研发与应用

MSM7512B与标准Modem建立连接

How to establish connection between MSM7512B & standard Modem

武汉力源电子股份有限公司技术开发部(430079) 黎 明

Wuhan Liyuan Holding Limited Company Technology Development Department (430079) Liming

摘 要： 探讨MSM7512B遵从ITU-T V.23规范、以主叫和被叫方式与标准Modem(如Hayes的AT指令集兼容的Modem)建立连接的方法和实现过程。

关键词： 调制解调器 、规范、程序

Abstract: This paper discusses the method to establish connection and accomplishment process between MSM7512B and standard Modem (for example. Modem is compatible with Hayes 's AT instruction set) by primary and slave calling pattern according to ITU_TV.23 normalization.

Key words: MSM7512B Modem Normalization Establishing connection

1 MSM7512B 工作模式

MSM7512B是日本OKI公司最新推出的单片FSK调制解调器。它遵从ITU-T V.23规范，可支持1200bps半双工或1200bps收/75bps发全双工两种方式的数据传送。这里所说的标准Modem是与Hayes的AT指令集兼容的Modem，本文就MSM7512B与标准Modem建立连接的过程做一些探讨。

关于MSM7512B基本结构和工作原理已在文献[1]中做过介绍，这里不去讨论MSM7512B所有模式的工作过程，仅说明所用到的模式0和模式1、它们的工作模式如表1所示。

2 MSM7512B 与标准 Modem 建立连接的方法及过程

ITU-T V.23规范没有描述怎样建立连接和连接的过程。图1所示的时序图描述了建立连接的具体过程。以Hayes为首的Modem生产厂商普遍使用它，所以基本上就像一个行业标准。这个过程建立的是1200bps/75bps（或75bps/1200bps）全双工的工作模式，而以1200bps/1200bps半双工连接的过程不遵从这个时序图。

从图1的时序中可以清楚地看出被叫Modem和主叫Modem是如何建立连接的。为了调试方便，假设标准Modem是与计算机连接的，使用超级终端对标准Modem进行操作。MSM7512B是以MCS-51系列单片机控制运行的。可分以下两种情况来讨论建立连接的具体过程。

1 MSM7512B Working Mode

MSM7512B is a single-chip FSK Modem newly produced by Japan's OKI Company. It supports two data sending patterns, which are 1200bps half-duplex and 1200bps receiving/75bps sending full duplex. Standard Modem discussed in this paper is compatible with Hayes's AT instruction set. This paper discusses how to establish connection between MSM7512B and standard Modem.

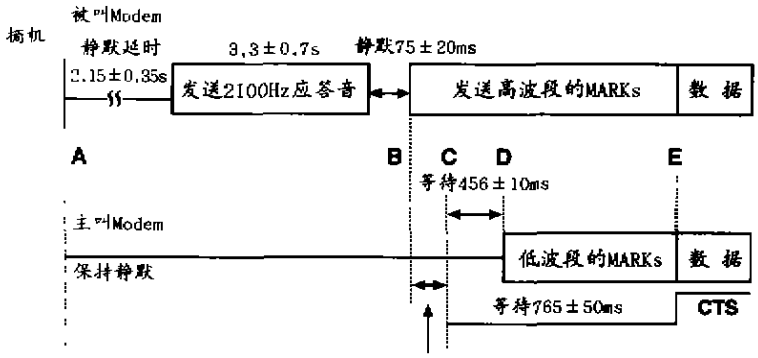
MSM7512B's basic structure and working principle have been introduced in document [1], where we only discuss the working process of mode 0 and mode 1 used in this paper, rather than all modes. Their working modes are described as Table 1

2 Method and process of establishing connection between MSM7512B and standard Modem

ITU_T V.23 normalization doesn't describe how to establish connection and connect. Sequence diagram illustrated in diagram 1 tells how to establish connection in details. It is widely accepted by Modem manufacturer led by Hayes, so it becomes an industry standard basically. This process is set up by 1200bps/75bps (or 75bps/1200bps) full duplex working mode, instead of conforming to this sequence diagram by 1200bps/1200bps half-duplex.

From sequence diagram in diagram 1,we can clearly see how to establish connection between slave Modem and primary Modem.

