■ OVERVIEW

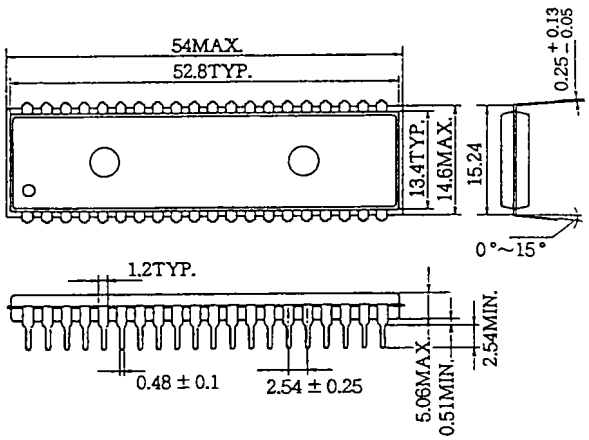
The SM8530B is a CMOS LSI designed specifically to offer a standardized interface bus meeting the IEC standard and a measuring equipment interface on a single chip. The SM8530B executes 3-line handshaking, address commands and bus line commands without software support. Standardized interface functions complying with the IEC standard can be realized easily by adding several external circuits and a bus line driver/receiver.

[Note] The LSI is also applicable to the IEEE-488, HP-IB and GP-IB.

■ FEATURES

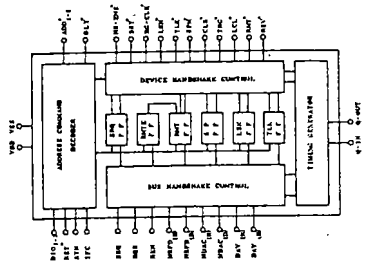
- The SM8530B does not require a microprocessor, hence:
  1) Software development is not necessary.
  2) The CPU of measuring equipment can be used effectively.
  3) A standardized interface function can be added easily to an existing measuring equipment.
- Output pins corresponding to interface states (TLK, LSN, RMT, CLR, TRG, etc.) are provided to facilitate operation and increase response speed.
- Low current consumption realized by CMOS construction
- Easy address setting with external switches
- Three-line handshaking can be controlled only with the HS-ENB* signal.
- Output pins (BSY, RG-CLK, etc.) for controlling external circuits simplify peripheral circuits.

■ PACKAGE DIMENSIONS Unit: mm

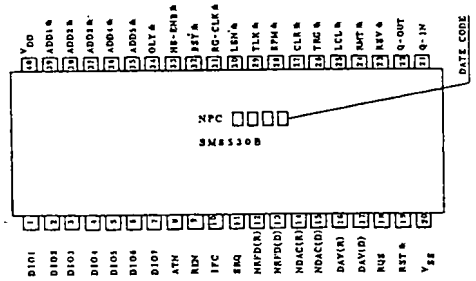


40-pin plastic DIP

■ BLOCK DIAGRAM



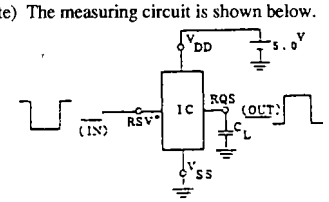
■ PINOUT TOP VIEW



■ AC ELECTRICAL CHARACTERISTICS

Item	Symbol	Condition	Min	Typ	Min	Unit
Input pulse Pulse width	tw	VDD=5.0V Vss=GND Ta=25°C CL=15pF	1.0			µSec
Rise time	tr				100	nSec
Fall time	tf				100	nSec
Output pulse Rise time	tr			5.0		nSec
Fall time	tf			5.0		nSec

Note) The measuring circuit is shown below.



$V_{DD} = 5.0\ V$
$Ta = 25\,^{\circ}C$
$C_L = 15\ pF$
t_w - IN = 1 µSec
t_r - IN = 100 nSec
t_f - IN = 100 nSec

■ ABSOLUTE MAXIMUM RATINGS

Item	Symbol	Rating	Unit
Supply voltage	VDD−Vss	-3.0 to +7.0	V
Input voltage	VIN	Vss≤VIN≤VDD	V
Operating temperature	Topr	0 to +70	°C
Storage temperature	Tstg	-40 to +125	°C

