SGS-THOMSON MICROELECTRONICS

APPLICATION NOTE

RAM MAPPING ST75C50

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1 - INTRODUCTION

The purpose of this application note is to explain what are the "interesting internal variables" that can be Read, Written or Modified using the **MR**, **MW**, **CR** commands.
Some of these variables have dedicated commands to modify them, like SETGN for _**TXGAIN** or tone detector. However the whole RAM (even external when using the ST18933) and also the DUAL RAM et internal peripherals can be accessed using the three above mentioned commands.

The address, characteristic (R = read, W = write, R/W = read or write), and function of key data pump variables is listed below by basic modem functional blocks.

Caution : The Mapping of the variables, given in the appendix is only valid for Revision 1.0 of the ST75C50.
There is no guarantee that it will remain exactely the same for further revisions.

2 - ECHO CANCELLER

_RTDELAY (R) Round trip delay in number of bauds

_EC_STA (R/W) Echo canceller execution status word. the echo canceller can be frozen in data mode by reading _EC_STA and performing a logical or with the value $0002 before writing to _EC_STA. (i.e. other bits must not be changed)

(PWREST+1) (R) Residual echo power estimator for determining loss of connection. The ABS() value of this variable will be greater than $20 to indicate connection loss, otherwise near 0.

(FREQOFF+3) (R) Far-end echo frequency offset. offset = FRQOFF*.0366 in Hz typically, FRQOFF = $1b(27) for 1Hz.

DELTA (R) Initial far-end echo power after near end echo canceller convergance. This variable can be read in data mode and has the following typical values.

	VALUE	POWER
$FFF6	(-10)	- 9dBm
$FFF7	(- 9)	-12dBm
.	.	.
$0000	(0)	-39dBm
.	.	.
$000A	(+10)	-69dBm

FEECENBL (R) Far end echo canceller is enabled. $FFFF = Enabled $0000 = Disabled (when initial far-end power is less han -69dBm.

3 - TIMING RECOVERY

(FRQOFF+1) (R) Receive clock frequency offset.

PSITHRSH (R) .94 Deg timing phase adjustement threshold for timing signal dpll.

Comments : The local-to-remote modem timing offset can be calculated using the following formula :

$$\text{TIMING OFFSET} = \frac{\text{FRQOFF}}{\text{PSITHRSH}} * \frac{.94}{360}$$

The normal timing offset is within +/- 1.0e-4 for most connections

4 - CARRIER RECOVERY

(FRQOFF+1) (R) Receive carrier frequency offset. OFFSET = FRQOFF*.0366 in Hz.
Typically, FRQOFF = $1B(27) for 1Hz.

5 - EQUALIZER, AGC

_RX_STA (R/W) Equalizer and AGC can be frozen independently or simultaneously.

```
%--------  X  -  X
          :     :
          :     .........1 = freeze equalizer
          ..... ..........1 = freeze AGC
```

- = Do not change

_RX_STA must be modified in data mode and the other bits must be unchanged. Read the value and change only the corresponding bits in the _RX_STA word.

(_AGCSCA+1) (R/W) Automatic gain control level for receive signal varies from $80(0dBm) to $7fff (48dBm).

RDQUA (R) Equalizer error energy gives an idea of signal to noise ratio seen by the receiver. RDQUA has the following typical values.

VALUE	POWER
$00C0	30 DB
$0180	27 DB
$0300	24 DB
$0600	21 DB
$0C00	18 DB
$1800	15 DB
$3000	12 DB

_RDCPT (R) Output of Demodulator. Complex number, can be used to display the received eye.

EQFRK0E (R/W) 32 Complex even equalizer coefficients.

EQFRK1E (R/W) 32 Complex odd equalizer coefficients.

6 - HANDSHAKE,RETRAIN,RATE NEGOTIATION

_SHSK (R) Handshake progression counter contains information about the progress of the handshake in v.32 and v.22b modes. It can be read to examine the progression of the handshake and it contains normal values and error values as below:

V.32 ORIG MODE

EVENT	SHSK Normal Value	SHSK Error Value
AC_DET	$20	
AC/CA DET	$21	$1
CA/AC DET	$22	$2
NO AC DET	$23	$B for RTRN, $C for RRN
S_DET	$24	$4
SB_DET	$25	$5
R1_DET	$26	$6
S_DET	$27	$7
SB_DET	$28	$8
R3_DET	$29	$9, $D no R5 det after RRN
E_DET	$2A	$A
DATA MODE	$30	

V.32 ANSW MODE

EVENT	SHSK Normal Value	SHSK Error Value
AA_DET	$40	$8 for RTRN, $9 for RRN
AA/CC DET	$41	$1
NO CC DET	$42	$2
S_DET	$43	$3
S_DET2	$44	$4
SB_DET	$45	$5
R2_DET	$46	$6, $A no R det after RRN
E_DET	$47	$7
DATA MODE		

V.22B MODE

EVENT	SHSK Normal Value
HSK	$60 ORIG,$80 ANSW
DATA	$70 ORIG,$90 ANSW

_RE_HSK (R) Stored R and E word values which were sent and received in their chronological order during the handshake, retrain, or rate negotiation. Positions _RE_HSK to (_RE_HSK+4) contain history during handshake or retrain while (_RE_HSK+5) to (_RE_HSK+8) contain history during a rate negotiation request.