To debug easily, let's suppose that Modem has been connected with computer and through supervisor terminal operate standard Modem.MSM7512B is controlled by MCS-51 series single-chip microprocessor. There are



在155 ± 50ms时间内检测被叫Modem发送的高波段的MARKs
During 155 ± 50ms.check slave call Modem sending high hand MAKs

图1 时序图 Diagram1 Sequence

2.1 MSM7512B为主叫Modem(呼叫标准Modem)

由于MSM7512B内部没有DTMF电路，因此要实现主叫拨号，必须外接一个DTMF产生电路，例如可使用HOLTEK公司的HT9200A。MSM7512B带DTMF信号输入接口(EAI)，外部产生的DTMF信号可从此输入。

首先摘机然后拨号，这个过程在图1中未表示出来。与计算机连接的标准Modem检测到振铃信号而摘机，表示在图1中A点处。从A点到B点过程中，主叫Modem要检测到静默过程和2100Hz的应答音；从B点到C点过程中，主叫Modem要检测到高波段的MARKs；从C点到D点过程中，主叫Modem等待；从D点到E点过程中，主叫Modem发送低波段的MARKs，再延时一段时间，等待标准Modem建立连接。两个Modem之间就可以进行数据通信了。

从表1可以看出，MSM7512B要实现高波段MARKs的检测和低波段MARKs的发送，须将它的工作方式选择为模式1(MODE2=0，MODE1=1)，即FSK接收模式。在这种模式下，MSM7512B以1200bps的速率接收数据，以75bps的速率发送数据，如图2所示。

下面给出MCS-51单片机控制程序。

```
CALL_MODEM:
        CLR     RELAY ，闭合继电器
        LCALL DELAY100    ；延时100ms
        LCALL DELAY100    ；延时100ms
        CLR   MOD1  ；MSM7512B设置为发送模式
        CLR   MOD2
        SETB  RS    ；为了发送DTMF信号、
                      关闭FSK信号
        LCALL SEND_DTMF   ；拨号子程序
        SETB  MOD1  ；MSM7512B设置为接收模式
        LCALL DELAY100    ；延时100ms
        JB    RXD,$ ；检测2100Hz的Answer
                      Tone
        JNB   RXD,S
CALL_MODEM1:
        JNB   RI,$
        MOV   A,SBUF
        CLR   RI
        CJNE  A,#0FFH, CALL_MODEM1; 是否收到
High Band MARKs
        MOV   R5,#5       ；延时500ms
CALL_MODEM2:
        LCALL DELAY100
```

表1 MSM7512B部分模式

Table 1 MSM7512B working Modes

MOD2	MOD1	工作方式 Working Pattern Sending	发送频率/Hz frequency /Hz		接收频率/Hz Receive Frequency/	
			SPACE	MARK	SPACE	MARK
0	0	1200bps 半双工 1200bps half-duplex	2100	1300	2100	1300
0	1	1200bps 收/75bps 发 1200bps Receiving/75bps Sending	450	390	2100	1300

two situations to discuss how to establish connection.

2.1 MSM7512B as primary call Modem (calling standard Modem)

Without a DTMF circuit inside MSM7512B, to complete primary call dialing, it's necessary to add to an outside DTMF generator circuit, such as HOLTEK

Company's HT9200A. MSM7512B has a DTMF signal input interface (EAI), which outside DTMF signal is inputted into.

First picking, then dialing, this process isn't illustrated in diagram 1.Once standard Modem connected with primary call Modem checks ring signal, then pick up, which is indicated by point A in diagram 1. During the process from point A to point B, primary call Modem must check silence process and 2100Hz answer tone, from point B to point C, primary call Modem must check high band MARKs; from point C to point D, primary call Modem waits; from point D to point E, it sends low band MARKs. Delay some time again, it waits for establishing connection from standard Modem. So two Modems can communicate each other

From table 1,it is known that, to complete checking of high band's MARKs and sending of low band's MARKs, working pattern must be selected to MODE1 (MODE2=0, MODE1=1), that is. FSK receiving mode. In this mode, MSM7512B receives data at the baud rate of 1200bps, and sends data at the rate of 75bps; it's illustrated as diagram 2.

