

# **STD-402TR**

## **SYNTHESIZED TRANSCEIVER UHF FM-NARROW BAND RADIO DATA MODULE**

### **[Auto Mode Operation Guide]**

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*CIRCUIT DESIGN, INC.*

*International Business Division*

7557-1 Hotaka, Hotaka-machi, Minamiazumi, Nagano 399-8303. JAPAN

Tel: ++(0263)-82-1010 Fax: ++(0263)-82-1016

web: <http://www.circuitdesign.co.jp>

e-mail: [cdint@po.circuitdesign.co.jp](mailto:cdint@po.circuitdesign.co.jp)

***CIRCUIT DESIGN, INC.***

## Precautions during usage

### Caution

- As the radio module communicates with electronic radio waves, there are cases where transmission will be temporarily cut off in accordance with the surrounding environment and method of usage. The manufacturer is exempt from all responsibility relating to damage to personnel or other equipment and other secondary damage.
- Do not use the equipment within the vicinity of devices that may malfunction as a result of electronic radio waves from the radio module.
- The manufacturer is exempt from all responsibility relating to secondary damage for the operation, performance and reliability of equipment connected to the radio module.
- Communication performance will be affected by the surrounding environment, so communication tests should be carried out before actual use.
- Ensure that the power supply for the radio module is within the specified rating. Short circuits and reverse connections may result in overheating and damage and must be avoided at all costs.
- Ensure that the power supply has been switched off before attempting any wiring work.
- The case is connected to the GND terminal of internal circuit, so do not contact the '+' side of the power supply terminal to the case.
- When batteries are used as the power source, avoid short circuits, recharging, dismantling, and pressure. Failure to observe this may result in the outbreak of fire, overheating and damage to the equipment. Remove the batteries when the equipment is not to be used for a long period of time. Failure to observe this may result in battery leaks damaging the equipment.
- Do not use this equipment in vehicles with the windows closed, in locations where it is subject to direct sunlight, or in locations with extremely high humidity.
- The radio module is neither waterproof nor splash proof. Ensure that it is not splashed with soot or water. Do not use the equipment which water or other foreign objects enter the case.
- Do not drop the radio module or otherwise subject it to strong shocks.
- Do not subject the equipment to condensation (including moving it from cold locations to locations with a dramatic increase in temperature.)
- Do not use the equipment in locations where it is likely to be affected by acid, alkalis, organic agents or corrosive gas.
- Do not bend or break the antenna. Metallic objects placed in the vicinity of the antenna will have a great effect on communication performance. As far as possible, ensure that the equipment is placed well away from metallic objects.
- The GND for the radio module will also affect communication performance. If possible, ensure that the case GND and the circuit GND are connected to a large GND pattern.

### Warning

- Do not take a part or modify the equipment.
- Do not remove the product label (the label adhering to the upper surface of the module.) The use of modules from which the label has been removed is prohibited.

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## General

The STD-402 auto mode is a operation mode that is equipped with automatic link function and an encoding/decoding function. Automatic link searches out vacant channels in order to use forty six channel frequencies without hindrance or interference. The encoding/decoding function establishes an interface between the data I/O circuit and radio assembly and executes the necessary communication protocols.

The transmitter's input circuit and the receiver's output circuit can easily be connected together with a general-purpose IC.

Note: This manual explains applications that use general-purpose logical ICs. For details on external micro-computer control serial data communication applications, refer to the manual that is scheduled for release in the future.

The STD-402 auto mode supports only one-way (uni-directional) transmissions (transmitter --> receiver,) but support for simplex communications (bi-directional) is planned for the future.

## Features

- The automatic link function automatically connects to channels that do not cause interference.
- Simple I/O circuits with the built-in encoder/decoder.
- The I/O connections can be expanded to a maximum of 63 bytes (504 bits.)
- The built-in micro-computer greatly reduces the cost of new development.
- Perfect for combining with other equipment.

## Application Examples

### One-way system

#### ★ Tele-control

- For controlling cranes, concrete pump vehicles, golf carts, remote opening/closing for various purposes, traffic lights for road works, etc.

Support for the following applications is planned for the future.

### Simplex systems

#### ★ Data transmission

- Handy terminals, bar-code readers

#### ★ Security

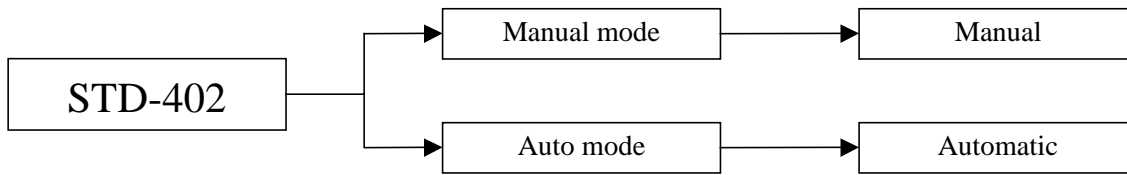
- Transmission of anti-theft alarms, immobilizers for cash delivery trucks, notification of customers entering retail shops, etc.

#### ★ Telemeter

- Water level monitoring for canals and dams, etc., monitoring of various alarms, etc.,

## Configuration

- The manual mode is the conventional radio module. Refer to the [Manual Mode Manual] for further details.
- The auto mode automates numerous functions with the use of the built-in micro-computer.



- The features of both modes are shown in the table below.

MODE	Channel	Encoder/Decoder
Manual mode	Manual	External
Auto mode	Automatic	Internal

<b>Auto mode features</b>	(1) Automatic link (2) Programmable encoder/decoder
---------------------------	--

The conventional module concentrated on a single element, and it was necessary to have an external CPU or dedicated hardware for the control circuit. The CPU built into the STD-402, on the other hand, has been equipped with the control software listed below, and this has resulted in a new type of module.

### (1) Automatic link

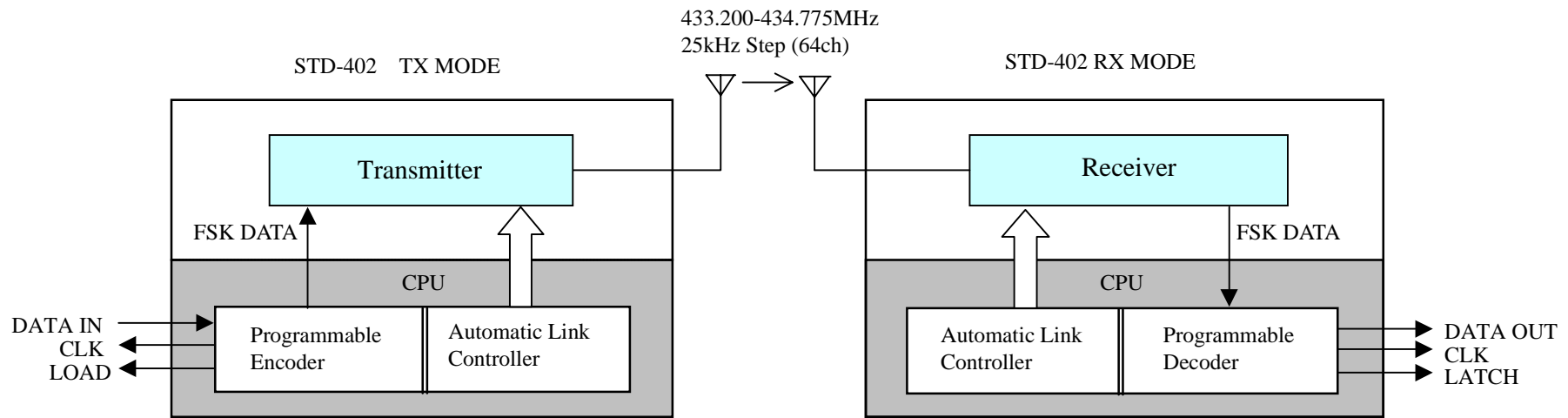
- The automatic frequency selection function consists of the Automatic Channel Search and the Automatic Link functions.
  - (1) The Automatic Channel Search is a system that searches for vacant channels amongst channels 0 to 63 (total of 64 channels).
  - (2) The Automatic Link is a system that verifies the ID numbers of the transmitter and receiver and establishes a link automatically.
- The above two functions are called collectively as the Automatic Link.

### (2) Programmable encoder/decoder

- With the conventional module, it was necessary to establish an interface between the I/O signals and external encoder/decoder and convert them to digital data (serial data.)
- The CPU built into the STD-402 is equipped with an encoder/decoder function. Establishing an interface is a simple matter by connecting an external general-purpose logical IC, and this enables a maximum of 63 bytes (504 bits) of data to be transmitted.

