



# Microcircuits

## ADV-CMOS Communications Terminal Unit (Telecommunication Microcomputer)

### Features

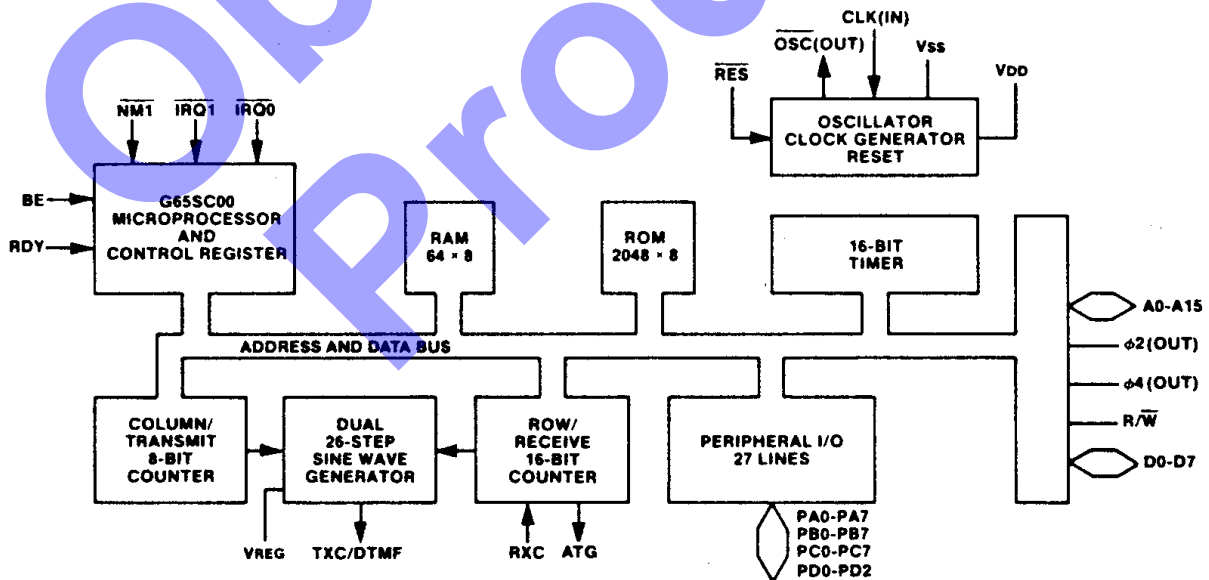
- Standard Option to the G65SC150 Communications Terminal Unit (CTU)
- Generates signals compatible with switched telephone networks or packet switched data networks
- Provides Dial Pulse (DP), Dual Tone Multi-Frequency (DTMF), and 0-600 baud modem signaling capabilities
- Low power mode (300  $\mu$ A) enables telephone line-powered operation
- External microprocessor address and data bus facilitates memory and I/O expansion
- On-chip memory: 64 bytes RAM, with facilities for external ROM or EPROM
- Standard DTMF and modem frequencies can be generated which are accurate to  $\pm 1.0\%$  with a 3.58 MHz crystal
- Two sine wave generators
- 6800 and 6500 bus compatibility
- Utilizes G65SC00 microprocessor as CPU
- 27 TTL compatible I/O lines
- Bus expandable to address 65K bytes of external memory
- Single +5 volt power supply
- Available in 68-pin chip carriers

### General Description

CMD Microcircuits' G65SC151 is configured as a **Standard Mask Option** to the G65SC150 Communications Terminal Unit (CTU). The G65SC150 CTU offers a variety of mask options which allow the user to configure a CTU that best suits the needs of a particular or unique design application. The G65SC151, however, is offered as a standard product (Standard Option) configuration which includes those options representing the general needs of most application requirements. Included options are detailed on page two. The G65SC151 is a single chip telecommunications microcomputer manufactured using CMD Microcircuits' Advanced CMOS (ADV-CMOS) processing technology. The G65SC151 has been optimized for telephone line signaling and data transmission applications. A functional block diagram is included to illustrate major system functions. For technical specifications and a detailed functional description, refer to the G65SC150 data sheet. The G65SC151 CTU uses CMD Microcircuits' G65SC00 8-bit microprocessor which executes the complete G65SC00 series instruction set. With 64 bytes of internal RAM and bus expandable memory, the CTU operates as a single-chip microcomputer.