■ DC ELECTRICAL CHARACTERISTICS

Ta = 25°C

Item		Symbol	Condition	Min	Typ	Min	Unit
Current consumption		I_{DD}	V_{DD}=5.25V fosc=4MHz All input pins GND			8.0	mA
Operating voltage		V_{DD}	Q_{in} = 4 MHz or less	4.75	5.0	5.25	V
Input voltage "1" (excluding ADD-1, Qin pins)		V_{IH}	V_{DD}=5.25V	3.0		5.25	V
Input voltage "0" (excluding ADD-1, Qin pins)		V_{IL}	V_{DD}=5.25V	0		0.8	V
Input voltage "1" (ADD-1 pin)		V_{IH} ADD-1	V_{DD}=5.25V	4.9		5.25	V
Input voltage "0" (ADD-1 pin)		V_{IL} ADD-1	V_{DD}=5.25V	0		0.4	V
Input voltage "1" (Qin pin)		V_{IH} Q_{in}	V_{DD}=5.25V	4.0		5.25	V
Input voltage "0" (Qin pin)		V_{IL}•Q_{in}	V_{DD}=5.25V	0		0.8	V
Output voltage "1" level	All pins except Q_{OUT}	V_{OH}	V_{DD}=4.75V, I_{OH}=10μA	2.4		4.75	V
	Q_{OUT} pin	V_{OH}•Q_{out}	V_{DD}=4.75V, I_{OH}=10μA	2.4		4.75	V
Output voltage "0" level	All pins except Q_{OUT}	V_{OL}	V_{DD}=5.25V,I_{OL}=3.2mA	0		0.4	V
	Q_{OUT} pin	V_{OL}•Q_{out}	V_{DD}=5.25V, I_{OL}=10μA	0		0.4	V

Note) Be sure to connect the ADD1 pin to V_{DD} or V_{SS} via a 1 KΩ (or less) resistor to set [H][L]. Connect OPEN [H] to V_{DD} via a 1 MΩ (or more) resistor. To pull up the ADD2 to ADD5 pins to V_{DD}, connect them via 2.2 KΩ (or less) resistors for stable operation.

■ INTERFACE FUNCTION

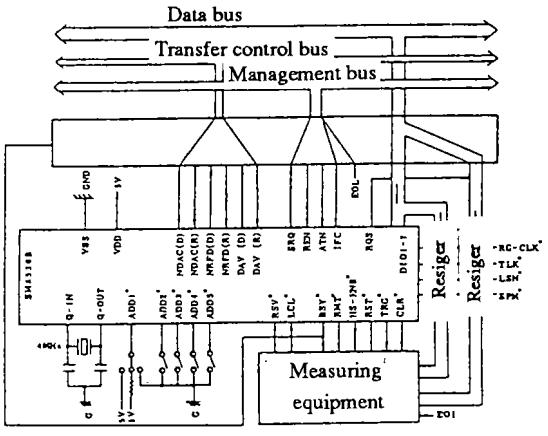
The SM8530B executes the following five interface functions.

(1) Talker function (T)
(2) Listener function (L)
(3) Serial poll service request function (SRQ)
(4) Remote/local (RL)
(5) Clear/trigger (DC, DT)

The table below lists the levels of functions that can be executed by the SM8530B in relation to the IEC standard.

Spec. category	Description	Subset of required function
SH1	All SH functions implemented	None
AH1	All AH functions implemented	None
T5	Basic talker function, serial poll function, talk-only mode, talk release by MLA possible	SH1 and (L1 to L4)
L3	Basic listener function, listen-only mode, listener release by MLA possible	AH1 and (T1 to T8)
SR1	All SR functions implemented	T1, 2, 5 or 6
RL1	All RL functions implemented	
PR0	No PP functions	
DC1	All DC functions implemented	L1 to L4
DT1	All DT functions implemented	L1 to L4
C0	No C functions	

■ SYSTEM CONFIGURATION



1) The IEC standard bus operates in negative logic. As the SM5830B interfaces with the standard bus in positive logic, the receiver/driver must have an inverter function.
2) In this catalog, all signals are explained with the logic level at the SM8530B pins. Thus signal levels should be inverted for the IEC standard bus.