## STD-402 Features

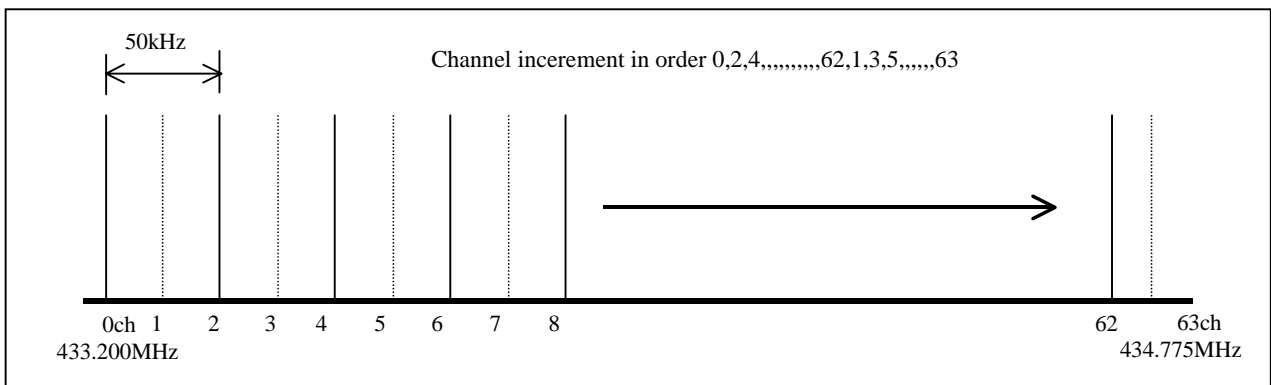
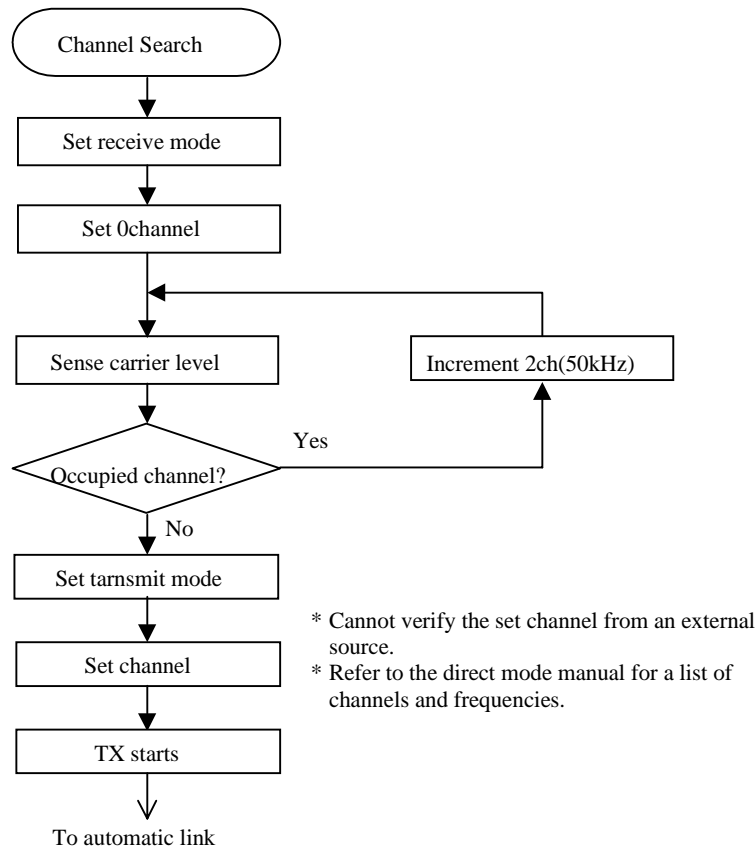
- (1) Automatic Link
- (2) Programmable Encoder / Decoder



## Explanation for internal processes (1) (automatic channel search)

- The automatic channel search is a system that detects the carrier level of the channel in use to search for vacant channels in order to avoid interference with other radios. This is controlled automatically by the built-in micro-computer.
- The channel search is executed by the module from the pre-determined starting channel.
- For example, if the channel search was executed from [0ch], the procedure would be as follows:

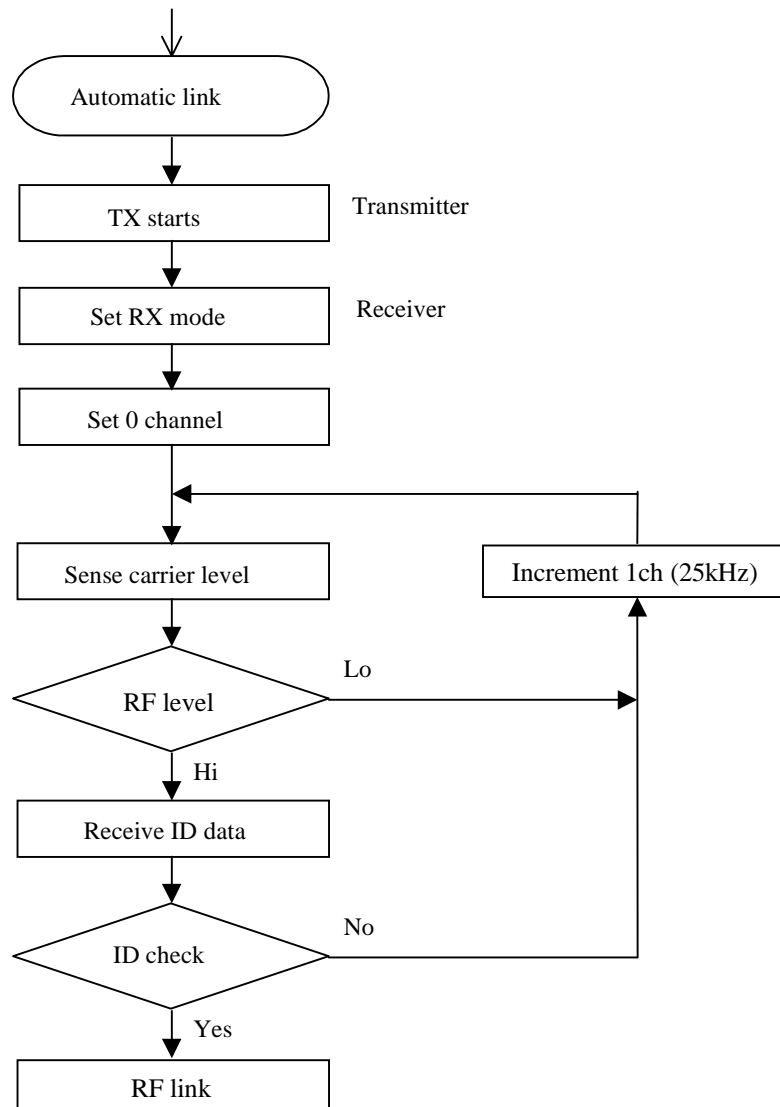
- (1) The STD-402 is set in the receiving mode
- (2) Set at channel 0 (433.200MHz)
- (3) The carrier level is detected and compared with the standard level
- (4) If the channel is occupied, the frequency is increased by two channels (50kHz.)
- (5) If the channel is vacant, the system is switched across to the transmission mode
- (6) The vacant channel is set
- (7) Transmission is started



## Explanation for internal processes (2) (automatic link)

- This is controlled automatically by the built-in micro-computer in the same way as the automatic channel search.
- All modules are started from [0ch] in the case of the automatic link.
- The channel search is executed by the module from the pre-determined starting channel.
- For example, if the channel search was executed from [0ch], the procedure would be as follows:

- (1) The transmitter set for the vacant channel commences transmission
- (2) The receiver is set at channel 0 (433.200MHz)
- (3) The carrier level is detected and compared with the reference level.  
\* The reference level is different for the transmitter and receiver.
- (4) If it is below the standard level, the frequency is increased by one channel (25kHz.)  
\* Increased by two channels for the transmitter, but only one channel for the receiver.
- (5) The ID data is received and compared with the ID register
- (6) Increased by one channel (25kHz) if the ID number matches
- (7) Switched across to the communication mode if the ID number matches



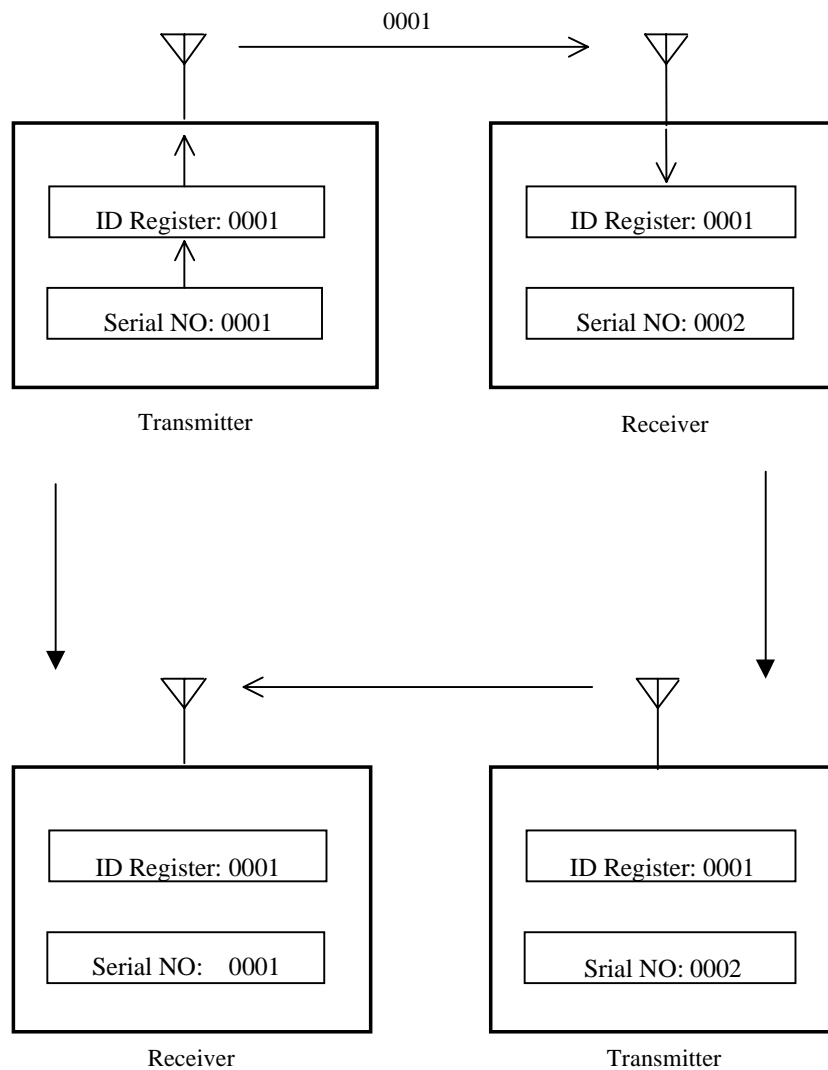


## Explanation for internal processes (3) (ID number registration)

- It is necessary to register an ID number for the transmitter and receiver in order to enable the STD-402 to establish an automatic link between two devices.
- The serial number of the transmitter is written into the transmitter's and receiver's ID register as shown in the illustration below.
- If transmission is performed on the same frequency from another radio or an STD-402 with a different ID number, the receiver will continue to search the channels until it finds an ID number that matches its own.

### Registration of ID

- \* The serial number is a unique number set in the factory at the time of shipment and can only be read.
- \* The ID register is a register for storing the ID number.

