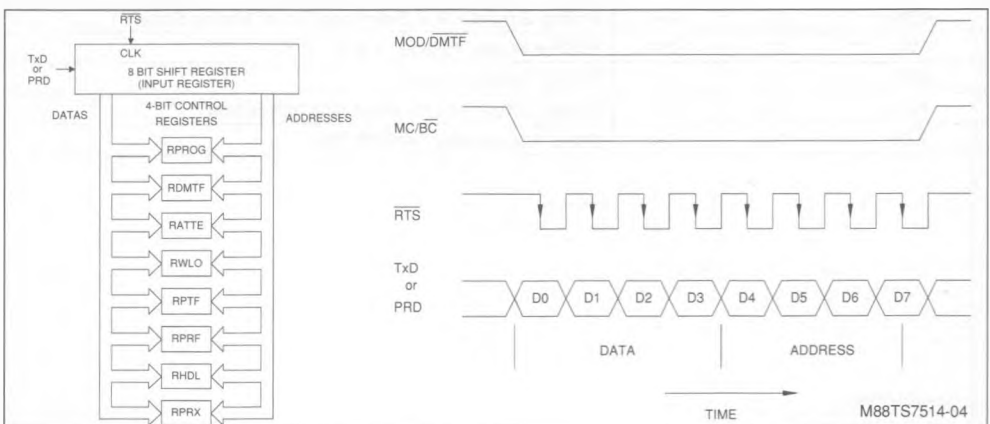
Registers

Write access to the DTMF data register and to other control registers is achieved in serial mode through TxD input or PRD input . Addressing of these 4 bit registers is indirect. They are accessed through an 8 bit shift register addressed when MOD/DTMF = 0 and MC/$\overline{BC}$ = 0. Data sent to the TxD input is strobed on the RTS signal trailing edge.

Serial data is sent to the TxD input, with Least Significant Bit (LSB) first. The 4 Most Significant Bits (MSB) contain the control register address while the 4 LSB contain associated data.

Data transfer from the input register to the control register (addressed by the MSB's) is started by the operating mode (MODEM or DTMF) selection (MOD/DTMF = 1 or MC/$\overline{BC}$ = 1).
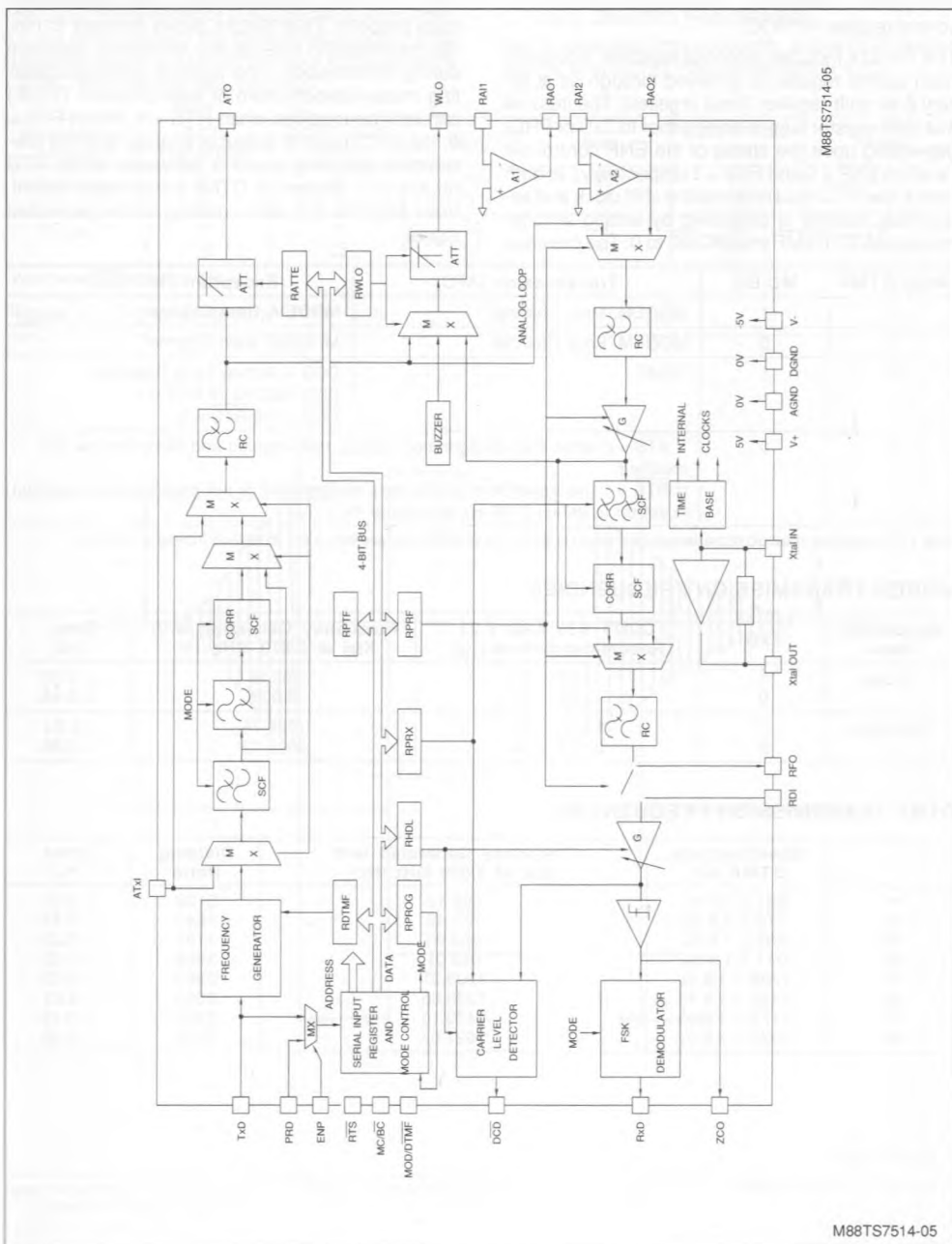
* N.B. PRD input can be used instead of TxD (when ENP = 1).