■ PIN DESCRIPTION (* mark indicates negative logic)

No.	Pin name	Function	
1 2 3 4 5 6 7	DI01 DI02 DI03 DI04 DI05 DI06 DI07	DI01 to DI07 input pins for data bus (D08 of data bus is not used.)	
8	ATN	Management bus ATN signal input	ATN
9	REN	Management bus REN signal input	REN
10	IFC	Management bus IFC signal input	IFC
11	SRQ	Management bus SRQ signal output	SRQS
12	NRFD(R)	NRFD signal input	NRFD
13	NRFD(D)	NRFD signal output	AIDSVACRS
14	NDAC(R)	NDAC signal input	NDAC
15	NDAC(D)	NDAC signal output	AIDSVAWNS
16	DAV(R)	DAV signal input	DAV
17	DAV(D)	DAV signal output	STRS
18	RQS	RQS signal output (for status byte)	APRS
19	RST*	Set the LSI internal circuit to idle state.	Pon
20	Vss	Ground	
21	QIN	Crystal oscillator connection pin. External clock input pin.	
22	QOUT	Oscillator connection pin	
23	RSV*	Input when service request (i.e., SRQ signal transmission to controller) is necessary.	
24	RMT*	Remote/local switching signal output. L to Sets measuring equipment to remote state. H to Sets measuring equipment to local state.	REMS VRWLS
25	LCL*	Pin for inputting signal that sets measuring equipment back to local state. Invalid at the time of local lock-out.	rt l
26	TRG*	Pin for outputting signal that starts measuring equipment operation.	DTAS
27	CLR*	Pin for outputting signal that sets measuring equipment to initial state	

No.	Pin name	Function	
28	SPM*	Pin for outputting signal that indicates system is in serial poll mode. L to Serial poll mode H to Other mode	SPMS
29	TLK*	Pin for outputting talker specified signal. L to Specified as talker. H to Not specified as talker.	TADSVTACS
30	LSN*	Pin for outputting listener specified signal. L to Specified as listener. H to Not specified as listener.	LADSVLACS
31	RG-CLK*	External register clock signal output. 1 pulse is output when the BSY signal is output.	
32	BSY*	Pin for outputting signal that indicates the execution of 3-line handshaking. L to 3-line handshaking being executed H to Other state Use of this signal is explained later. Data and status must be transmitted/ received while this signal is L.	(i) Transmission (SDYSVSTRS) ∧ TACSVSPAS) (ii) Receiption ACDS ∧ LACS
33	HS-ENB*	Pin for inputting signal that starts transmission/reception of data and status. Use of this signal is explained later.	(i) Transmis-sion - nba (ii) Receiption, rdy
34	OLY*	Input signal for identifying only mode/ address mode of measuring equipment L to Only mode pin 35: L to Talker only H to Listener only H to Address mode	(i) Talker ton (ii) Listener l on
35	ADD5*	Pin for specifying address bit 5. Talker/listener is specified in the only mode.	
36	ADD4*-ADD2*	Address bits 2 to 4 (See the Address Code Table.)	
38	ADD1*	Pin for specifying address bit 1. Connect a 1 MΩ (or more) pull-up resistor for dual address, which validates only the high-order 4 bits of the address converter.	
39	VDD	Ground	

■ SPECIFIED ADDRESS AND SPECIFIED ONLY MODE

Address No.	ADD5*	ADD4*	ADD3*	ADD2*	ADD1*	OLY*
0	H	H	H	H	H	H
1	H	H	H	H	L	
2	H	H	H	L	H	
3	H	H	H	L	L	
4	H	H	L	H	H	
5	H	H	L	H	L	
≈	≈	≈	≈	≈	≈	≈
29	L	L	L	H	L	
30	L	L	L	L	H	
Talker only	L	×	×	×	×	L
Listener only	H	×	×	×	×	L

Address mode

■ INTERFACE COMMAND EXECUTED BY THE SM8530B

SYMBOL	NAME	Sexadecimal code	
MLA	MY LISTEN ADDRESS	2X	
UNL	UNLISTEN	3F	
MTA	MY TALK ADDRESS	4X	Note 1
OTA	OTHER TALK ADDRESS	4X	Note 1
UNT	UNTALK	5F	Note 2
DCL	DEVICE CLEAR	14	Note 2
SDC	SELECTED DEVICE CLEAR	04	
GET	GROUP EXECUTE	08	
GTL	TRIGGER	01	
LLO	GO TO LOCAL	11	
SPE	LOCAL LOCK OUT	18	
SPD	SERIAL POLL ENABLE	19	

Note 1) OTA = TAG∧ $\overline{\text{MTA}}$

Note 2) Valid only when listener is specified.

■ ESTABLISHMENT OF 3-LINE HANDSHAKING AND DATA RECEPTION

In the SM8530B, NRFD, DAV and NDAC signals have both reception (R) and transmission (D) pins, and they have positive logic. As all signals have negative logic in the standard bus line, the logic must be inverted at the time of input to or output from the SM8530B.