Diagram 2 FSK receive mode

MCS-51 single-chip microprocessor control program is given as follows.

```
CALL_MODEM.
CLR          RELAY £*Switch on relay
LCALL DELAY100    £*Delay 100ms
LCALL DELAY100    £*Delay 100ms
CLR          MOD1£*MSM7512B is set
to            Sending mode
CLR          MOD2
SETB  RS     £*To send DTMF signal£
Switch off FSK signal
LCALL SEND_DTMF   £*Dialing subprogram
SETB  MOD1£*MSM7512B is set to
Receivmg Mode
LCALL DELAY100    £*Delay 100ms
JB           RXD,$        £*Check
2100Hz Answer
Tone
JNB          RXD, $
CALL_MODEM1:
JNB          RI, $
MOV          A, SBUF
CLR          RI
CJNE  A,#0FFH, CALL_MODEM1
£*Receive High Band MARKs or not
        MOV          R5,#5
£*Delay 500ms
CALL_MODEM2:
LCALL DELAY100
DJNZ  R5, CALL_MODEM2
SETB  TXD                 £*Send
Low Band MARKs
CLR          RS
MOV          R5,#65H
£*Delay until other Modem establish connection
CALL_MODEM3:
LCALL DELAY100
DJNZ  R5, CALL_MODEM3
RET
```

Notice that baud rate at 75bps can't be produced through timer override, but can be completed through software timer.

2.2 MSM7512B As Slave call Modem (answering standard Modem call)

Without ring checking circuit inside MSM7512B, ring signal is transformed by outside circuit and is checked by single-chip microprocessor. Now we don't talk about how to check ring signal.

First slave call Modem check ring signal, then poll at the point A of diagram 1; during the process from A to B, slave call Modem keep silent and send 2100Hz answer tone. From the beginning of point B, slave call

Modem sends high band MARKs till

```
        DJNZ   R5, CALL_MODEM2
        SETB   TXD    ; 发送 Low Band MARKs
        CLR    RS
        MOV    R5,#65H      ;
延时等待对方 Modem 连接建立
CALL_MODEM3:
        LCALL  DELAY100
        DJNZ   R5, CALL_MODEM3
        RET
```

在使用过程中要注意，75bps 的波特率一般无法用定时器溢出产生，可以采用软件定时的办法来实现。

2.2 MSM7512B 为被叫 Modem（回答标准 Modem 的呼叫）

MSM7512B 内部也不带振铃检测电路，振铃信号可通过外部电路转换并由单片机检测。这里不讨论如何检测振铃信号。

在图 1 中的 A 点处，被叫 Modem 系统检测到振铃信号而摘机，从 A 点到 B 点的过程中，被叫 Modem 静音并发送 2100Hz 的应答音；从 B 点开始，被叫 Mocem 发送高波段的 MARKs，直至标准 Modem 建立连接，两个 Modem 之间就可以进行数据通信了。

从表 1 可以看出，MSM7512B 要实现高波段 MARKs 的发送，要将它的工作方式选择为模式 0（MODE2=0，MODE1=0），即 FSK 发送模式。在这种模式下，MSM7512B 以 1200bps 的速率发送数据，如图 3 所示。但工作在这种模式下也存在一有个问题，因为标准 Modem 是不能半双工工作的，而 MSM7512B 在模式 0 时只有高波段发送而不能同时低波段的接收，工作过程中 MSM7512B 不能进行模式切换，因此 MSM7512B 无法检测到低波段的 MARKs，也无法接收标准 Modem 发送的数据，即 MSM7512B 只能工作在单向发送状态。

下面给出 MCS-51 单片机控制程序。

```
ANSWER_MODEM:
        CLR    RELAY ; 闭合继电器
        MOV    R5,#22;  延时大约 2200ms
ANSWER_MODEM1:
        LCALL  DELAY100
        DJNZ   R5, ANSWER_MODEM1
        CLR    MOD1  ; MSM7512B设置为发送模式
        CLR    MOD2
        CLR    TXD   ; 发送2100Hz Answer Tone
3.3 ± 0.7s
        CLR    RS
        MOV    R5,#34       ; 延时大约 3400ms
```