(continued)

### Block Diagram





The CTU's internal bus interconnects all microcomputer functions. The address and data bus buffers permit expansion for the addition of ROM, RAM and memory mapped I/O using the full 65K addressing space of the microprocessor. A peripheral mode is available for use with multiprocessor systems. The on-chip oscillator may be driven by an external clock source.

The telecommunications interface circuitry consists of a timer, row/receive counter, column/transmit counter and dual sine wave generators. In addition, 27 general purpose I/O lines can be used for keyboard, telephone Dial Pulse (DP) signaling, phone line control, and other peripheral devices.

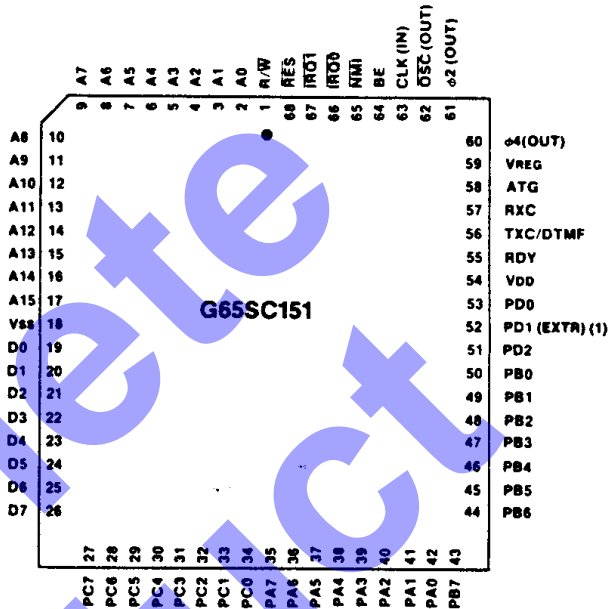
Standard Options

The following Standard Options have been implemented within the G65SC151 CTU. Note that the G65SC151 is identical to the G65SC150 CTU in technical specifications and functional operation. Refer to the G65SC150 CTU data sheet for detailed specifications and operation.

- 1. The oscillator feedback resistor (between CLK (IN) and OSC (OUT)) is not provided.
2. The following control signals are provided with pull-up resistors at 20 uA pull-up current: BE, NMI, IRQ0, RDY, IRQ1, RES
3. Pin 51 is provided with the Port D signal PD2.
4. Pin 59 (VREG) requires an external connection to VDD.
5. The following I/O source currents are provided: PA0-PA7 200 uA pull-up, PD0-PD2 1 mA pull-up, PB0-PB7 200 uA pull-up, ATG 10 uA pull-up, PC0-PC7 no pull-up

Pin Configuration

68-Pin Leaded Plastic and Ceramic Chip Carrier (Top View)



- NOTES: 1. EXTR SELECTED ONLY IN TEST AND PROTOTYPE MODE.

Application Programs

The following program consists of two subroutines which will be of value in G65SC151 applications. Note that these subroutines will be included in internal ROM on future devices. These subroutines include:

External Interrupt Vector Table

During the "Normal Mode" startup sequence, this subroutine automatically directs the microprocessor to an Interrupt Vector

```
0020 0000 CTUR0M START
0021 0000
0022 0000 ORG $FE00
0023 0000
0024 0000 * TABLE OF ACCUMULATOR VALUES
0025 0000 * FOR DUAL TONE FREQUENCIES
0026 0000 * (same as 8860 and 8870 DTMF decoders)
0027 0000
0028 0000 * +-----+
0029 0000 * | 1 | 2 | 3 | D | 697
0030 0000 * +-----+
0031 0000 * | 4 | 5 | 6 | E | 770
0032 0000 * +-----+
0033 0000 * | 7 | 8 | 9 | F | 852
0034 0000 * +-----+
0035 0000 * | B | A | C | 0 | 941
0036 0000 * +-----+
0037 0000 * 1209 1336 1477 1633
0038 0000
0039 0000 * EXTERNAL INTERRUPT VECTOR ADDRESSES
0040 0000 NMIV EQU $EFEC Non-Maskable Interrupt
0041 0000 RSTV EQU $EFEE Reset
0042 0000 RCWV EQU $EFF8 Row-Receive Counter
0043 0000 EXTU EQU $EFFA External
0044 0000 TMCV EQU $EFFC Timer
```

Table located in external ROM. In this way, the external Reset circuit is no longer required to initiate the Test and Prototype Mode in order to access external ROM. The Reset circuit can now perform the normal reset function, thus greatly simplifying the Reset circuit requirement.

DTMF Frequency Generator

This subroutine generates DTMF frequencies for various oscillator frequencies. The DTMF frequencies are presented at the TXC/DTMF output (pin 56).



```

0045 0000      BRKV  EQU  %EFFE  Break Instruction
0046 0000
0047 0000      * CTU ON-CHIP I/O ADDRESSES
0048 0000      ROW   EQU  %F4   Row-Receive Counter
0049 0000      COL   EQU  %F6   Column-Transmit Counter
0050 0000      CNTRL EQU  %F7   Control-Status Register
0051 0000
0052 0000      * CONSTANTS
0053 0000      TSC   EQU  %20   External Bus Three-State Control
0054 0000      DTMF  EQU  %07   DTMF Mode
0055 0000      EJECT
0056 0000      * DTMF VALUES FOR ROW-RECEIVE COUNTER
0057 0000
0058 0000 486262 R358  DC   11'72,98,98,98' 3.58 MHz
0059 0004 585858      DC   11'88,88,88,80'
0060 0008 505048      DC   11'80,80,72,72'
0061 000C 486258      DC   11'72,98,88,80'
0062 0010
0063 0010 516060 R40   DC   11'81,109,109,109' 4.0 MHz
0064 0014 636363      DC   11'99,99,99,89'
0065 0018 595951      DC   11'89,89,81,81'
0066 001C 516063      DC   11'81,109,99,89'
0067 0020
0068 0020 7AA5A5 R60   DC   11'122,165,165,165' 6.0 MHz
0069 0024 959595      DC   11'149,149,149,134'
0070 0028 86867A      DC   11'134,134,122,122'
0071 002C 7AA595      DC   11'122,165,149,134'
0072 0030
0073 0030 A2DCDC R80   DC   11'162,220,220,220' 8.0 MHz
0074 0034 C7C7C7      DC   11'199,199,199,180'
0075 0038 8484A2      DC   11'180,180,162,162'
0076 003C A2DCC7      DC   11'162,220,199,180'
0077 0040
0078 0040      * DTMF Values for Column Divider
0079 0040
0080 0040 293833 C358  DC   11'41,56,51,46' 3.58 MHz
0081 0044 38332E      DC   11'56,51,46,56'
0082 0048 332E33      DC   11'51,46,51,56'
0083 004C 2E2929      DC   11'46,41,41,41'
0084 0050
0085 0050 2E3F39 C40   DC   11'46,63,57,51' 4.0 MHz
0086 0054 3F3933      DC   11'63,57,51,63'
0087 0058 393339      DC   11'57,51,57,63'
0088 005C 332E2E      DC   11'51,46,46,46'
0089 0060
0090 0060 445E55 C60   DC   11'70,94,85,77' 6.0 MHz
0091 0064 5E554D      DC   11'94,85,77,94'
0092 0068 554D55      DC   11'85,77,85,94'
0093 006C 4D4646      DC   11'77,70,70,70'
0094 0070
0095 0070 5D7E72 C80   DC   11'93,126,114,103' 8.0 MHz
0096 0074 7E7267      DC   11'126,114,103,126'
0097 0078 726772      DC   11'114,103,114,126'
0098 007C 675D5D      DC   11'103,93,93,93'
0099 0080      EJECT
0100 0080      * Subroutine loads dividers with DTMF tone values
0101 0080
0102 0080 BD3000 D80   LDA   R80,X
0103 0083 BC7000      LDY   C80,X
0104 0086 8016      BRA   SEND
0105 0088
0106 0088 BD2000 D60   LDA   R60,X
0107 008B BC6000      LDY   C60,X
0108 008E 800E      BRA   SEND
0109 0090
0110 0090 BD1000 D40   LDA   R40,X
0111 0093 BC5000      LDY   C40,X
0112 0096 8006      BRA   SEND
0113 0098
0114 0098 BD0000 D358  LDA   R358,X
0115 009B BC4000      LDY   C358,X
0116 009E
0117 009E 85F4      SEND  STA   ROW
0118 00A0 84F6      STY   COL
0119 00A2 60      RTS
0120 00A3
0121 00A3
0122 00A3 A907      DOFF  LDA   %DTMF  INITIALIZE TONES OFF
0123 00A5 04F7      TSB   CNTRL
0124 00A7 64F5      STZ   ROW+1
0125 00A9 64F4      STZ   ROW
0126 00AB 64F6      STZ   COL
0127 00AD 60      RTS
0128 00AE
0129 00AE      * INTERRUPT VECTOR ROUTINES
0130 00AE 6CECEF NMI   JMP   (NMI) Non-Maskable
0131 00B1