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FUNCTIONAL DESCRIPTION (continued)

Figure 3 : Detailed Block Diagram.

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OPERATING MODES

The various operating modes are defined by MC/$\overline{BC}$ and MOD/$\overline{DTMF}$ inputs, and by the content of a control register RPROG.

The TS7514 includes 8 control registers. Access to each control register is achieved through an auxiliary 8 bit shift register (input register). The input of that shift register is connected either to TxD or PRD, depending upon the status of the ENP control pin (ie when ENP = 0 and ENP = 1 respectively). In both cases, the $\overline{RTS}$ input receives the shift clock and sequentialy transfer is controlled by setting simultaneously MOD/$\overline{DTMF}$ and MC/$\overline{BC}$ to 0. The previous internal status and data are memorized during loading of the input register so that transmission continues properly. That feature allows the user to modify transmission level or line monitoring selection during transmission. The transmit channel operating mode (Modem main or back channel, DTMF) can only be modified when $\overline{RTS}$ = 1. When RTS = 0, the ATO transmit output is enabled and the preselected operating mode is activated. When RTS returns to 1, Modem or DTMF transmission is inhibited after the first zero crossing of the generated signal.

MOD/$\overline{DTMF}$	MC/$\overline{BC}$	Transmission (ATO)	Reception (RxD, $\overline{DCD}$)
1	1	MODEM, Main Channel	MODEM, Back Channel
1	0	MODEM, Back Channel	MODEM, Main Channel
0	1	DTMF	$\overline{DCD}$ = Active Tone Detection (270 -500 Hz) if $\overline{RTS}$ = 1... $\overline{DCD}$ = 1 if RTS = 0
0	0	If $\overline{RTS}$ = 0 when that configuration occurs, transmission and reception are not modified. If RTS = 1 (no signal sent on the line), transmission is not modified and reception is set up to detect 2100 Hz tone (note 1).	

Note 1 : The decision threshold of the demodulator output is shifted, so that RxD changes from 0 to 1 at 1950 Hz instead of 1700 Hz.

MODEM TRANSMISSION FREQUENCIES

Modulation Rate	TxD	CCITT R35 AND V.23 Recommendations (Hz)	Frequency Generated with Xtal at 3.579 MHz (Hz)	Error (Hz)
75 bps	1	390 ± 2	390.09	+ 0.09
	0	450 ± 2	450.45	+ 0.45
1200 bps	1	1300 + 10	1299.76	− 0.24
	0	2100 ± 10	2099.12	− 0.88

DTMF TRANSMISSION FREQUENCIES

	Specifications DTMF (Hz)	Frequency Generated with Xtal at 3.579 MHz (Hz)	Dividing Ratio	Error (%)
f1	697 ± 1.8 %	699.13	5120	+ 0.31
f2	770 ± 1.8 %	771.45	4640	+ 0.19
f3	852 ± 1.8 %	853.90	4192	+ 0.22
f4	941 ± 1.8 %	940.01	3808	- 0.10
f5	1209 ± 1.8 %	1209.31	2960	+ 0.03
f6	1336 ± 1.8 %	1335.65	2680	- 0.03
f7	1477 ± 1.8 %	1479.15	2420	+ 0.15
f8	1633 ± 1.8 %	1627.07	2200	+ 0.36

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CARRIER LEVEL DETECTOR

- Output Level Detection conditions

The DCD signal detector output is set to logic state 0 if the RMS value of the demodulator input signal is greater than N1. The DCD output has logic state 1 if the RMS value is less than N2.

The detector has an hysteresis effect : N1 - N2.

- Timing Detection Requirements

Signal detection time constants at the DCD output comply with CCITT Recommendation V.23.

Modulation Ratio	DCD Transition	CCITT V.23 (min)	Min.	Max.	CCITT V.23 (max)	Unit
1200 bps	t1	10	10	20	20	ms
	t2	5	5	15	15	ms
75 bps *	t1	0	15	40	80	ms
	t2	15	15	40	80	ms

* Wide band Rx filter used (Fig 4c.)

Figure 4 : Signal Detection Time Out.
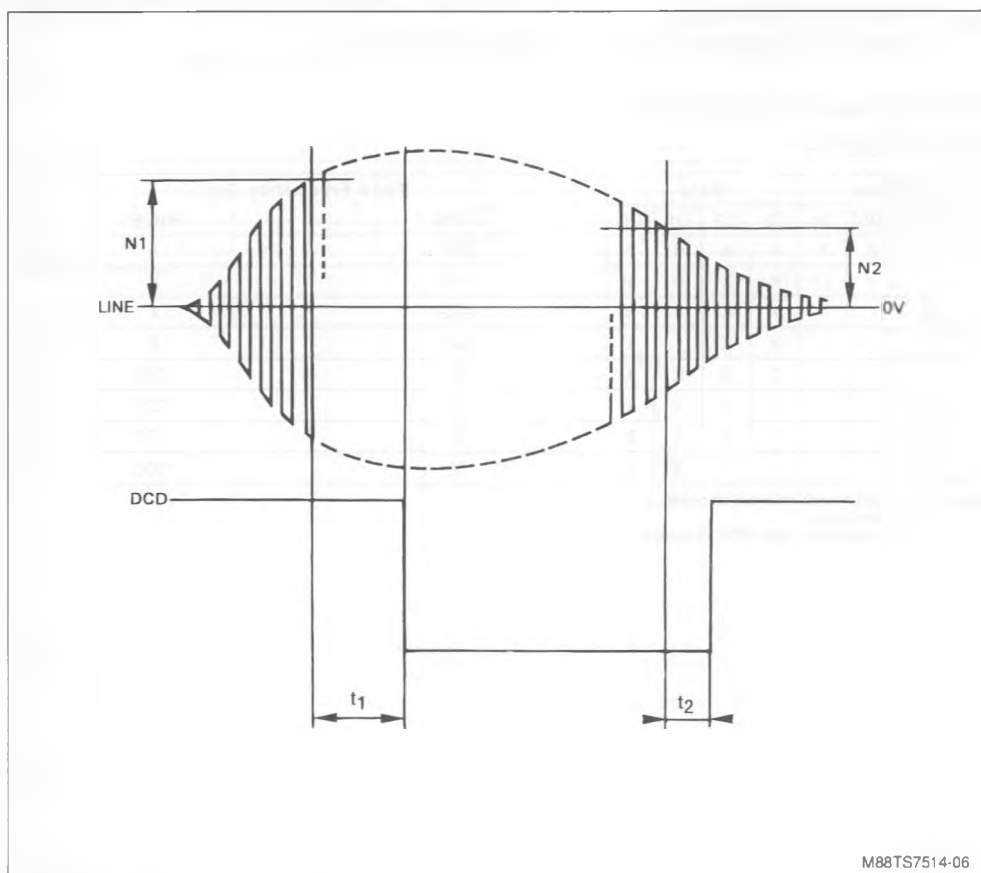
M88TS7514-06