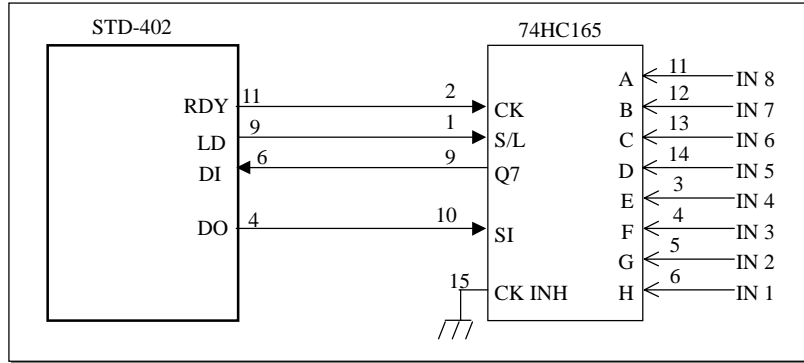


- \* As shown above, the number registered in the ID register remains the same even when switching between the transmitter and receiver, so it is not necessary to register a new ID number.

## Explanation for internal processes (4) (encoder)

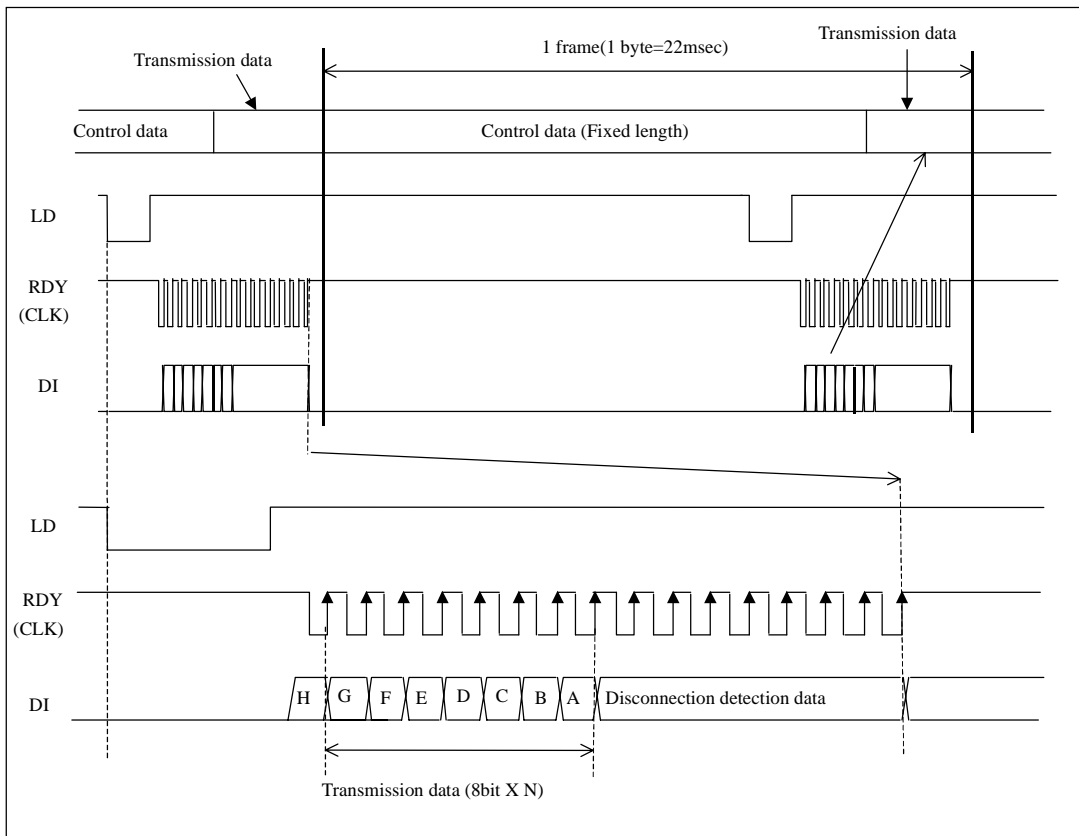
### • Connection method

- The illustration below shows the basic circuit when the STD-402 is used in the TX mode (transmitter.)
- The 74HC165 is a general-purpose 8-bit parallel input --> serial output converter.
- The STD-402 detects disconnection, so ensure that a DO is connected to the SI.



### • Timing chart

- The timing for the STD-402 TX mode is shown below.
- The micro-computer built into the STD-402 is equipped with an encoding function and communication protocols to convert the automatic link ID numbers, the various control data and the transmitted data into FSK data.
- The entire data is called as a 'frame,' and the transmission data is inserted once into a single frame. The data is transmitted continually until the power supply is switched off.
- The length of the control data is fixed, but the transmission data can be changed between 1 byte to a maximum of 63 bytes (504 bits) in accordance with the application.

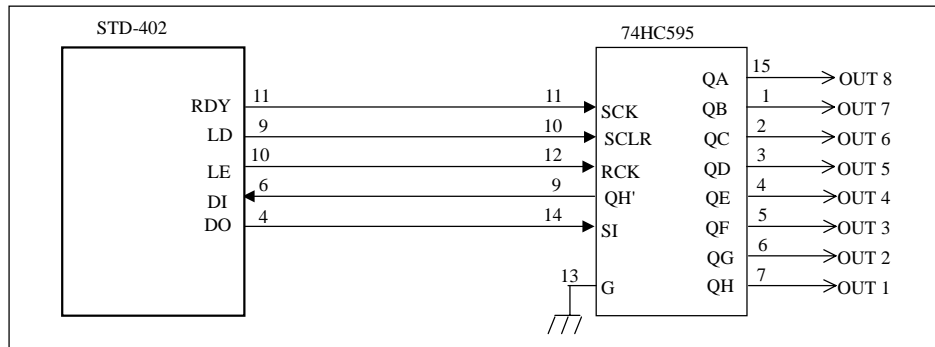


- (1) The parallel data is latched onto the clock asynchronously when the LD signal is "L".
- (2) Serial data is shifted at the RDY (clock) rises when the LD signal is "H".

## Explanation for internal processes (5) (decoder)

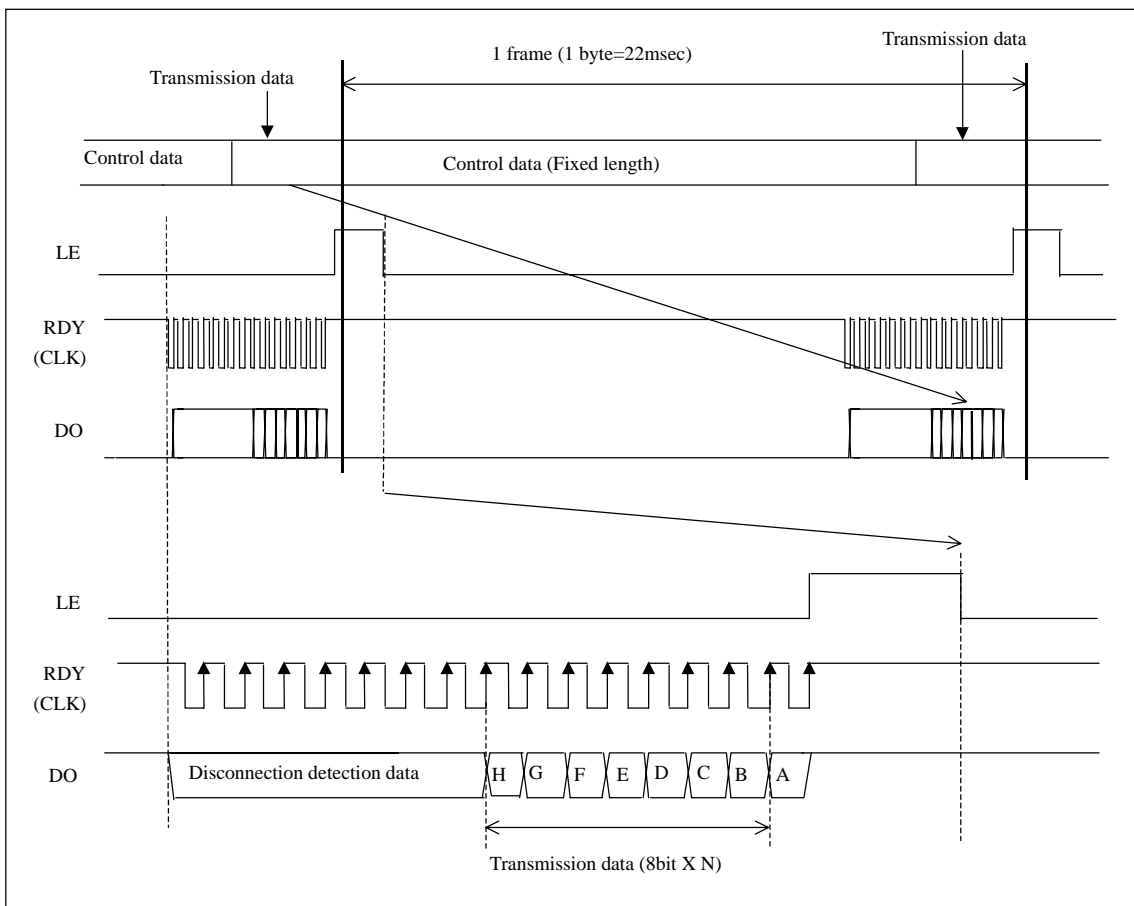
### • Connection method

- The illustration below shows the basic circuit when the STD-402 is used in the RX mode (receiver.)
- The 74HC595 is a general-purpose serial input → 8-bit parallel output converter.
- The STD-402 detects disconnection, so ensure that a QH is connected to the DI.
- The 74HC595 latch data is cleared when LD is "L".



### • Timing chart

- The timing for the STD-402 RX mode is shown below.
- The micro-computer built into the STD-402 is equipped with a decoding function and communication protocols to convert the received FSK data into control data and the transmitted data (serial data.)
- The transmission data is output once into a single frame. The data is received continually until the power supply is switched off.