```



```

0132 00B1 A920 RST LDA #TSC Reset
0133 00B3 85F7 STA CNTRL Set TSC bit to enable
0134 00B5 6CEEEF JMP (<RSTV> external bus
0135 00B8
0136 00B8 6CF8EF RCV JMP (<RCVU> Row-Receive
0137 00BB 6CFAEF EXT JMP (<EXTV> External
0138 00BE 6CFCEF TMC JMP (<TMCV> Timer
0139 00C1 6CFEEF BRK JMP (<BRKV> Break Instruction
0140 00C4 EJECT
0141 00C4 ORG $FFB0
0142 00C4
0143 00C4 * Set DTMF tone, oscillator frequency
0144 00C4 4CA300 DTMFOF JMP DOFF Tones off, and initialize
0145 00C7 4C9800 DTMF35 JMP D358 3.579545 MHz
0146 00CA 4C9000 DTMF40 JMP D40 4.000000 MHz
0147 00CD 4C8800 DTMF60 JMP D60 6.000000 MHz
0148 00D0 4C8000 DTMF80 JMP D80 8.000000 MHz
0149 00D3
0150 00D3 ORG $FFEC
0151 00D3
0152 00D3 * Interrupt Vectors
0153 00D3 AE10 DC A'NMI' Non-Maskable
0154 00D5 B110 DC A'RST' Reset
0155 00D7
0156 00D7 ORG $FFF8
0157 00D7
0158 00D7 B810 DC A'RCV' Row-Receive
0159 00D9 BB10 DC A'EXT' External
0160 00DB BE10 DC A'TMC' Timer
0161 00DD C110 DC A'BRK' Break Instruction
0162 00DF
0163 00DF END

```

Local Symbol Table

BRK	00C1	BRKV	EFFE	C358	0040	C40	0050
C60	0060	C80	0070	CNTRL	00F7	COL	00F6
D358	0098	D40	0090	D60	0088	D80	0080
DOFF	00A3	DTMF	0007	DTMF35	00C7	DTMF40	00CA
DTMF60	00CD	DTMF80	00D0	DTMFOF	00C4	EXT	00BB
EXTV	EFFA	NMI	00AE	NMIU	EFEC	R358	0000
R40	0010	R60	0020	R80	0030	RCV	00BB
RCVU	EFFB	RCW	00F4	RST	00B1	RSTV	EFEE
SEND	009E	TMC	00BE	TMCV	EFEC	TSC	0020

Ordering Information