(1) In the case of talker

- The talker must be established (TLK* = L) first.
  - (i) Talker-only mode
    The talker is always set when pins 34 and 35 are both on the L level.
  - (ii) Address mode
    After ATN at pin 8 goes H with pin 34 having alread been H, the talker is set by MTA input.
- When data is to be transmitted, a measuring equipment pulls the HS-ENB* signal for the SM8530B to the Low (active) level to control 3-line handshaking. The concept of this operation is shown in Figure 1, and the time chart in Figure 2.
- When the measuring equipment is in the data transmission enabled state, make the HS-ENB* signal go from H to L. The following condition is necessary for this timing.
  $(TLK^* = L) \wedge (BSY^* = H)$
- While HS-ENB* is L, the SM8530B senses the state of the NRFD (R) signal. It outputs the BSY* signal about 500 ns after NRFD (R) goes L. Thus, it is possible to transmit 1 byte if this BSY* signal is used to open the gate and output data previously set in the register to the bus. The SM8530B outputs the DAV (D) signal 3 µs after it senses the NRFD (R) signal. The BSY* signal returns to the H level within 0.45 µs after the DAV (D) signal goes L. The HS-ENB* signal may return to H anytime during the L period of the BSY* signal. More precisely, in the following condition.
  $(TLK^* = L) \wedge (BSY^* = L)$
- DAV (D) is not output as long as the HS-ENB* signal remains H, so that 3-line handshaking does not start. On the contrary, when the HS-ENB* signal remains L, data is sent with no limit every time NRFD (R) goes L.

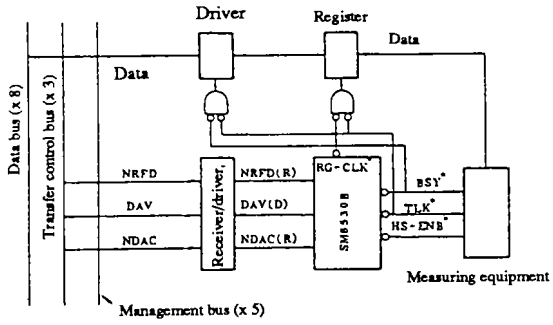
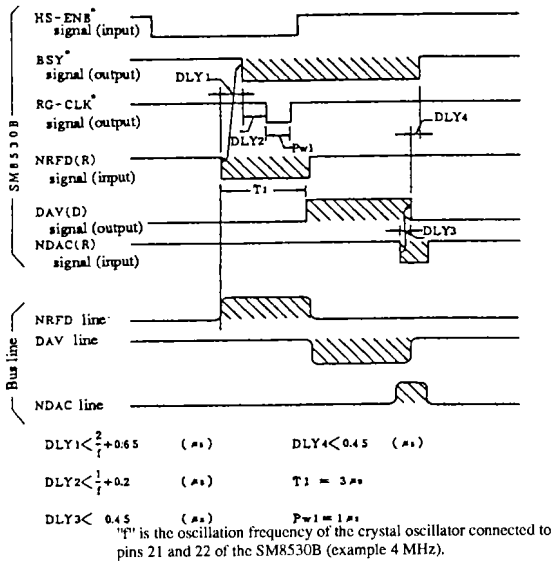


Figure 1 Schematic drawing of a talker



"f" is the oscillation frequency of the crystal oscillator connected to pins 21 and 22 of the SM8530B (example 4 MHz).

Figure 2 Talker handshaking

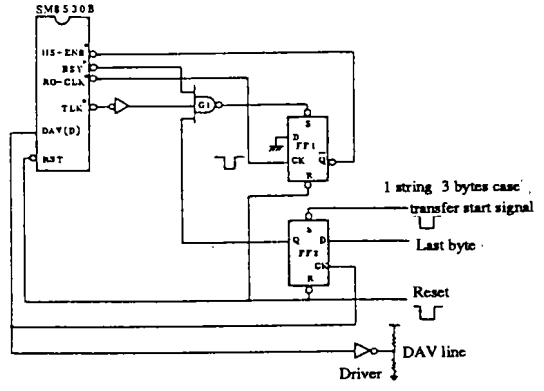
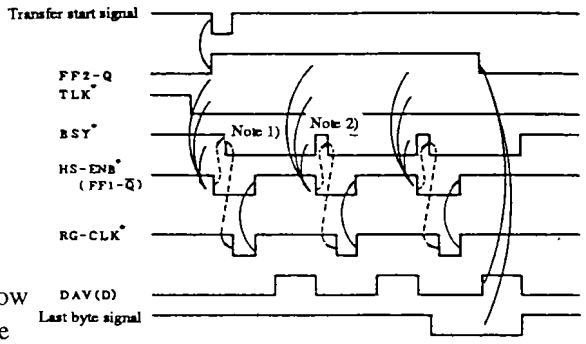