Note : When delays are bypassed (see RPRX register programming) response time ranges from 0 to 5 ms in receive mode at 1200 bps, and from 0 to 10 ms at 75 bps.

PROGRAMMING REGISTER

RPROG

Address				Data				Selected Mode (note 1)
D7	D6	D5	D4	D3	D2	D1	D0	
X	0	0	0	0	X	0	0	The most significant bit (D 7) is not used when decoding control
				0	X	1	1	register addresses.
				0	X	0	1	Control register addressing is enabled when D 7 = 0 (see note 2).
				0	X	1	0	Control register addressing is enabled when D 7 = 1 (see note 2).
				0	0	X	X	Reception positioned in the channel opposite to the transmission channel controlled by MC/BC
				0	1	X	X	Reception positioned in the same channel as transmission (see note 3).
				1	X	X	X	Programming inhibited in normal operating mode. This mode is used for testing purposes.

Note : 1. RPROG is set to 0000 on power-up.
2. Excepted for RPROG register whose address is always 000, regardless of D0 and D1.
3. This mode allows either full duplex operation on a 4-wire line, or circuit testing with external Tx/Rx loopback.

DTMF DIALING DATA REGISTER

RDTMF REGISTER

Address				Data				Tone Frequency (Hz)	
D7	D6	D5	D4	D3	D2	D1	D0	LOW	HIGH
P	0	0	1	X	X	0	0	697	X
				X	X	0	1	770	X
				X	X	1	0	852	X
				X	X	1	1	941	X
				0	0	X	X	X	1209
				0	1	X	X	X	1336
				1	0	X	X	X	1477
				1	1	X	X	X	1633

Note : This register is not initialized on power up.
X : Don't care value.
P : 1,0 or X depending upon RPROG content.

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DATA REGISTER FOR THE TRANSMISSION ATTENUATOR

RATE REGISTER

Address				Data				Attenuation (dB)	Output Transmit Level (dBm)	On Line Level (dBm) Coupler Gain (− 6dB)
D7	D6	D5	D4	D3	D2	D1	D0			
P	0	1	0	0	0	0	0	0	+ 4	− 2
				0	0	0	1	1	+ 3	− 3
				0	0	1	0	2	+ 2	− 4
				0	0	1	1	3	+ 1	− 5
				0	1	0	0	4	0	− 6
				0	1	0	1	5	− 1	− 7
				0	1	1	0	6	− 2	− 8
				0	1	1	1	7	− 3	− 9
				1	0	0	0	8	− 4	− 10
				1	0	0	1	9	− 5	− 11
				1	0	1	0	10	− 6	− 12
				1	0	1	1	11	− 7	− 13
				1	1	0	0	12	− 8	− 14
				1	1	0	1	13	− 9	− 15
				1	1	1	0	Infinite	< − 64	< − 70
				1	1	1	1	Infinite*	< − 64 *	< − 70 *

* Power - up configuration.

LINE MONITORING PROGRAMMING REGISTER

RWLO REGISTER

Address				Data				Line Monitoring In Transmit Mode Relative Level (dB)	Line Monitoring In Receive Mode Relative Level (dB)	Signalling Frequency Absolute Level (V_{PP}) Relative Level (dB) (see note)
D7	D6	D5	D4	D3	D2	D1	D0			
P	0	1	1	0	0	0	0	− 10		
				0	0	0	1	− 20		
				0	0	1	0	− 31		
				0	0	1	1	− 42		
				0	1	0	0		0	
				0	1	0	1		− 10	
				0	1	1	0		− 20	
				0	1	1	1		− 31	
				1	0	0	0			0.42 V_{PP}
				1	0	0	1			− 10 dB
				1	0	1	0			− 20 dB
				1	0	1	1			− 31 dB
				1	1	X	X			< − 60 dB*

* Power - up configuration
Note : Signalling frequency is a square wave signal at 2982 Hz.

RECEIVE FILTER SELECTION AND GAIN PROGRAMMING REGISTER

RPRF REGISTER

Address				Data				Reception Gain (dB) (note 1)	Comments
D7	D6	D5	D4	D3	D2	D1	D0		
P	1	0	1	X	X	0	0	0	
				X	X	0	1	+ 6 *	
				X	X	1	0	+ 12	
				X	X	1	1	0	Rx Channel Band = Tx Channel Band Tx to Rx Loopback − 33 dBm ≤ Rx Level ≤ −40dBm
				X	0	X	X	X	Receive Filter Selected
				X	1	X	X	X	Receive Filter Desabled
				1	X	X	X	X	Receive Filter Disconnected from RDI Output and from Demodulator. Offset Disabled.

* Power - up configuration
Note 1 : Depending on the line length, the received signal can be amplified. Programmable reception gain allows setting a level close to + 3dBm at the filter input to take benefit of the maximum filter dynamic range (S / N ratio). The following requirement must be met : Max line level + prog. gain ≤ + 3 dBm.