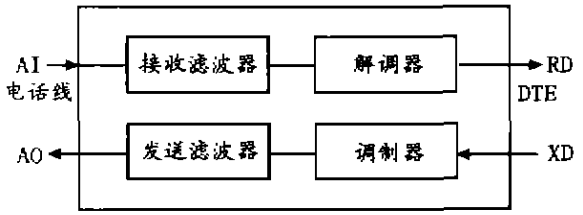


图 2 FSK 接收模式

Diagram 2 FSK receive mode

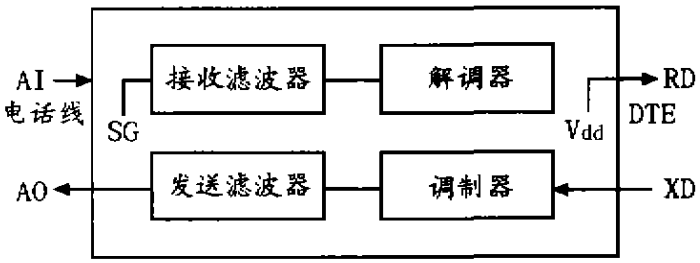


图 3 FSK 发送模式

Diagram 3 FSK Sending mode

standard Modem establishes connection. The two Modems can communicate each other

From table 1, we can know that if MSM7512B want to send high band MARKs, mode 0 is selected (MODE2=0, MODE1=0), that is, FSK sending mode. In this mode, MSM7512B send data at the baud rate of 1200bps, illustrated as diagram 3. It exists a problem in this working mode. Standard Modem can't work in half-duplex pattern, and MSM7512B send data in high band rather than receive data in low band. During the course of work, MSM7512B can't switch each other automatically. So MSM7512B can't check low band MARKs and receive standard Modem's data. In other word, MSM7512B can only work in a single direction state.

Diagram 3 FSK Sending Modes

MCS_51 single chip microprocessor control program is given as follows.°£

```
ANSWER_MODEM:
CLR          RELAY £ºSwitch on delay
MOV          R5,#22 £ºDelay about
2200ms
ANSWER_MODEM1:
LCALL DELAY100
DJNZ   R5, ANSWER_MODEM1
CLR          MOD1
MSM7512B is set to
Sending mode
CLR          MOD2
CLR          TXD
£ºSend 2100Hz Answer Tone   3.3°¿0.7s
CLR          RS
MOV          R5,#34 £ºDelay about
3400ms
ANSWER_MODEM2:
LCALL DELAY100
DJNZ   R5, ANSWER_MODEM2
SETB   RS                    £ºKeeping
silent 75°¿20ms
MOV          R5, #8
ANSWER_MODEM3:
LCALL DELAY10      £ºDelay 10ms Sub-
program
DJNZ   R5, ANSWER_MODEM3
SETB   TXD
Send High Band MARKs
CLR          RS
MOV          R5,#10   Delay about
1000ms
ANSWER_MODEM4.
    LCALL    DELAY100
    DJNZ     R5, ANSWER_MODEM4
    MOV          R5,#10H
Wait for delay till other
Modem establish connection
    ANSWER_MODEM5:
    LCALL    DELAY100
    DJNZ     R5, ANSWER_MODEM5
    RET
```

Note: the two above programs don't start timer or check some process while checking signal. In practicable application you can start timer or add to some check.

Reference

1 Chenghuaping . MSM7512B's application in data remote transmission. LiYuan Electricity Project,1999(3):24~25.

2 MSM7512B Data Manual. Wuhan: Wuhan Liyuan Electricity holdings Limited Company, 1999

3 ITU-T Recommendation V.23. International Telecommunication Union. 1988£"1993

4 Recommendations for V.23 1200bps/75bps Full-Duplex Call Set-Up. MX°§COM, INC. 1998

```
ANSWER_MODEM2:
        LCALL DELAY100
        DJNZ  R5, ANSWER_MODEM2
        SETB  RS     ; 静音 75 ± 20ms
        MOV   R5,#8
ANSWER_MODEM3:
        LCALL DELAY10      ; 延时 10ms 子程序
        DJNZ  R5, ANSWER_MODEM3
        SETB  TXD    ; 发送 High Band MARKs
        CLR   RS
        MOV   R5,#10       ; 延时大约 1000ms
ANSWER_MODEM4:
        LCALL DELAY100
        DJNZ  R5, ANSWER_MODEM4
        MOV   R5,#10H; 延时等待对方 Modem 连
接建立
ANSWER_MODEM5:
        LCALL DELAY100
        DJNZ  R5, ANSWER_MODEM5
        RET
```