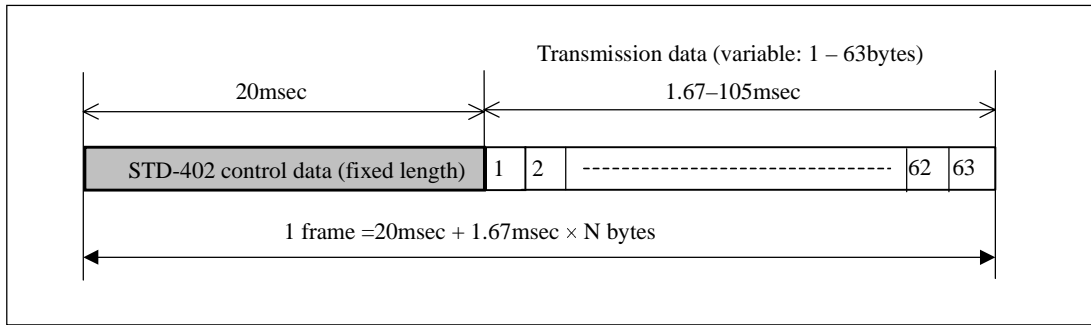


- (1) The serial data is shifted when the RDY (clock) rises.
- (2) The parallel data is latched onto the clock asynchronously when the LE signal rises.

## Explanation for internal processes (6) (data format)

### • Communication data format

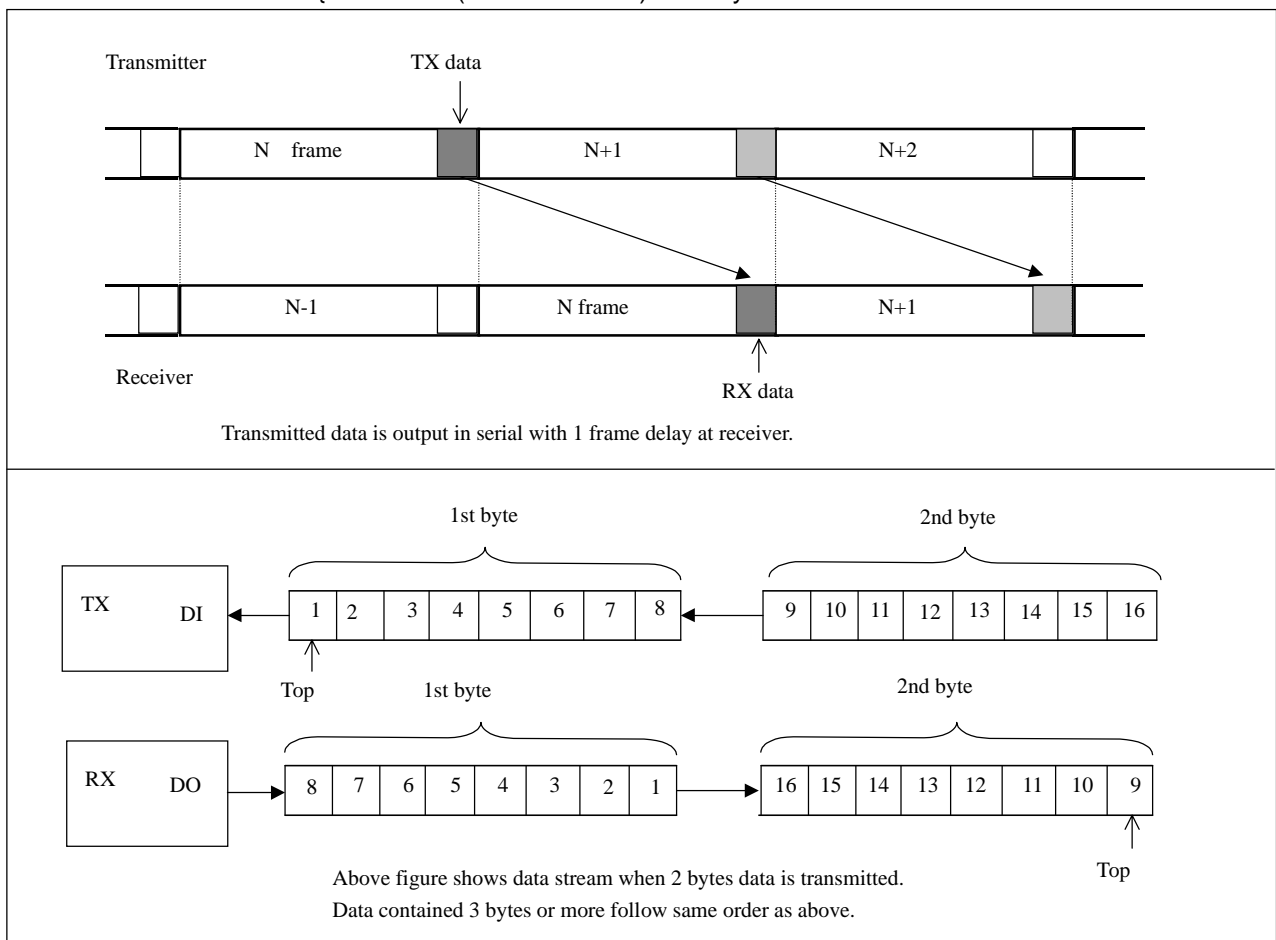
- The STD-402 control data is of fixed length and comes in a unique format that includes the ID code for radio links and special codes.
- The user data (transmission data, receiving data) is between 1 byte (8 points) and 63 bytes (504 points) depending on the number of I/O connections, and the transmission time will be extended in accordance with the length of the transmission data.
- The communication data format is shown below.



### • Transmitting data between Transmitter and receiver

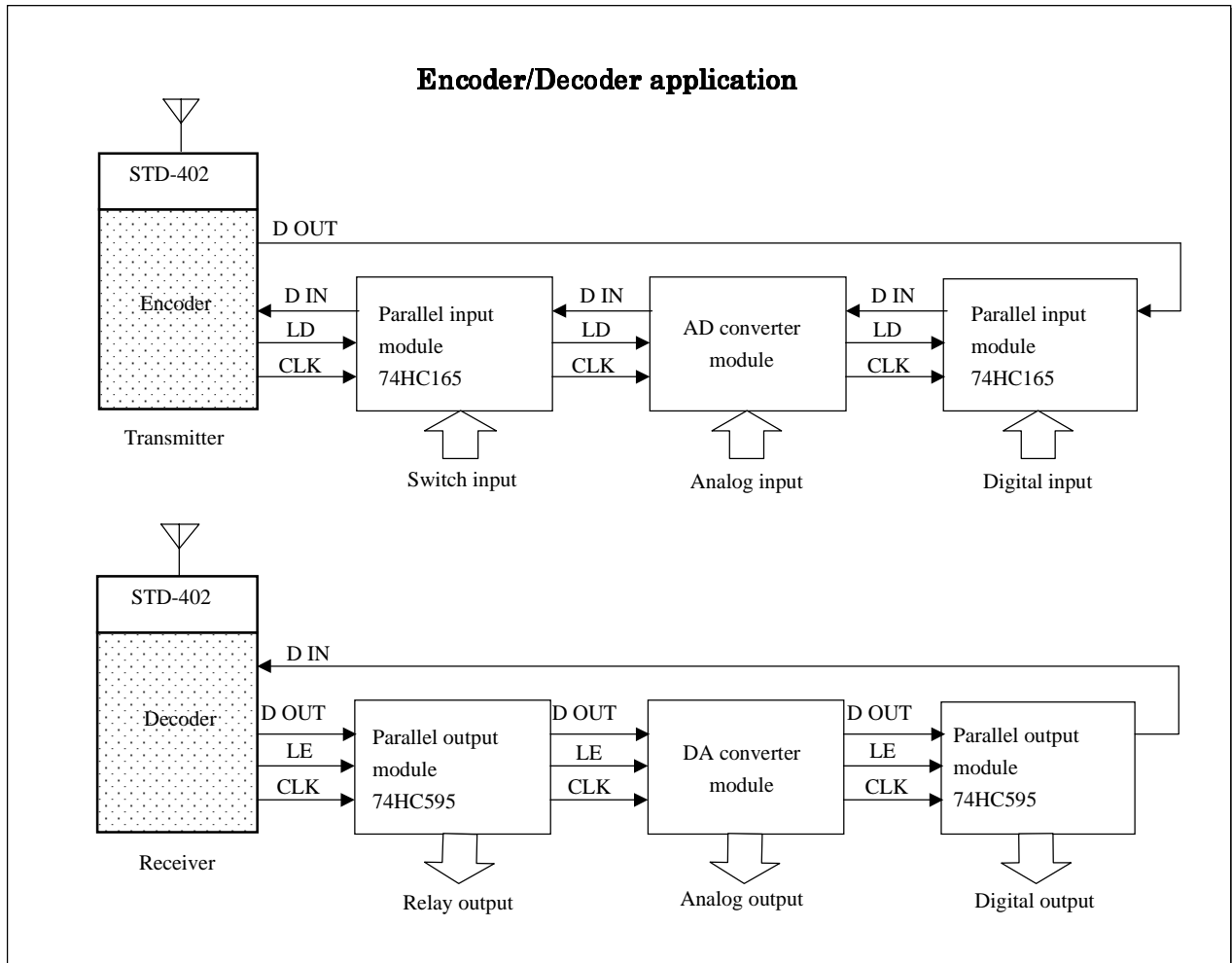
- The communication data is transmitted continually during transmission. However, the transmission data will not actually travel continuously at 4,800bps owing to the fact that the control data is transmitted by frame by the encoder.
- Using 1 byte of data as an example, the data volume (number of bytes) transmitted within a one-second period is as follows.

$$D = 1000\text{msec} \div \{ 20\text{msec} + ( 1.67\text{msec} \times 1 ) \} \approx 46 \text{ bytes}$$



- **Application example for the encoder/decoder function**

- The encoder/decoder function built into the STD-402 enables an interface with external circuits to be established easily.
- As the interface is established with serial data, AD converter and DA converter applications and application with general purpose logical IC are possible.
- User will be required an additional peripheral for RS232C communication.