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TRANSMISSION FILTER PROGRAMMING REGISTER

RPTF REGISTER

Address				Data				ATO Transmission
D7	D6	D5	D4	D3	D2	D1	D0	
P	1	0	0	0	0	0	0	MODEM or DTMF Signal*
				0	0	0	1	ATxI via Smoothing Filter and Attenuator
				0	0	1	0	ATxI via Low-pass Filter and Attenuator
				0	0	1	1	ATxI via Band-pass Filter and Attenuator
				0	1	0	0	In DTMF Mode, Transmision of High Tone Frequency
				1	0	0	0	In DTMF Mode, Transmission of Low Tone Frequency

* Power - up configuration.

HYSTERESIS AND SIGNAL DETECTION LEVEL PROGRAMMING REGISTER

RHDL REGISTER

Address				Data				N2 (dBm) (note 1) See Figure 4	N1/N2 (dB)
D7	D6	D5	D4	D3	D2	D1	D0		
P	1	1	0	X	0	0	0	− 43 *	X
				X	0	0	1	* − 41	X
				X	0	1	0	− 39	X
				X	0	1	1	− 37	X
				X	1	0	0	− 35	X
				X	1	0	1	− 33	X
				X	1	1	0	− 31	X
				X	1	1	1	− 29	X
				0	X	X	X	X	3 *
				1	X	X	X	X	3.5

* Power - up configuration.
Note 1 : Detection low level measured at the demodulator input. The line signal detection level is obtained by reducing the gain ate the filter input.

RECEIVE CHANNEL PROGRAMMING REGISTER

RPRX REGISTER

Address				Data				Configuration
D7	D6	D5	D4	D3	D2	D1	D0	
P	1	1	1	X	X	0	X	Low Frequency Wide Band Selected (fig. 4b)*
				X	X	1	X	Low Frequency Narrow Band Selected (fig. 4c)
				X	X	X	0	Carrier Level Detector Delay Enabled*
				X	X	X	1	Carrier Level Detector Delay Disabled.

Note : In active tone detection mode (MOD/DTMF = Ø, MC/BC = 1, RTS = 1 see op. modes), The low frequency wide band is automatically selected for the receive channel, whatever the RPRX register programming value.
After a switch back to modem mode (MOD/DTMF = 1, MC/BC = Ø or 1) the RPRX register indicates again the value programmed before the active tone detection mode.

ABSOLUTE MAXIMUM RATINGS

Symbol	Parameter	Value	Unit
DGND	DGND (digital ground) to AGND (analog ground)	− 0.3 to + 0.3	V
V+	Supply Voltage V+ to DGND ro AGND	− 0.3 to + 7	V
V−	Supply Voltage V- to DGND or AGND	− 7 to + 0.3	V
V_I	Voltage at any Digital Input	DGND - 0.3 to V+ + 0.3	V
V_{in}	Voltage at any Analog Input	V− 0.3 to V + + 0.3	V
I_o	Current at any Digital Output	− 20 to + 20	mA
I_{out}	Current at any Analog Output	− 10 to + 10	mA
P_{tot}	Power Dissipation	500	mW
T_{op}	Operating Temperature Range	0 to 70	°C
T_{stg}	Storage Temperature Range	− 65 to + 150	°C
T_{lead}	Lead Temperature (soldering, 10 s)	+ 260	°C

If the Maximum Ratings are exceeded, permanent damage may be caused to the device. This is a stress rating only, and functional operation of the device under these or any other conditions for extended periods may affect device reliability. Standard CMOS handling procedures should be employed to avoid possible damage to the device.

ELECTRIC OPERATING CHARACTERISTICS

Symbol	Characteristic	Min.	Typ.	Max.	Unit
V+	Positive Supply Voltage	4.75	5	5.25	V
V−	Negative Supply Voltage	− 5.25	− 5.0	− 4.75	V
I+	V+ Operating Current	−	10	15	mA
I-	V- Operating Current	− 15	− 10	−	mA

DC AND OPERATING CHARACTERISTICS

Electrical characteristics are guaranteed over the complete temperature range, with typical load except where otherwise indicated. Typical values are given for :

V+ = +5V, V- = -5V and room temperature = 25°C

DIGITAL INTERFACE (MOD / $\overline{DTMF}$, $\overline{RTS}$, $\overline{DCD}$, RxD, ZCO, TxD, MC / $\overline{BC}$, ENP, PRD)

Symbol	Characteristic		Min.	Typ.	Max.	Unit
V_{IL}	Input Voltage, Low Level		−	−	0.8	V
V_{IH}	Input Voltage, High Level		− 2.2	−	−	−
I_{IL}	Input Current, Low Level	DGND < Vi < VIL (max)	− 10	−	10	µA
I_{IH}	Input Current, High Level	VIH (min) < V_I < V+	− 10	−	10	µA
I_{OL}	Output Current Low, Level	V_{OL} = 0.4 V	1.6	−	−	mA
I_{OH}	Output Current, High Level	V_{OH} = 2.8 V	−	−	− 250	µA

ANALOG INTERFACE-PROGRAMMABLE (ATxl)

Symbol	Characteristic	Min.	Typ.	Max.	Unit
V_{in}	Input Voltage Range	− 1.8	−	+ 1.8	V
I_{in}	Input Current (filter output selected)	− 10	−	+ 10	µA
C_{in}	Input Capacitance (ATT output selected)	−	−	20	pF
R_{in}	Input Resistance (ATT output selected)	100	−	−	kΩ

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ANALOG INTERFACE - TRANSMIT OUTPUT (ATO) (load conditions R_L = 560 Ω, C_L = 100 pF)

Symbol	Characteristic	Min.	Typ.	Max.	Unit.
V_{OS}	Output Offset Voltage	− 250	−	+ 250	mV
C_L	Load Capacitance	−	−	100	pF
R_L	Load Resistance	−	560	−	Ω
V_{out}	Output Voltage Swing	− 1.8	−	+ 1.8	V
R_{out}	Output Resistance	10	−	25	Ω
−	ATO Attenuation Ratio when $\overline{RTS}$ = 1	70	−	−	dB