应该注意：以上两个程序在检测信号时没有启动定时或对某些过程进行检测，实际使用时可根据需要启动定时检测或增加某些检测项。

参考文献

1 程化平 MSM7512B 在数据远传中的应用. 力源电子工程, 1999 (3): 24-25

2 MSM7512B 数据手册. 武汉: 武汉力源电子股份有限公司, 1999

3 ITU-T Recommendation V.23. International Telecommunication Union, 1988, 1993

4 Recommendations for V.23 1200bps/75bps Full-Duplex Call Set-Up. MX-COM, INC. 1998

新器件介绍
Introduction of new Device

一、NS 推出 LLP 的音频放大电路芯片

美国国家半导体公司 National Semiconductor 最新推出无引线线框封装 (Leadless Leadframe LLP) 的 LM4871Bommer (R)音频放大器。这种封装结构可以在更小的芯片封装里有更高的功率密度，在保证性能优异的前提下，大大节省了芯片占用空间。LM4871 广泛用于移动电话、笔记本和桌上电脑，以及信息家电声音系统中作桥式连接放大器。它能够直接驱动 2.4W 的扬声器。LM4871在供电电压下降到2.0V时仍能提供较高的输出功率和优良的声音质量。另外，LM4871 还集成了关断方式，以减少电源电流损耗，为改善系统性能，LM4871还具有在打开和关闭时出现的弹出和点击抑制电路，而且无需使用引导程序或缓冲器网络，LM4871使用的外围元件少，从而可简化系统设计，提高可靠性，节省空间，降低生产成本。该器件在过热时会有一个内部热关断机械装置自动保护芯片过热损坏。

二、美信公司推出用于双频蜂窝电话的高集成度发送 IC

该芯片将双频 I/Q 调制器、上变频、PA 驱动、IF VCO 和双频 IF/RF 锁相环，全部集成于单片 48 脚 TQFP 封装。

新款 MAX2360 是为双频 cdmaOne(tm)、TDMA、EDGE 和 W-CDMA 双频蜂窝电话而设计的，具有业界最高的集成度，可以显著缩小发射机尺寸，并且降低整机的成本。

基带信号送入 MAX2360 的宽带 I/Q 调制器，调制器具有两路 IF 输出。内置的双 VCO 允许 PCS 信道和蜂窝信道采用不同的 IF 频率，而接收单元只用单一 IF 滤波器。双频上变频采用镜频抑制结构实现，并后接三个功放 (PA) 驱动器。为降低PCS信道的接收带噪声功率，提供两路PCS驱动器输出以便采用信道分割降噪滤波器，但所增加的成本极微。PA 驱动器的高输出功率允许每信道只用一个 SAW 发射滤波器，进而缩减了系统的尺寸和成本。

通过射频 (RF) 和中频 (IF) AGC 的统一控制，MAX2360 可以提供超过 90dB 的输出功率调节范围。整 N 型 IF 和 RF 锁相环以及器件的大多数操作模式都可以通过三线串行接口完全编程。

对于单频应用，可采用 MAX2362 (PCS 专用) 或 MAX2364 (蜂窝专用)。它们采用相同的封装并具有兼容于MAX2360的引出脚。

三、NS 与 ThaTer 携手推出带隙电压参考电路芯片

国家半导体公司 (National Semiconductor) 宣布 Thaler Corporation 重新测试及校准美国国家半导体的电压参考技术，成功推出全球最精确的带隙电压参考电路。Thaler这个全新的解决方案可以保证准确度高达 0.05%，而温度系数则保证可低至 1.0ppm/℃，为工业用及便携式测量系统提供一个先进的解决方案。

美国国家半导体的LM4140 电压参考电路采用先进的技术，这款芯片若与 Thaler 的测试及校准技术结合一起，便成为一个极具竞争优势的解决方案，使系统设计工程师可以充分利用两家公司的先进技术开发具有超高精确度及低噪声的应用方案如测试仪表、测试设备及便携式系统。这款电压参考电路的温度系数极低，最适用于手持式设备，可确保仪器在某一温度范围内仍可保持高度的准确性。

国家半导体的 LM4140 芯片于去年第三季推出，是业内首例系列次带隙 (1.024 V) 电压参考电路，其精确度达 0.1%，而温度系数达 3ppm/℃。Thaler 系列 VRE4100 电路采用该公司的测试及校准技术，可以确保精确度达到 0.05%，而标准温度系数则可达 1 及 2ppm/℃ (商业应用温度范围) 以至 3ppm/℃ (工业应用温度范围)。Thaler 系列 VER4100 电路自前已有大量现货供应。