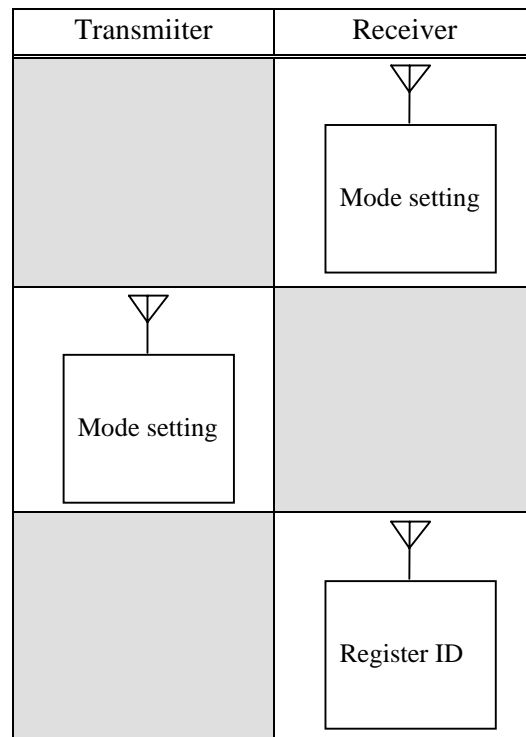
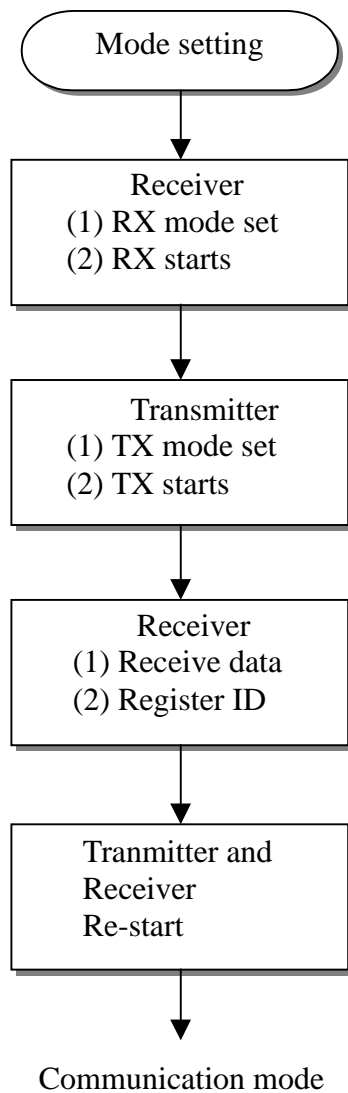


- If the data is not looped, an error will be judged during the disconnection check when the STD-402 is switched on, and normal operations will not be possible.

## Setting mode

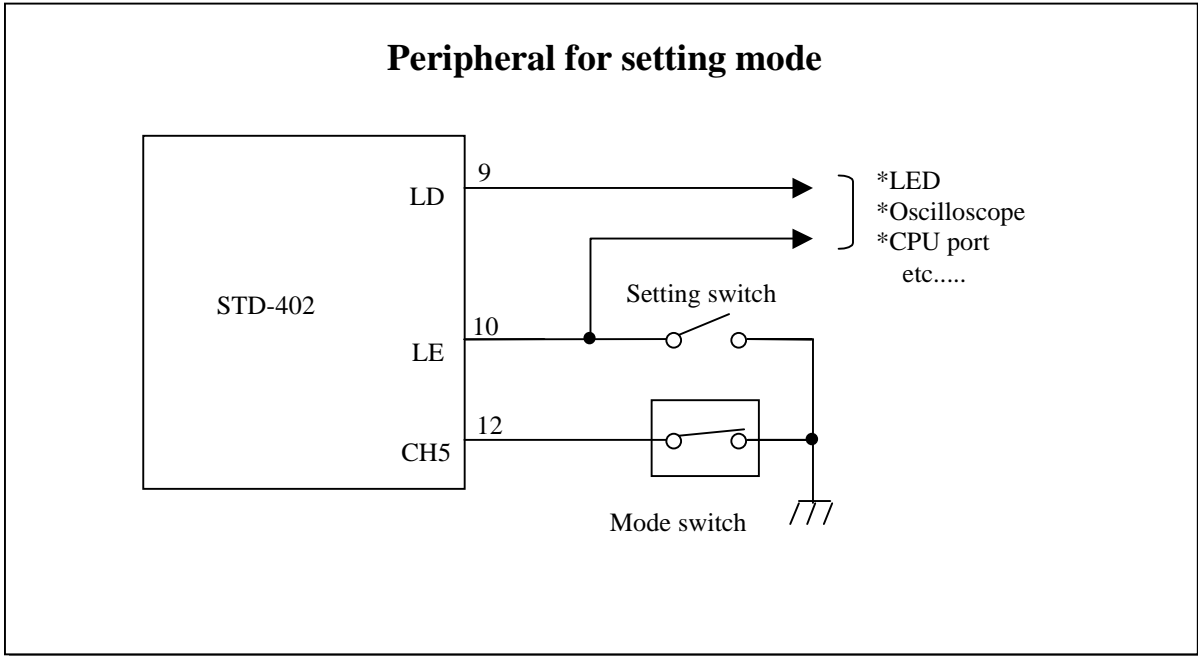
### • Auto mode setting procedure

- It is necessary to set the data for the built-in micro-computer before the STD-402 can be used. This procedure is known as the "setting mode."
- Once the settings have been made, they do not require further setting unless the data registered in the transceiver is to be amended or the mode changed.
- The contents of the settings registered with the setting mode are as follows:
  - (1) Manual mode / Auto mode setting
  - (2) Registration of ID
- It is necessary to have setting switch and verify the status of the setting mode by the LE and LD terminals. The STD-402 is not equipped with these switches and LEDs.
- If space or cost restrictions prevent the installation of the above-mentioned hardware, it is necessary to make circuit or equivalent board.
- Ensure that the transmitter and receiver are located less than ten meters apart when making the settings to avoid the wrong parameters being registered by a different STD-402.
- The system is set in the Manual mode when shipped from the factory.
- An outline of the setting procedure is shown below. Refer to the separate explanations for further details.



• **Peripheral circuits**

- CH5 is the port for the Auto mode / Manual mode setting.
- CH0 to 5 are the setting ports for the local ID address when in the communication mode. Refer to [Communication Mode] for further details.
- The LE port performs mode setting switch input and status output.
- The LD port is the status output port.
- \* Refer to [Ports] for further details on each port.



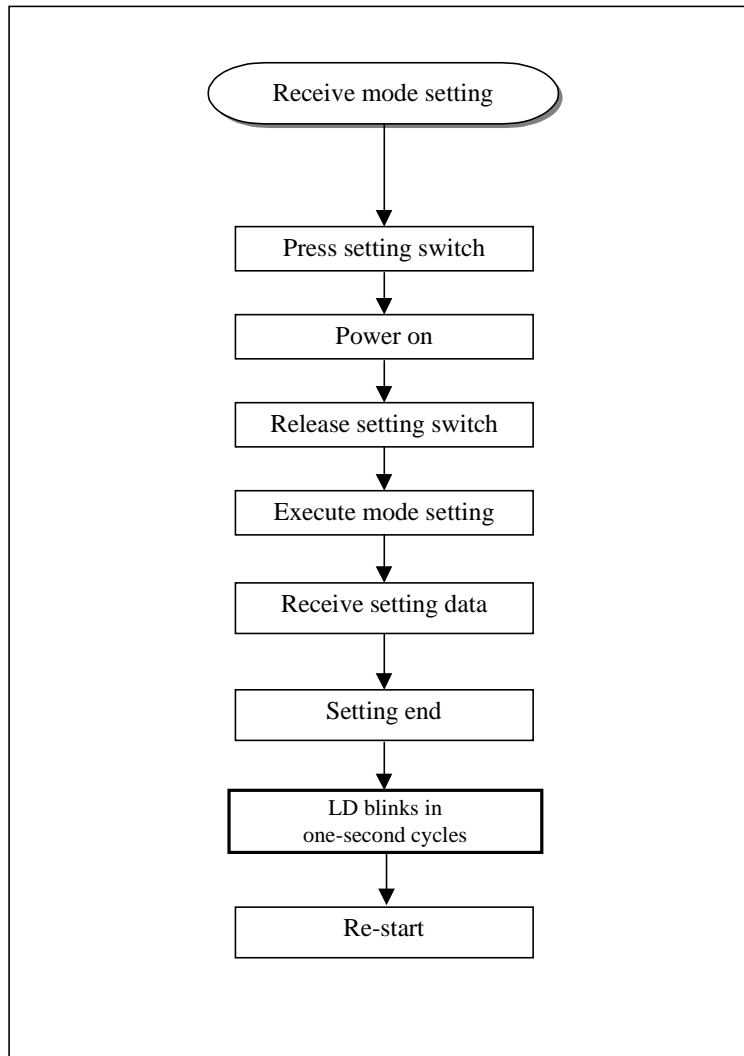
• **Auto mode / Manual mode setting**

- Auto / Manual mode setting is only possible when the T/R port is set in the [H=RX (receiver) mode].
- Ensure the GND is set when in the auto mode.

CH5	Mode
GND	Auto mode
OPEN	Manual mode

## • Receiver mode setting

- An example of this setting is provided in the [Explanation for internal processes (5) (decoder)] application.
- Set the receiver mode by setting the T/R terminal to [OPEN=RX].
- Make the setting in accordance with the following procedure:
  - (1) Set the CH5 port to [GND= auto mode].
  - (2) Switch on the power supply while pressing the setting switch.
  - (3) Release the setting switch.
  - (4) Commence the built-in micro-computer settings.
  - (5) Receive the setting data from the transmitter.  
DATA rate is automatically set by the setting data.
  - (6) The LD port will blink L and H in one-second cycles when the receiver settings are complete.
  - (7) Switch on the power supply once again.