ANALOG INTERFACE - LINE MONITORING (WLO) (load conditions , R_L = 10 kΩ, C_L = 50 pF)

Symbol	Characteristic	Min.	Typ.	Max.	Unit
V_{OS}	Output Offset Voltage	− 250	−	+ 250	mV
C_L	Load Capacitance	−	−	100	pF
R_L	Load Resistance	10	−	−	kΩ
V_{out}	Output Voltage Swing	− 1.8	−	+ 1.8	V
R_{out}	Output Resistance	−	−	15	Ω
−	WLO Attenuation Ratio	70	−	−	dB

ANALOG INTERFACE - DUPLEXER (RAI +, RAI −, RA0)

Symbol	Characteristic		Min.	Typ.	Max.	Unit
V_{in}	Input Voltage Range RAI+, RAI−		− 2	−	+ 2	V
I_{in}	Input Current RAI+, RAI−		− 10	−	+ 10	μA
C_{in}	Input Capacitance RAI+, RAI−		−	−	10	pF
V_{off}	Input Offset Voltage RAI+, RAI−		− 20	−	+ 20	mV
V_{out}	Output Voltage Swing, RA0	C_L = 100 pF, R_L = 600 Ω R_L = 300 Ω	− 1.8 − 0.9	− −	+ 1.8 + 0.9	V V
C_L	Load Capacitance RAO1	C_L = 100 p F	−	−	100	pF
R_L	Load Resistance RA01		300	−	−	Ω
G	DC Voltage Gain in Large Signals, RA01	R_L = 300 Ω C_L = 100 p F	60	−	−	dB
CMRR	Common Mode Rejection Ratio, RA01, RA02		60	−	−	dB
PSRR	Supply Voltage Rejection Ratio, RA01, RA02		60	−	−	dB
V_{out}	Output Voltage Swing, RA02	C_L = 50 pF, R_L = 10 kΩ	− 2.5	−	2.5	V
C_L	Load Capacitance, RA02		−	−	50	pF
R_L	Load Resistance, RA02		10	−	−	kΩ
AV_O	DC Voltage Gain in Large Signals, RA02		60	−	−	dB

ANALOG INTERFACE-RECEIVE FILTER OUTPUT (RFO)

AMPLIFIER LIMITER INPUT (RDI)

Symbol	Characteristic		Min.	Typ.	Max.	Unit
V_{in}	Input Voltage Range	RPRF = 1 xxx	− 2.2	−	+ 2.2	V
R_{in}	Input Resistance	RPRF = 1 xxx	1.5	−	−	kΩ
C_{in}	Input Capacitance	RPRF = 1 xxx	−	−	20	pF
C_L	Load Capacitance	RPRF = 1 xxx	−	−	50	pF
R_L	Load Resistance		1.5	−	−	kΩ
V_{out}	Output Voltage Swing	R_L = 1.5 kΩ R_L = 50 pF	− 1.8	−	+ 1.8	V
R_{out}	Output Resistance		−	−	15	Ω

DYNAMIC CHARACTERISTICS FOR PROGRAMMING REGISTER ACCESS

N°	Symbol	Characteristic	Min.	Max.	Unit
1	t_{CYC}	Cycle Time	600	−	ns
2	P_{wel}	Pulse Width, RTS Low	300	−	ns
3	P_{Weh}	Pulse Width, RTS High	300	−	ns
4	t_r, t_f	RTS Rise and Fall Times	−	50	ns
5	t_{HCE}	Control Input Holding Time	100	−	ns
6	t_{SCE}	Control Input Setup Time	300	−	ns
7	t_{SDI}	TxD or PRD Input Setup Time	200	−	ns
8	t_{HDI}	TxD or PRD Input Hold Time	100	−	ns
9	t_{WW}	TWW Input Writing Inpulsion Width (high level)	300	−	ns
10	t_{BD}	TxD Input Setup Time	100	−	ns
11	t_{HD}	TxD Input Hold Time	100	−	ns

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INPUT SHIFT REGISTER ACCESS

1st Case : Programmation without Data Transmission.

M88TS7514-07
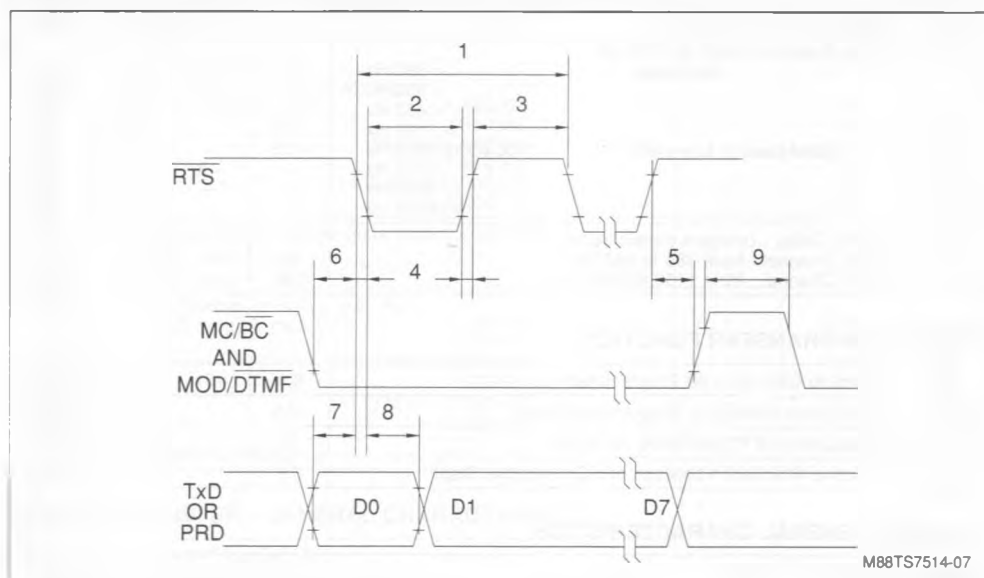
2st Case : Programmation with TXD During Data Transmission.