Figure 3 Talker circuit example (I)

- Talker reset (in the address mode)
  The talker is reset in the following five cases:
  (1) When IFC is input
  (2) When RST* is input
  (3) When specified as the listener by MLA
  (4) When the listen-only mode is specified by pins 34 and 35
  (5) When OTA is input
- Figures 3 to 6 show examples of the data transmission circuits and timing. Figures 3 and 4 show an example of sending the HS-ENB* signal byte by byte. Figures 5 and 6 show an example of sending several bytes in succession.

(2) In the case of the listener

- The listener must be established first (LSN* = L).
  (i) Listener-only mode
  The listener is always established when pin 34 is on the L level and pin 35 is on the H level.
  (ii) In the address mode
  After ATN at pin 8 goes H with pin 34 having already been H, the listener is set by the MLA input.
- When a measuring equipment becomes ready to receive data, the SM8530B changes the HS-ENB* signal from H to L and starts 3-line handshaking. The following condition is necessary for this timing.
  $(LSN^* = L) \wedge (BSY^* = H)$
  Figure 7 shows the schematic drawing of data reception, and Figure 8 its timing chart. Refer to talker's explanation for its way of thinking.
- The HS-ENB* signal is pulled H at the end of data reception. The following condition is necessary for this timing.
  $(LSN^* = L) \wedge (BSY^* = L)$
  If the HS-ENB* signal is kept L, NDAC (D) also remains H, so 3-line handshaking will not end.
- The listener reset operation is the same as the talker reset operation except that the self-listener is not reset by specifying other equipment as a listener.
- Figure 9 shows a data reception circuit, and Figure 10 its timing chart.



→ LSI internal operation
Note 1) In this period, establish DIO line data. Do not change the data.
Note 2) In this period, change the data to be sent to the DIO line.
(It is recommended that data be changed at the rising edge of BSY*.)

Figure 4 Timing chart of circuit in Figure 3

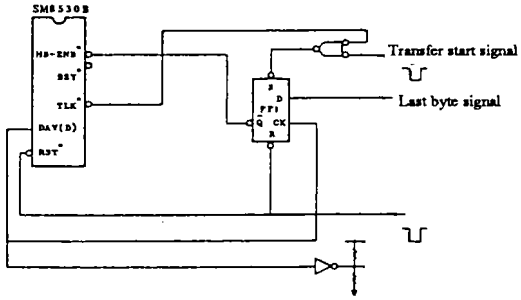
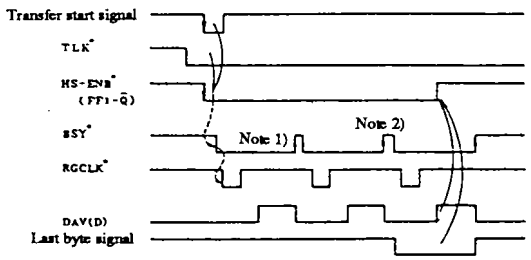


Figure 5 Talker circuit example (II)



→ LSI internal operation
Note 1) In this period, establish the DIO line data. Do not change the data.
Note 2) In this period, change the data to be sent to the DIO line.
(It is recommended that data be changed at the rising edge of BSY*.)
Note 3) Continuous transmission of several bytes are enabled by keeping HS-ENB "L".

Figure 6 Timing chart of circuit in Figure 5

(3) Command reception

When a command is received (ATN = H), handshaking is executed regardless of the state of the HS-ENB* signal. The BSY* signal and the RG-CLK* signal are not output at this time. Figure 11 shows the timing chart of this operation.