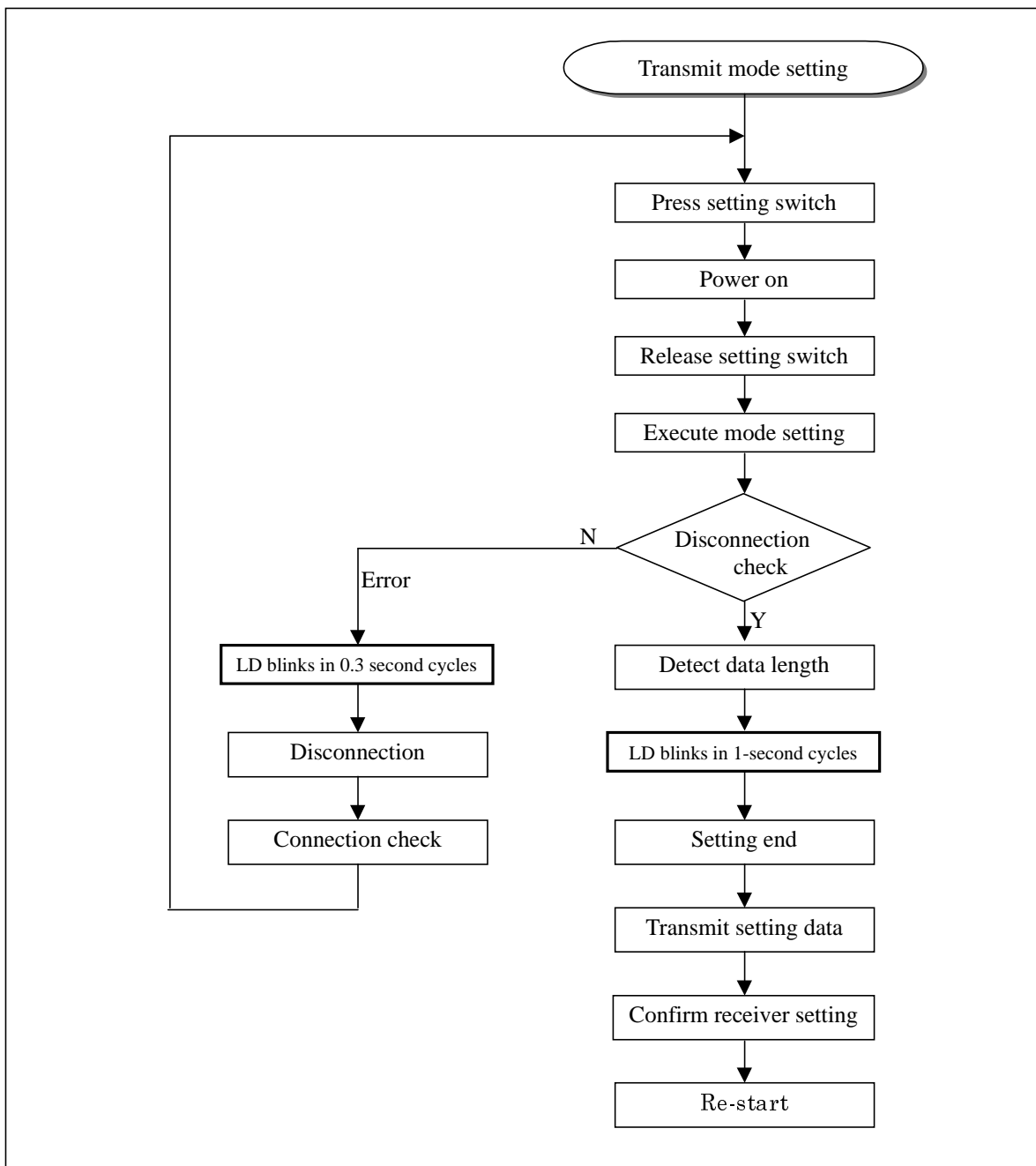
Port settings

	T/R	CH5	CH4	CH3	CH2	CH1	CH0
OPEN							
GND							



## • Transmitter mode setting

- An example of this setting is provided in the [Explanation for internal processes (4) (encoder)] application.
- Set the transmit mode by setting the T/R terminal to [GND=TX].
- Make the setting in accordance with the following procedure:
  - (1) Set all ports between CH0 and CH5 as shown in figure below.
  - (2) Switch on the power supply while pressing the setting switch.
  - (3) Release the setting switch.
  - (4) Commence the built-in micro-computer settings.
  - (5) The data volume (byte length) is automatically detected at the same time as the disconnection check is run.
  - (6) The LD port will blink L and H in 0.3 second cycles if a disconnection is detected.  
\* Recheck the connections and perform the settings again.
  - (7) The LD port will blink L and H in one-second cycles if all is normal.
  - (8) The setting data will be transmitted. A time-out will occur after approximately ten seconds.
  - (9) After the receiver settings are complete, switch off and on the power supply to the transmitter once again, then enter the communication mode.



Port settings

	T/R	CH5	CH4	CH3	CH2	CH1	CH0
OPEN							
GND							

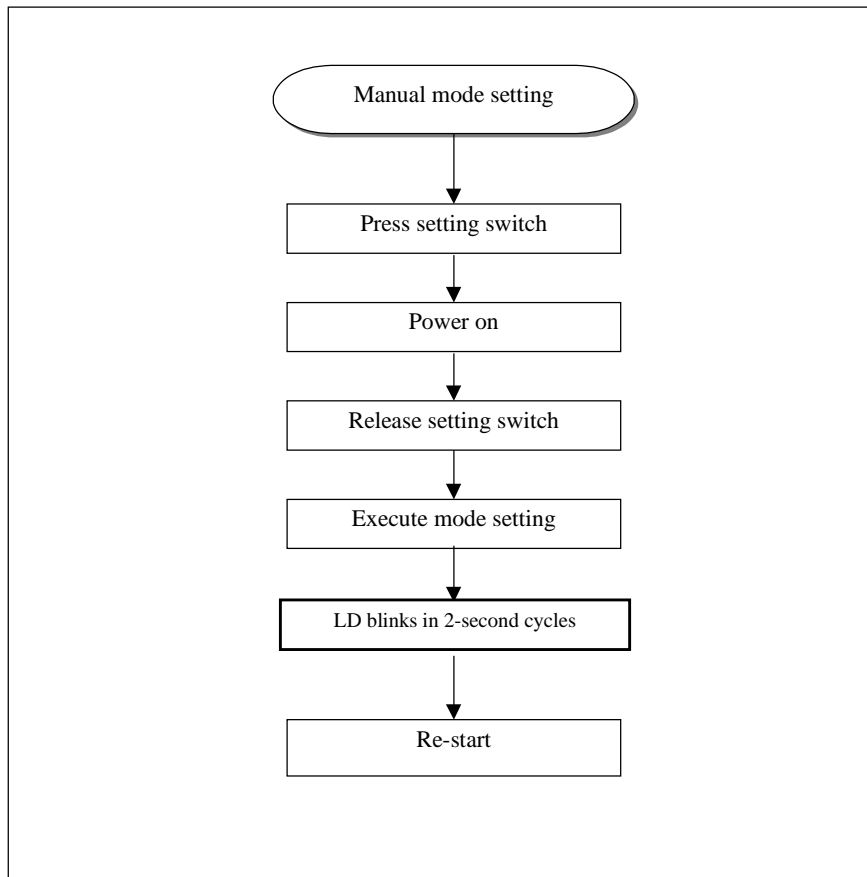
[4800 bps]

	T/R	CH5	CH4	CH3	CH2	CH1	CH0
OPEN							
GND							

[9600 bps]

• **Manual mode settings**

- Set the receive mode by setting the T/R terminal to [OPEN=RX]. Manual mode setting is not possible when in the transmit mode.
- Make the setting in accordance with the following procedure:
  - (1) Set the CH5 port to [OPEN = manual mode].
  - (2) Switch on the power supply while pressing the setting switch.
  - (3) Release the setting switch.
  - (4) Make the settings in the direct mode.
  - (5) The LED will be illuminated in 2-second cycles.
  - (6) Switch on the power supply once again when the setting is complete.



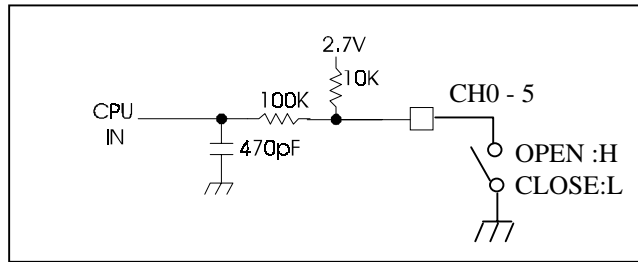
Port settings

	T/R	CH5	CH4	CH3	CH2	CH1	CH0
OPEN							
GND							

## Ports

### • CH0 to CH5 ports

- Mode setting and local ID setting is performed by the CH0 to CH5 ports with the external dip switches or jumpers.
- An equivalent circuit to the ports is shown in the illustration below, and as the port is pulled up with resistor, the switches must be connected to the GND.
- A latch-up is triggered if more than 2.7V of voltage is applied to the ports, and this may result in damage to the device.



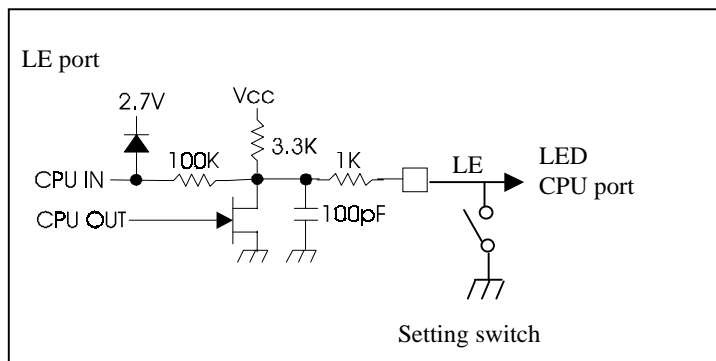
### • LE ports

#### (1) Setting switches

- Connect the setting switch to the LE (10 pin) terminal.
- An equivalent circuit to the ports is shown in the illustration below, and as the port is pulled up with resistor, the switch must be connected to the GND.
- The setting switch can only be pressed when the power supply is switched on. A communications error will occur if the switch is pressed during normal operations.