_TSPEED (R/W) Target speed initialized by CONF or RTRA commands but can be changed in data mode for the case of a remote RTRA or RRN requests.

%0000000000000010 = 1200 BPS
%0000000000000011 = 2400 BPS
%0000000000000100 = 4800 BPS
%0000000000000101 = 7200 BPS
%0000000000000110 = 9600 BPS
%0000000000000111 = 12000 BPS
%0000000000001000 = 14400 BPS

_TRWORD (R/W) Target RWORD initialized by CONF or RTRA commands but can be changed (both
_RWORD of them) in data mode for the case of remote RTRA or RRN requests. In reference to the CCITT recommendation the bits are programmed in the following order :

(CCITT RECOMMENDATION)

B00, B01, B02, B03, B04, B05, B06, B07, B08, B09, B10, B11, B12, B13, B14, B15

. . . . . .

D15, D14, D13, D12, D11, D10, D09, D08, D07, D06, D05, D04, D03, D02, D01, D00

(_TRWORD)

RNTHRSH (R/W) Threshold for rate negotiation during handshake or retrain. The quality of the receive signal is observed (can be disabled by the command MODC) and the corresponding R word is proposed in the handshake or retrain rate negotiation. The default value is $300. This gives the typical R word authorization characteristics as shown below:

SPEED authorized	SNR
14400	> 24DB
12000	< 24DB
9600	< 21DB
7200	< 18DB

Doubling the threshold will decrease the corresponding snr by 3dB approximately.

7 - CARRIER DETECT

DETH1 (R/W) Fast detection threshold
DETH (R/W) Slow detection threshold
LOSSTH1 (R/W) Slow loss threshold
LOSSTH (R/W) Fast loss threshold

The carrier detect contains 2 signal level integrators, a fast integrator for quick detection with a limited precision and a slow integrator for enhanced precision. There are four thresholds programmed with default values for each of the modes V.22B, V.33, V.17, FSK, V.29, and V.27 which can be modified by the user after the conf command. Typical values are shown below and doubling the value will increase the threshold by approximately 6dB :

(-40DBM)	$B0	DETH1 (fast detection threshold)
(-44DBM)	$90	DETH (slow detectiion threshold)
(-47DBM)	$60	LOSSTH1 (slow loss threshold)
(-51DBM)	$40	LOSSTH (fast loss threshold)

8 - TRANSMIT FILTER COEFICIENTS

TXCOEF (R/W) Address of first pulse shaping/compromise equalizer complex coefficient (16-bit real,16-bit imag).

GAIN (R/W) Attenuation factor for the transmit filter.

SHIFTVAL (R/W) Gain (Left shift value) from 0 to 15. To be use in conjonction with GAIN for fine adjustment of the transmit signal. Up and down scaling.

The pass-band pulse shaping and transmit compromise equalizer functions are combined in the transmit filter coeficients. The pulse shaping also performs the multi-phase interpolation from different baud rates to a fixed sample rate 7200Hz (14400Hz for V.27 4800) thus requiring multiple coeficient sub-tables containing complex (16-bit real,16-bit imag) coeficients. The number of coeficients depends on the shape, baud rate,and sampling rate. A default table depending on the compromise equalizer selected in the conf command is loaded from coeficient memory to external memory, after which, if desired, they can be modified by the user. The table below summarizes the location and the number of coeficients to be loaded.

(* = DEFAULT VALUES)

MODE	BAUD RATE	PHASE	COEF/PHS	STRT ADR	ROLL-OFF*	NO. OF COMPEQ*
V.32/33/17	2400	0	32	TXCOEF	0.125	3
		1		(TXCOEF+64)		
		2		(TXCOEF+128)		
V.29	2400	0	24	TXCOEF	0.20	2
		1		(TXCOEF+48)		
		2		(TXCOEF+96)		
V.27(2400)	1200	0	8	TXCOEF	0.50	1(FLAT)
		1		(TXCOEF+16)		
		2		(TXCOEF+32)		
		3		(TXCOEF+48)		
		4		(TXCOEF+64)		
		5		(TXCOEF+80)		
V.27(4800)	1600	0	7	TXCOEF	0.50	1(FLAT)
		1		(TXCOEF+14)		
		2		(TXCOEF+28)		
		3		(TXCOEF+42)		
		4		(TXCOEF+56)		
		5		(TXCOEF+70)		
		6		(TXCOEF+84)		
		7		(TXCOEF+98)		
		8		(TXCOEF+112)		
V.22 ORIG/ANS	600	0	5	TXCOEF	0.50	1(FLAT)
		1		(TXCOEF+10)		
		2		(TXCOEF+20)		
		3		(TXCOEF+30)		
		4		(TXCOEF+40)		
		5		(TXCOEF+50)		
		6		(TXCOEF+60)		
		7		(TXCOEF+70)		
		8		(TXCOEF+80)		
		9		(TXCOEF+90)		
		10		(TXCOEF+100)		
		11		(TXCOEF+110)		

9 - TONE DETECTOR PROGRAMMING

LEVOUT (R/W) 16 Programmable static levels.