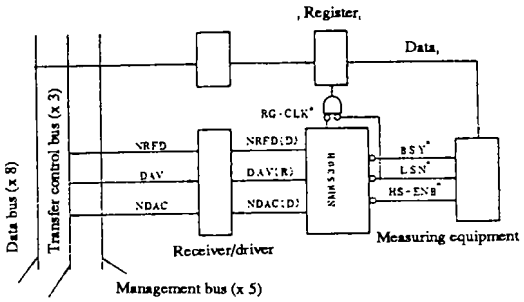


Figure 7 Conception

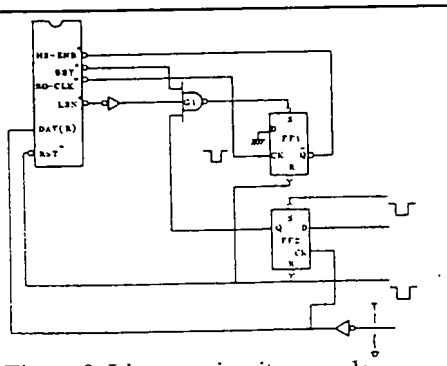
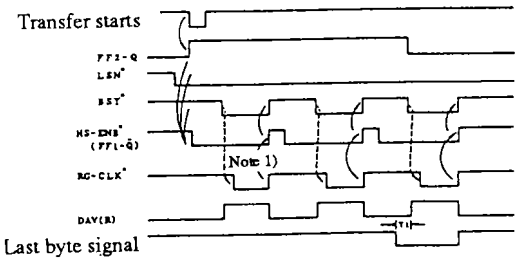


Figure 9 Listener circuit example



→ LSI internal operation
Note 1) DI0 line data must be stored in the register at the rising edge of RG CLK.

Figure 10 Timing chart of circuit in Fugure 9

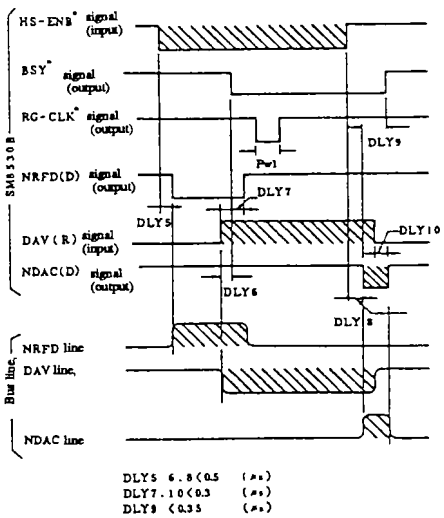


Figure 8 Listener handshaking

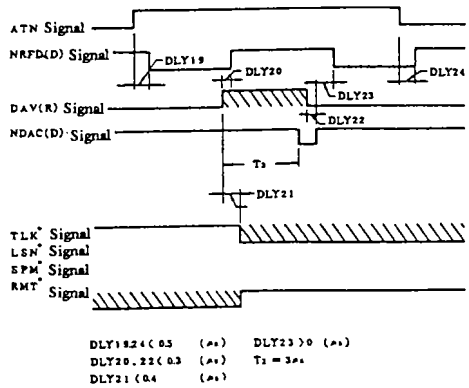


Figure 11 Command reception timing chart

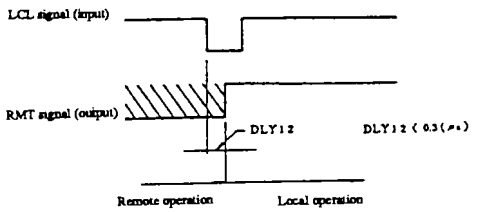


Figure 12 Remote/Local

■ REMOTE/LOCAL SWITCHING

In the idling state (initialization) after power-on, the SM8530B sets RMT* at pin 24 to the H level and a measuring equipment to the local state.

(1) Switching to remote
When the SM8530B receives MLA with REN = H, the RMT* signal goes L to establish the remote state.

(2) Resetting the remote state
The remote state can be reset by the following three methods:
(i) Pulling REN Low sets the local state (in this case, all the equipment in the system is set to the local state).
(ii) Receiving GTL in the listener mode sets the local state.
(iii) Pulling the LCL* signal Low with a control switch etc. of a measuring equipment sets the local state. The timing is shown in Figure 12. This method can set a measuring equipment in the local state independent of the controller state. This, however, may cause trouble in some cases. The 25-pin input can be invalidated by the LLO (local lock-out) command input in advance by the controller to the SM8530B.

(3) Note that the remote state cannot be reset by the IFC command.
Even when the RMT* signal is H (i.e., local state), no limitations are placed on the SM8530B operation. Therefore, interface control is performed normally.