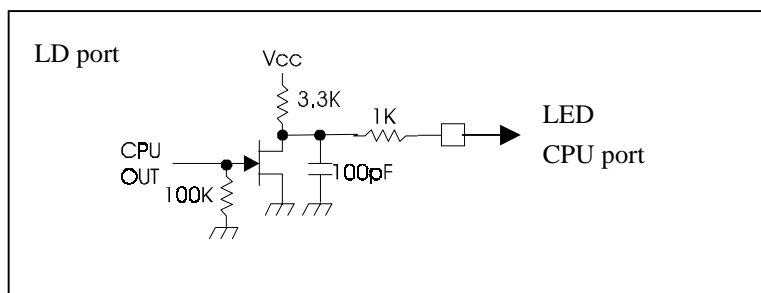
#### (2) Status output

- Verify the setting mode operations for the LD and LE ports. The STD-402 is not equipped with LEDs.
- Connect the ports to the LED drive circuit or the CPU input port. The LED cannot be driven directly with this port.



### • LD port

- Verify the setting mode operations for the LD and LE ports. The STD-402 is not equipped with LEDs.
- Connect the ports to the LED drive circuit or the CPU input port. The LED cannot be driven directly with this port.



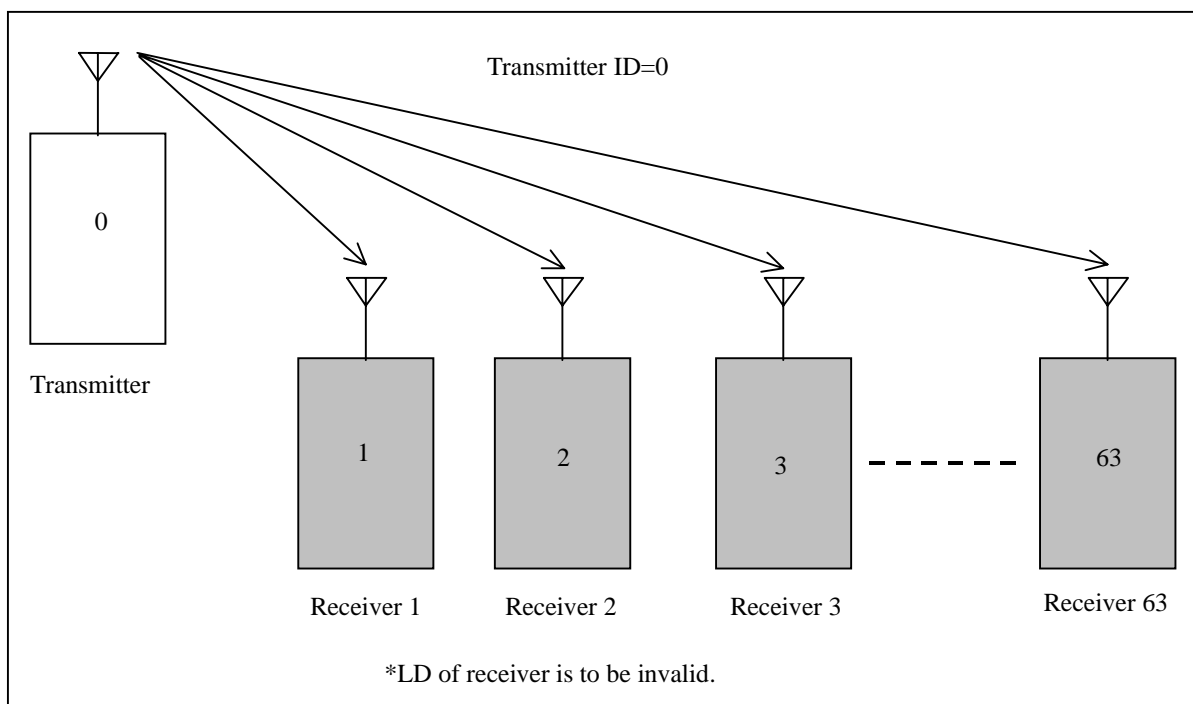
## Communications mode

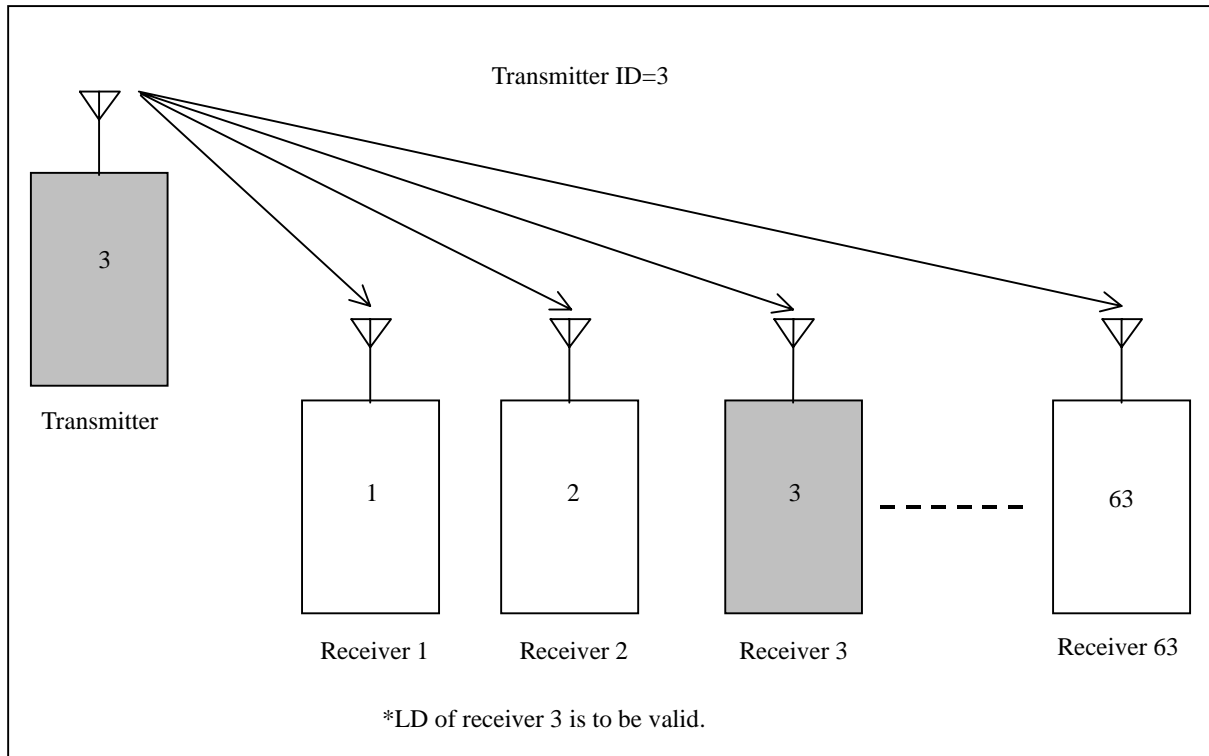
- The communications mode enters normal operation when the power supply is switched on after all transceiver settings have been made in the setting mode.
- First of all with the communications mode, a link is established with the transmitter and receiver with the same ID number in accordance with the procedure explained for the automatic link, and data transmission is then started.
- Once a link has been established, communications will be carried out on the same channel unless the power supply is switched off.

### • Local ID numbers

- It is possible to transmit the data from one transmitter to a maximum of 63 different receivers with the STD-402 auto mode.
- Local ID numbers must be set for each of the receivers for identification purposes. The ID numbers are set with the CH0 to CH5 ports.
- The [LD=L] reset signal is output and the data is cleared under normal conditions when the ID number for the transmitter and receiver do not match. [LD] is invalidated and the receiving data is output if the ID numbers do match. However, if the ID number for the data and clock matches, it is output regardless of the local ID.
- If the ID number for the transmitter is [0 (ALL)], the receiver will output the data regardless of the ID number.

Transmitter	Receiver	Remarks
<b>0 (ALL)</b>	<b>1</b>	All receiver recognize transmitted data.
	<b>2</b>	
	⋮	
	<b>62</b>	
	<b>63</b>	
<b>1</b>	<b>1</b>	Only same ID receiver can recognize transmitted data.
<b>2</b>	<b>2</b>	
⋮	⋮	
<b>62</b>	<b>62</b>	
<b>63</b>	<b>63</b>	