BIQCOEF (R/W) 16*2*6 Biquad coeficients.
Coef. order for each of 16 4th order cells :
C0, C1, C2, C3, C4, C5, C6, C7, C8, C9, CA, CB
Where each 4th order cell has the following xfer function :

$$\frac{OUT}{IN} = C0 \cdot \frac{C5 \cdot Z^2 + 2 \cdot C3 \cdot Z + 2 \cdot C4}{Z^2 - 2 \cdot C1 \cdot Z - 2 \cdot Z} \cdot C6 \cdot \frac{CB \cdot Z^2 + 2 \cdot C9 \cdot Z + 2 \cdot CA}{Z^2 - 2 \cdot C7 \cdot Z - 2 \cdot C8}$$

POWCOEF (R/W) 16 Power coeficients p1 Power estimator using absolute value of the input signal :

$$\frac{OUT}{IN} = P1 \cdot \frac{1}{Z - (1 - P1)}$$

BPWIRE (R/W) 16 Biquad and pwr estimator input wiring addresses
FORMAT = [4TH ORDER BIQ(MSB),PWR(LSB)]

CPWIRE (R/W) 16 Comparator input wiring addresses
FORMAT = [COMPARATOR+(MSB),COMPARATOR-(LSB)]
The wiring addresses furnished in bpwire,cpwire are from the following possible sources :

GND	$00
RX SIGNAL	$01
RX SIGNAL*2	$02
RX SIGNAL*4	$03
4TH ORDER BIQ BLOCK OUTPUT	$10 TO $1F
POWER OUTPUT	$20 TO $2F
STATIC LEVELS PROGRAMMED IN LEVOUT	$30 TO $3F

_NTDCELL (R/W) Number of tone detector cells active (0-15)

_TONEDET (R) Outputs of tone detectors. The low byte of _TONEDET contains the outputs of tone detector cells 0 to 8. The low byte of _TONEDET+1 contains outputs of cells 9 to 15. When the corresponding bit is "1" the signal at the positive input of the comparator is higher than that at the negative input. Only _NTDCELL bits are valid at one time, the other one are 0.

10 - GENERAL PURPOSE

_TXGAIN (R/W) Transmit gain. Any signal to transmit is multiplied by this number. This is the value modified by SETGN command.

11. TONE GENERATOR

_TGNFLG (R/W) Tone generator flag. Each of the four low bits of this variable define if the corresponding tone generator is enabled. This is the value modified by a TGEN command.

_TG0PHC (R/W) Tone generator #0 phase reversal threshold. If different from 0, a phase reversal will be executed on the tone genarator #0 after _TG0PHC bauds. This is used in V.32 answer tone generation (default value is 1080 for 450ms).

_TGNBLK (R/W) For each of the four tone generators (i) contains:
_TGNBLK+(3*i): Frequence of tone (i.e. $4000 = 1800Hz).
_TGNBLK+1+(3*i): Instantanous phase.
_TGNBLK+2+(3*i): Amplitude ($7FFF refers to maximum signal).

12 - APPENDIX
Address Equivalences for Version 1.0

Variable	Address
ECHO CANCELLER	
_RTDELAY	$016
_EC_STA	$019
PWREST	$BAC
FREQOFF	$BAE
DELTA	$BBD
FEECENBL	$BCE
TIMING RECOVERY	
FRQOFF	$E8A
PSITHRSH	$E95
CARRIER RECOVERY	
FRQOFF	$EA2
EQUALIZER,AGC	
_RX_STA	$017
_AGCSCA	$192
RDQUA	$2A7
_RDCPT	$048
EQFRK0E	$CBC
EQFRK1E	$CFC
HANDSHAKE,RETRAIN, RATE NEGOTIATION	
_SHSK	$1BB
_RE_HSK	$1BD
_TSPEED	$1AF
_TRWORD	$1B0
_RWORD	$014
RNTHRSH	$2AA

Variable	Address
CARRIER DETECT	
DETH1	$F9A
DETH	$F99
LOSSTH1	$F9C
LOSSTH	$F9B
TRANSMIT FILTER COEFICIENTS	
TXCOEF	$2E4
GAIN	$2E2
SHIFTVAL	$2E1
TONE DETECTOR PROGRAMMING	
LEVOUT	$3E6
BIQCOEF	$476
POWCOEF	$536
BPWIRE	$456
CPWIRE	$466
_NTDCELL	$006
_TONEDET	$007
GENERAL PURPOSE	
_TXGAIN	$001
TONE GENERATOR	
_TGNFLG	$002
_TG0PHC	$003
_TGNBLK	$3A8

Caution

Add $1000 to the Addresses when using ST75C50 single chip or ST75C50CIA Kit part.
Add $9000 to the Addresses when using Emulation Module.