■ SERVICE REQUEST (interrupt processing)

- Measuring equipment sends the RSV* signal to the SM8530B to make a service request.
  In response to the RSV* signal, the SM8530B outputs the H-level SRQ signal to the management bus and reports the service request to the controller (logic of the SRQ signal is inverted to L in the management bus).
- After receiving SRQ, the controller calls the interrupt processing subroutine.
  The SM8530B is applicable only to serial-polling systems. Figure 13 shows a service request timing chart. This figure shows an example of the 3-line handshaking timing for status byte (STB) transmission.

  UNL -- Inhibit other measuring equipment in the system (equipment in the listener period) to receive the requester's status.
  SPE -- When the controller calls the talker by serial polling, a special command (Serial Poll Enable) must be sent in advance to distinguish it from the ordinary talker specification.
  SPD -- When the serial poll mode is over, the controller sends Serial Poll Disable to the bus line, then returns to the ordinary mode.

The IEC interface standard does not specify any procedure after the controller receives SRQ, so the system designer can design software freely. Figure 14 shows a service request circuit.

■ IFC, RST*

- The SM8530B is initialized when the IFC command is received.
  Initialization → LSN, TLK reset, DAV (D), NDAC (D), NRFD (D) → L level
- The SM8530B can be initialized by externally inputting the RST* signal of the L level. Use after resetting the SM8530B at power-on. The RST* signal differs from the IFC command in that it also turns off the RMT* output (local) and the SRQ output.

■ APPLICATION

- Examples of talker and listener configurations made with the SM8530B are shown below. Figure 15 shows a talker for reading A/D converter data, and Figure 16 a listener for controlling a D/A converter.
- Using a microprocessor

  Combined with a microprocessor, the SM8530B can be used to create even more sophisticated applications. In this case, the SM8530B carries out the handshake operation for sending/receiving data byte by byte. As transmission/reception data can be sent to the microprocessor for complex processing, versatile system configurations are possible. Using a microprocessor also allows controller applications to be designed. In this case, the SM8530B performs only the handshake function, so the ATN, IFC, REN, SRQ and EOI control signals are processed directly by microprocessor IN/OUT commands. In this case, it is effective to use the SM8530B in the only mode. Figure 17 shows the schematic drawing of the former case, and Figure 18 the latter case.