M88TS7514-08

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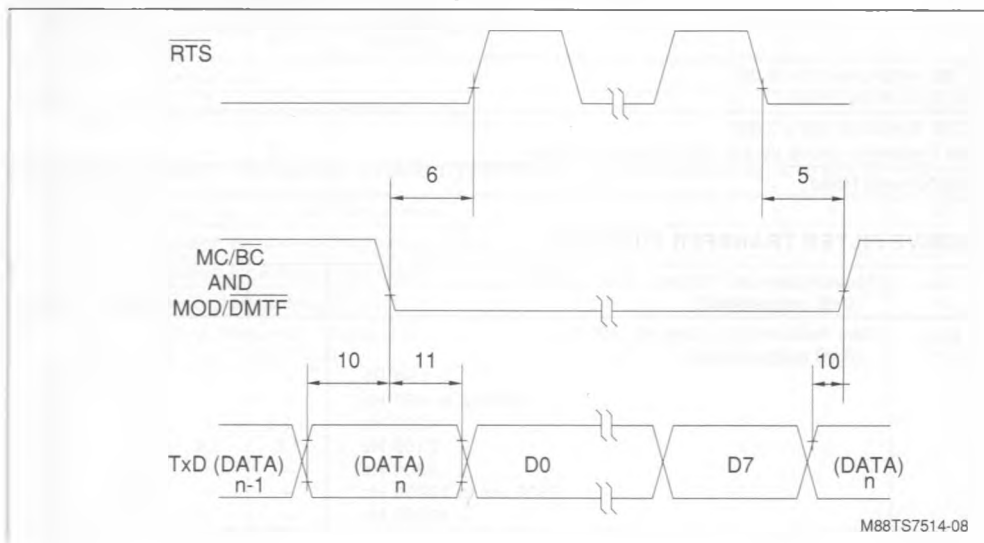
TRANSMIT FILTER TRANSFER FUNCTION (load conditions : R_L = 560 Ω, C_L = 100 pF)

Symbol	Parameter		Min.	Typ.	Max.	Unit
G_{AR}	Absolute Gain at 2100 Hz		–	0	–	dB
G_{HH}	Gain Relative to Gain at 1700 Hz					
	Band-pass	< 390 Hz	–	–	– 30	dB
		= 390 Hz	–	–	– 35	dB
		= 450 Hz	–	–	– 35	dB
		= 1100 Hz	– 0.5	–	+ 0.5	dB
	Band-pass or Low-pass	1100 Hz to 2300 Hz	– 0.5	–	+ 0.5	dB
		3300 Hz	–	– 3	–	dB
		5800 Hz	–	–	– 15	dB
		> 16000 Hz	–	–	– 35	dB
D_{AR}	Group Delay : (modem transmission)					
	Main Channel : from 380 to 460 Hz		90	–	110	μs
	Back Channel : from 1100 to 2300 Hz		1.04	–	1.	ms

ATTENUATOR TRANSFER FUNCTION

		Min.	Typ.	Max.	Unit
A_{TT}	Absolute Gain for 0 dB Programmed	0.3	0	0.3	dB
R_{AT}	Attenuation Relative to Programmed Value	- 0.5	-	+ 0.5	dB
	Attenuation for Programmed Value = ∞	70	-		dB
R_{LT}	Relative Attenuation between two Consecutive Steps	0.8	-	1.2	dB

TRANSMIT GENERAL CHARACTERISTICS

		Min.	Typ.	Max.	Unit
Modem Amplitude (Att = 0 dB)					
	390 Hz	+ 3.5	–	+ 4.5	dBm
	450 Hz	+ 3.5	–	+ 4.5	dBm
	1300 Hz	+ 3.5	–	+ 4.5	dBm
	2100 Hz	+ 3.5	–	+ 4.5	dBm
DTMF Amplitude (Att = 0 dB)					
Low Frequency Group		– 3	–	– 1.5	dBm
DTMF Amplitude (Att = 0 dB)					
Low Frequency Group Versus Low Frequency Group		+ 1.5	–	+ 2.5	dB
Psophometric Noise		–	–	250	μV

RECEIVE FILTER TRANSFER FUNCTION

Symbol	Parameter		Min.	Typ.	Max.	Unit
G_{AR}	Absolute Gain at 1100 Hz - Main Channel					
	(0 dB programmed)		– 0.5	–	+ 0.5	dB
G_{RR}	Gain Relative to the Gain at 1300 Hz					
	(0 dB programmed)					
		< 150 Hz	–	–	– 60	dB
		150 Hz to 450 Hz	–	–	– 50	dB
		1300 Hz	– 0.5	–	0.5	dB
		2100 Hz	1.1	1.8	2.3	dB
		2300 Hz	–	–	2.7	dB
		5500 Hz to 10000 Hz	–	–	– 50	dB
		> 10000 Hz	–	–	– 60	dB

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RECEIVE FILTER TRANSFER FUNCTION (continued)

Symbol	Parameter	Min.	Typ.	Max.	Unit
G_{AR}	Absolute Gain at 420 Hz (back channel - narrow band)				
	(0 dB programmed)	0.5	–	+ 0.5	dB
G_{RR}	Gain Relative to Gain at 420 Hz				
	(0 dB programmed) < 150 Hz	–	–	– 50	dB
	380 Hz	–	–	+ 0.5	dB
	400 Hz to 440 Hz	– 0.5	–	+ 0.5	dB
	460 Hz	–	–	+ 0.5	dB
	1100 Hz to 10000 Hz	–	–	– 50	dB
	> 10000 Hz	–	–	– 60	dB
G_{AR}	Absolute Gain at 425 Hz (tone detection or back channel wide band)				
	(0 dB programmed)	– 0.5	–	+ 0.5	dB
G_{RR}	Gain Relative to Gain at 425 Hz				
	(0 dB programmed) < 112 Hz	–	–	– 50	dB
	275 Hz	–	–	+ 0.5	dB
	300 Hz to 525 Hz	– 0.5	–	+ 0.5	dB
	575 Hz	–	–	+ 0.5	dB
	1375 to 10 000 Hz	–	–	– 50	dB
	> 10 000 Hz	–	–	– 60	dB
	Psophometric Noise	–	–	300	μV