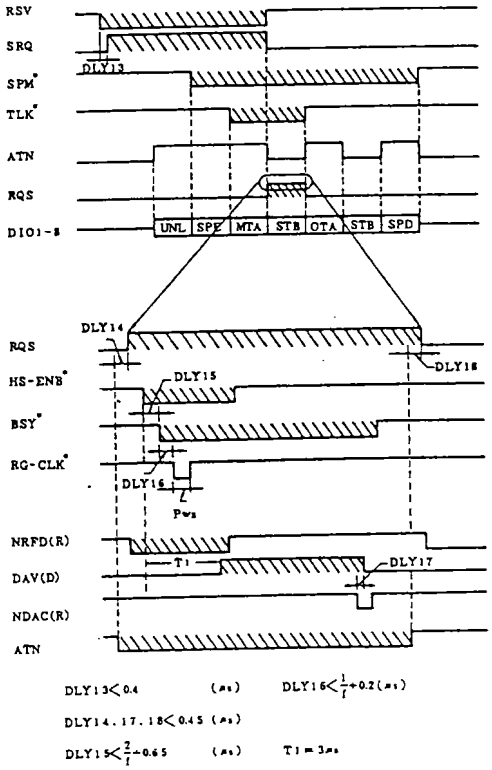


Figure 13 Service request timing chart

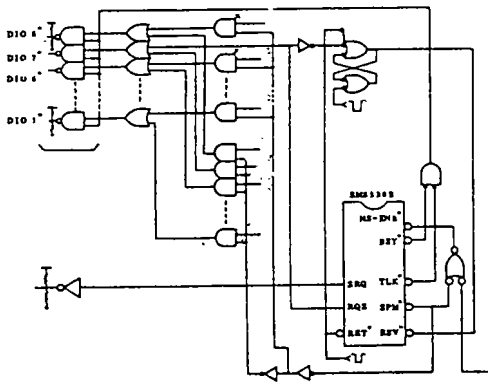


Figure 14 Service request circuit example

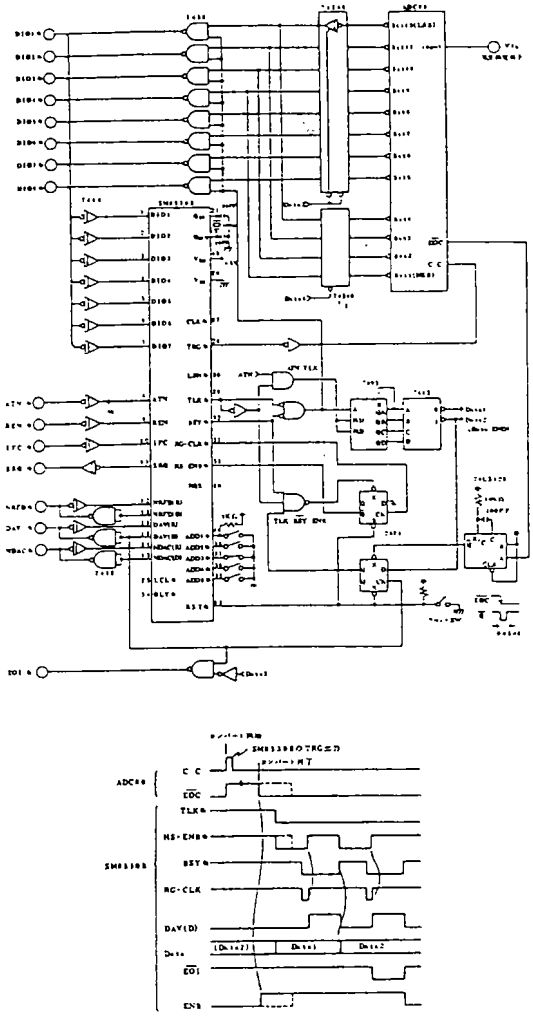


Figure 15 Talker application (AD converter control)

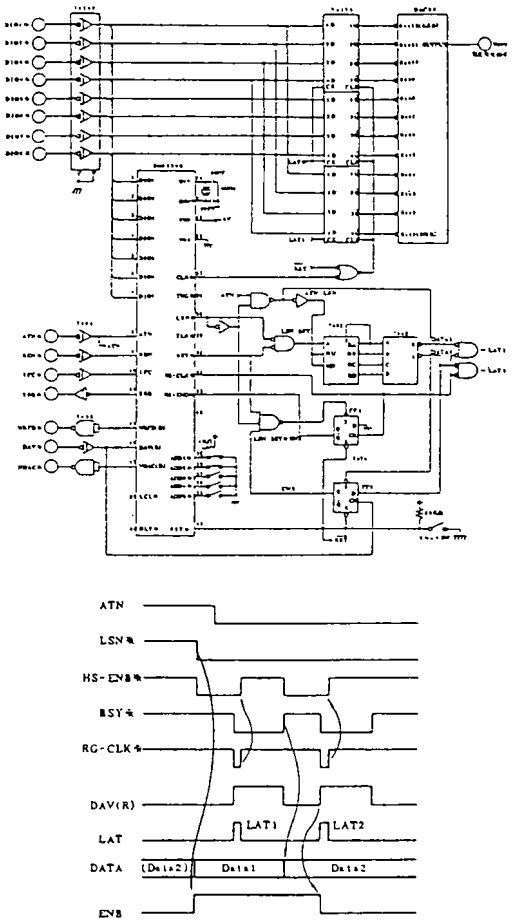


Figure 16 Listener application (DA converter control)

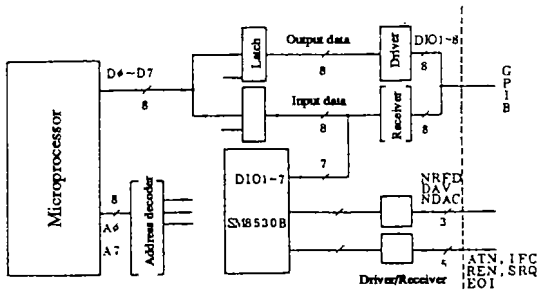


Figure 17 Talker/listener with processor

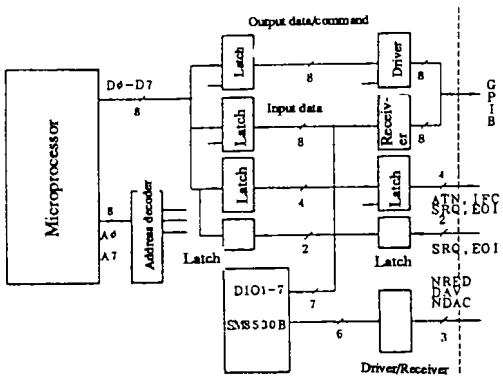


Figure 18 Application as controller