RECEIVE TRANSFER - GENERAL CHARACTERISTICS

	Absolute Filter Gain for :				
	0 dB programmed	– 0.5	–	+ 0.5	dB
	6 dB programmed	+ 5.5	–	+ 6.5	dB
	12 dB programmed	+ 11.5	–	12.5	dB
R_{DS}	Signal Detection Level Relative to Programmed Value	– 0.5	–	+ 0.5	dB
R_{HY}	Hysteresis Value	– 2	–	–	dB
	Signal Level (loop 3) at Reception Input	– 40	– 35	– 33	dBm

## LINE MONITORING - GENERAL CHARACTERISTICS (load conditions : R_L = 10 kΩ, C_L = 50 pF)

A_{TT}	Absolute Gain for 0 dB Programmed	–	0	–	dB
R_{AT}	Attenuation Relative to Programmed Value	– 1	–	+ 1	dB
	Attenuation for Programmed Value	70	–		dB
FS	Buzzer Signalling Frequency	–	2982	–	Hz
	Signalling Frequency Amplitude at :				
	0.42 V_{PP} Programmed	0.38	0.42	0.46	V_{PP}

Figure 4 : Receive Filter Transfer Characteristics.
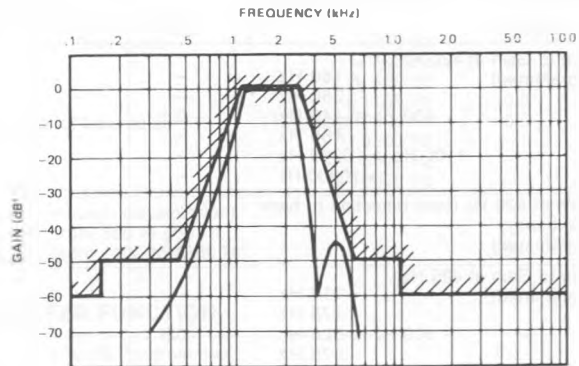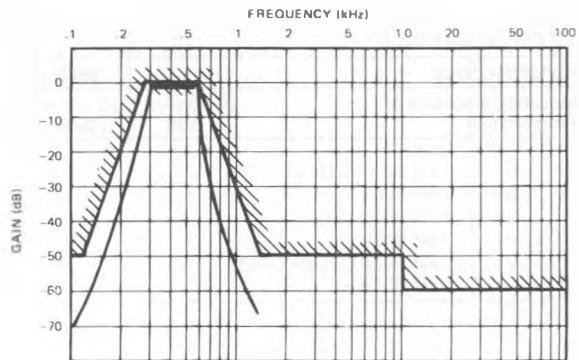

a : Main channel

M88TS7514-09
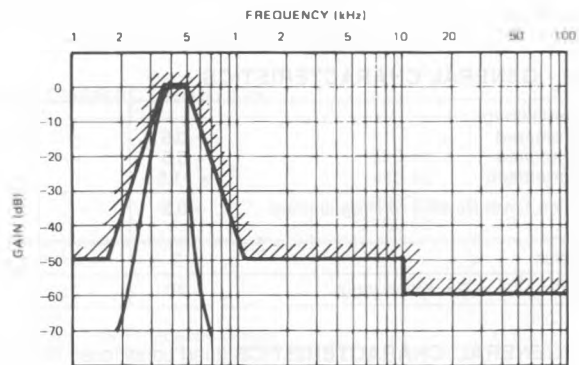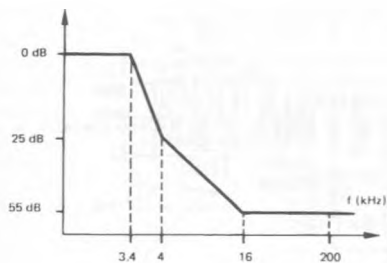
b : Back channel - Narrow band

M88TS7514-10

c : Basic channel = Wide band and tone detection

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Transmission spectum

At the ATO output. the out-of-band signal power conforms to the following specifications :

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Receiver

Measurement conditions

Local transmit level : -10 dBm on lower channel at 75 bps.
Receive level : -25 dBm, with 511 bit pseudo-random test pattern.
Test equipment : TRT sematest.

Isochronous distortion

The following table shows typical isochronous distortion obtained with the TS 7514 circuit :

Line	Reception (1200)	Reception (75)
Line 1 (fiat)	10 %	4 %
Line 2	12 %	4 %
Line 3	18 %	6 %
Line 4	14 %	6 %

Bit error rate

Typical bit error rates versus white noise are as follows (noise and signal levels are measured without weighting on the 300/ 3400 Hz band) :

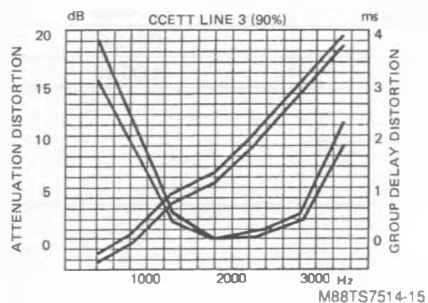|	Reception (1200 bds)		Reception (75 bds)	
	S/N	BER	S/N	BER
Line 1	6 dB	2.10^{-3}	– 3 dB	2.10^{-3}
Line 2	7 dB	2.10^{-3}	– 3 dB	2.10^{-3}
Line 3	8 dB	2.10^{-3}	– 3 dB	2.10^{-3}
Line 4	7 dB	2.10^{-3}	– 3 dB	2.10^{-3}

CHARACTERISTICS OF TEST LINES
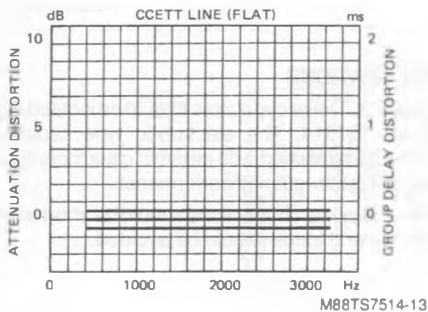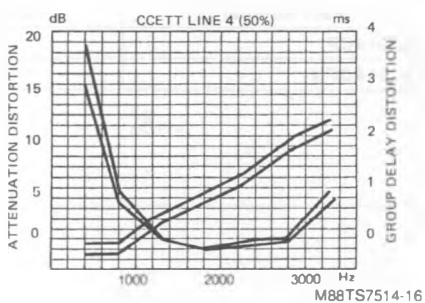

M88TS7514-13
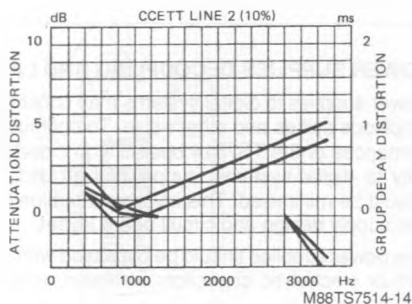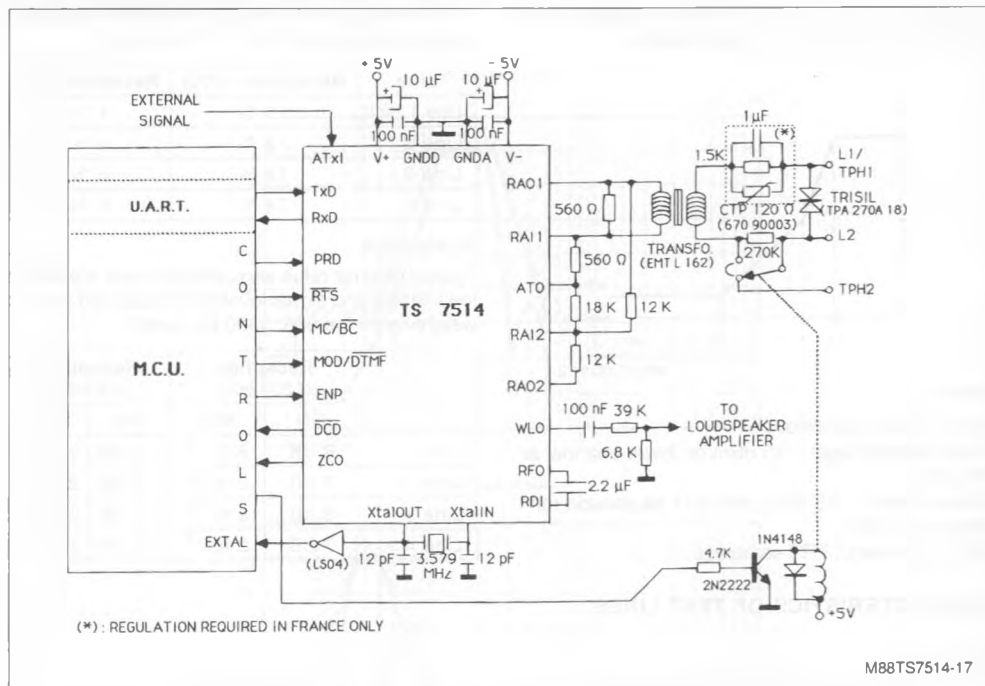

M88TS7514-14

M88TS7514-15

M88TS7514-16

TYPICAL APPLICATION INFORMATIONS

M88TS7514-17

POWER SUPPLIES DECOUPLING AND LAYOUT CONSIDERATIONS

Power supplies to digital systems may contain high amplitude spikes and other noise. To optimize performances of the TS7514 operating in close proximity to digital systems, supply and ground noise should be minimized. This involves attention to power supply design and circuit board layout.

The power supplies should be bypassed with tantalum or electrolytic capacitors to obtain noise free operation. These capacitors should be located close to the TS7514. The electrolytic type capacitors should be bypassed with ceramic capacitors for improved high frequency performance.
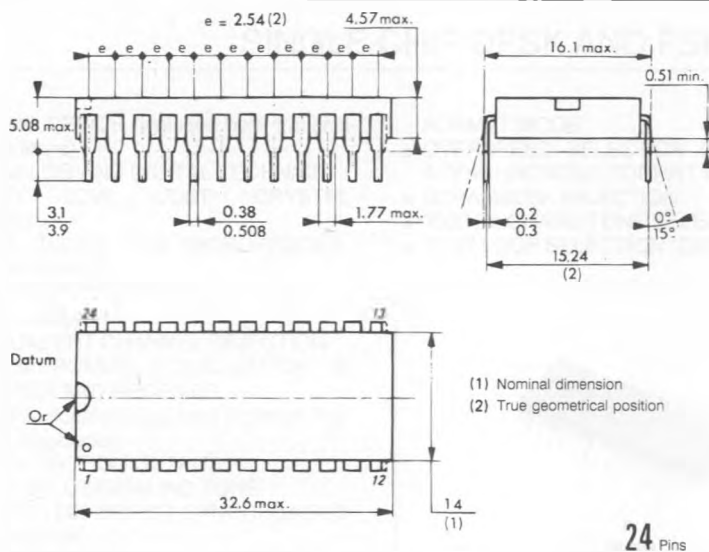
Power supplies connections should be short and direct. Ground loops should be avoided.

ORDER CODES

Part Number	Temperature Range	Package
TS7514CP	0 to + 70 °C	DIP 24
TS7514CFN	0 to + 70 °C	PLCC 28

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PACKAGE MECHANICAL DATA

24 PINS – PLASTIC DIP

(1) Nominal dimension
(2) True geometrical position

24 Pins

28 PINS – PLASTIC LEADLESS CHIP CARRIER

28 Pins