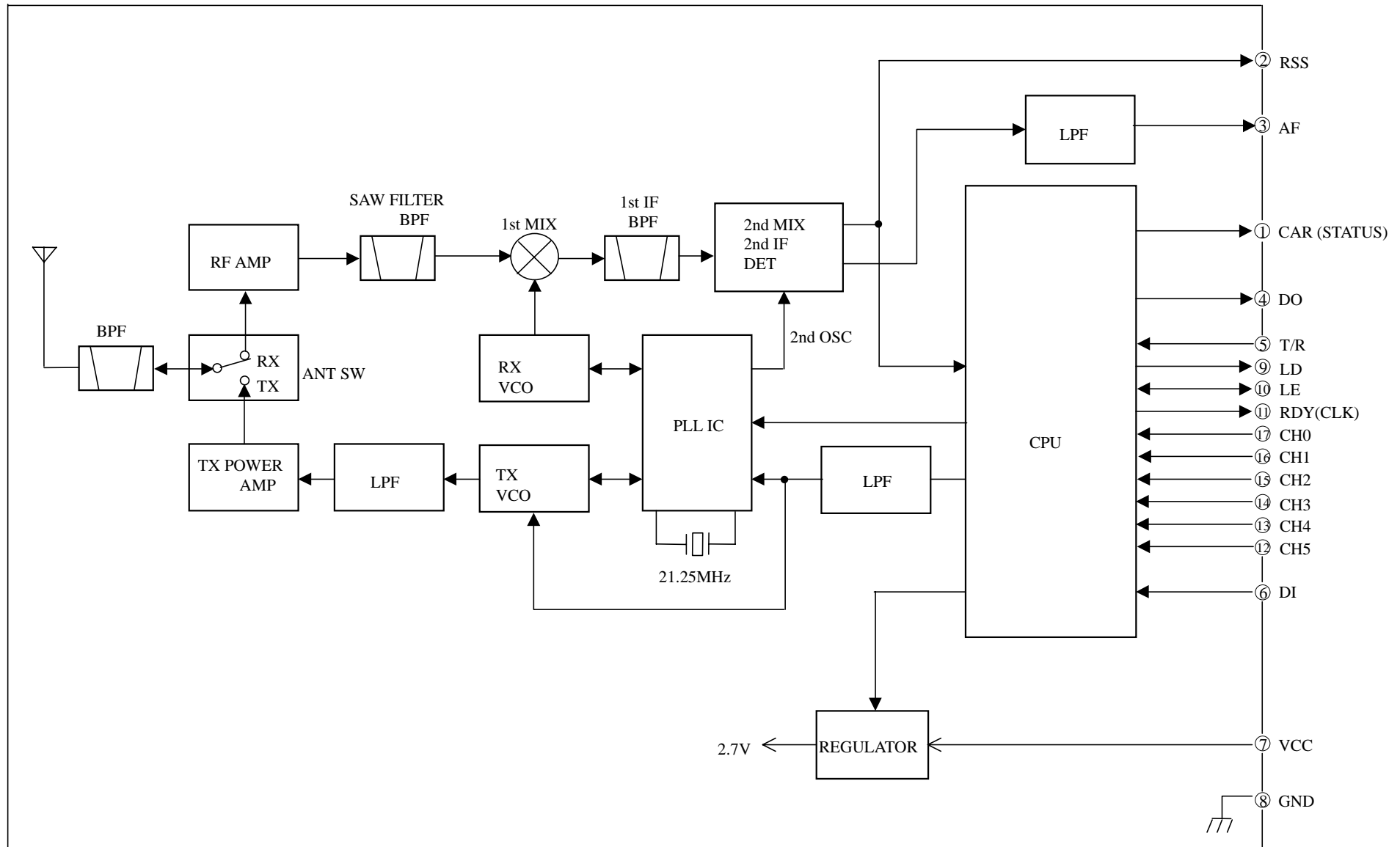
- The methods for setting the local ID number include connecting switches to the CH0 to CH5 ports and performing the task manually, or performing control by connecting into the micro-computer port. Use the method that best suits the application.
- Refer to the table for the CH0 to CH5 port settings and local ID numbers provided on the next page.
- The STD-402 auto mode supports only one-way transmissions (transmitter --> receiver,) but support for simplex communications (bi-directional) is planned for the future.

- ID address

- ID address table is shown in below.

ID address	CH5	CH4	CH3	CH2	CH1	CH0	TX
0	OPEN	OPEN	OPEN	OPEN	OPEN	OPEN	ALL
1	OPEN	OPEN	OPEN	OPEN	OPEN	GND	1
2	OPEN	OPEN	OPEN	OPEN	GND	OPEN	2
3	OPEN	OPEN	OPEN	OPEN	GND	GND	3
4	OPEN	OPEN	OPEN	GND	OPEN	OPEN	4
5	OPEN	OPEN	OPEN	GND	OPEN	GND	5
6	OPEN	OPEN	OPEN	GND	GND	OPEN	6
7	OPEN	OPEN	OPEN	GND	GND	GND	7
8	OPEN	OPEN	GND	OPEN	OPEN	OPEN	8
9	OPEN	OPEN	GND	OPEN	OPEN	GND	9
10	OPEN	OPEN	GND	OPEN	GND	OPEN	10
11	OPEN	OPEN	GND	OPEN	GND	GND	11
12	OPEN	OPEN	GND	GND	OPEN	OPEN	12
13	OPEN	OPEN	GND	GND	OPEN	GND	13
14	OPEN	OPEN	GND	GND	GND	OPEN	14
15	OPEN	OPEN	GND	GND	GND	GND	15
16	OPEN	GND	OPEN	OPEN	OPEN	OPEN	16
17	OPEN	GND	OPEN	OPEN	OPEN	GND	17
18	OPEN	GND	OPEN	OPEN	GND	OPEN	18
19	OPEN	GND	OPEN	OPEN	GND	GND	19
20	OPEN	GND	OPEN	GND	OPEN	OPEN	20
21	OPEN	GND	OPEN	GND	OPEN	GND	21
22	OPEN	GND	OPEN	GND	GND	OPEN	22
23	OPEN	GND	OPEN	GND	GND	GND	23
24	OPEN	GND	GND	OPEN	OPEN	OPEN	24
25	OPEN	GND	GND	OPEN	OPEN	GND	25
26	OPEN	GND	GND	OPEN	GND	OPEN	26
27	OPEN	GND	GND	OPEN	GND	GND	27
28	OPEN	GND	GND	GND	OPEN	OPEN	28
29	OPEN	GND	GND	GND	OPEN	GND	29
30	OPEN	GND	GND	GND	GND	OPEN	30
31	OPEN	GND	GND	GND	GND	GND	31
32	GND	OPEN	OPEN	OPEN	OPEN	OPEN	32
33	GND	OPEN	OPEN	OPEN	OPEN	GND	33
34	GND	OPEN	OPEN	OPEN	GND	OPEN	34
35	GND	OPEN	OPEN	OPEN	GND	GND	35
36	GND	OPEN	OPEN	GND	OPEN	OPEN	36
37	GND	OPEN	OPEN	GND	OPEN	GND	37
38	GND	OPEN	OPEN	GND	GND	OPEN	38
39	GND	OPEN	OPEN	GND	GND	GND	39
40	GND	OPEN	GND	OPEN	OPEN	OPEN	40
41	GND	OPEN	GND	OPEN	OPEN	GND	41
42	GND	OPEN	GND	OPEN	GND	OPEN	42
43	GND	OPEN	GND	OPEN	GND	GND	43
44	GND	OPEN	GND	GND	OPEN	OPEN	44
45	GND	OPEN	GND	GND	OPEN	GND	45
46	GND	OPEN	GND	GND	GND	OPEN	46
47	GND	OPEN	GND	GND	GND	GND	47
48	GND	GND	OPEN	OPEN	OPEN	OPEN	48
49	GND	GND	OPEN	OPEN	OPEN	GND	49
50	GND	GND	OPEN	OPEN	GND	OPEN	50
51	GND	GND	OPEN	OPEN	GND	GND	51
52	GND	GND	OPEN	GND	OPEN	OPEN	52
53	GND	GND	OPEN	GND	OPEN	GND	53
54	GND	GND	OPEN	GND	GND	OPEN	54
55	GND	GND	OPEN	GND	GND	GND	55
56	GND	GND	GND	OPEN	OPEN	OPEN	56
57	GND	GND	GND	OPEN	OPEN	GND	57
58	GND	GND	GND	OPEN	GND	OPEN	58
59	GND	GND	GND	OPEN	GND	GND	59
60	GND	GND	GND	GND	OPEN	OPEN	60
61	GND	GND	GND	GND	OPEN	GND	61
62	GND	GND	GND	GND	GND	OPEN	62
63	GND	GND	GND	GND	GND	GND	63

Block diagram



## Pin description 1

- As the built-in STD-402 circuit operations on 2.8V, the interface circuit operates on Vcc.

Number	Pin name	I/O	Description	Equivalent circuit
1	CAR (STATUS)	O	Carrier sense output of the receiver. The RSSI signal (receiving level) will become "H" when the signal exceed the threshold.	
2	RSS	O	The receiving level output of the receiver. The strength of the RF level is converted to the direct current voltage.	
3	AF	O	The AF output of the receiving section.	
4	DO	O	The data output from decoder section. The port uses FET buffer output, the "H" level is Vcc.	
5	T/R	I	TX(transmit mode) / RX(receive mode) setting. The port is pulled up with resistor. TX mode : L (GND) RX mode : H(open)	
6	DI	I	Data input for the encoder section. The port uses transistor input, the digital "H" level is Vcc and the digital "L" is GND.	
7	VCC	-	The power supply terminal. Operates on 2.8V to 5V. <ul style="list-style-type: none"> <li>The STD-402 is designed based upon 74HC series IC (5V) operations.</li> </ul>	
8	GND	-	The ground. Extend the pattern over the widest area possible on the printed circuit board.	



## Pin description 2

Number	Pin name	I/O	Description	Equivalent circuit
9	LD	O	<ul style="list-style-type: none"> <li>The LOAD signal output for external parallel → serial register.</li> <li>The RESET signal is output with the receive mode.</li> </ul> <p>The port uses FET buffer output, the 'H' level is Vcc.</p>	
10	LE	I/O	<ul style="list-style-type: none"> <li>The LATCH ENABLE signal output for external serial → parallel register.</li> <li>Setting mode switch input.</li> </ul>	
11	RDY (CLK)	O	<ul style="list-style-type: none"> <li>Serial data shift CLK signal output.</li> <li>The data is shifted when the clock rises.</li> </ul>	
12	CH5	I	<ul style="list-style-type: none"> <li>Sets the various conditions when in the setting mode.</li> <li>* Refer to [Setting Mode] for further details.</li> <li>Sets the ID address with normal operations.</li> <li>* 63 address types between 1 and 63 are available.</li> <li>Pulls up each port.</li> </ul>	
13	CH4			
14	CH3			
15	CH2			
16	CH1			
17	CH0			

**Electrical characteristics**

- Common characteristics

Item	Rating	Conditions/remarks
Communication form	Semi-duplex	
Modulation	F1D	FSK
Oscillation system	PLL controlled VCO	
Frequency range	433.200-434.775MHz	
Channel step	25KHz	
Number of RF channel	64 channels	
Baud rate	4800, 9600bps	FSK
Modulation polarity	Positive	
Demodulation polarity	Positive	
Antenna impedance	50Ω	
1st IF	21.7MHz	
2nd IF	450KHz	
Range	200 m or more	F1D 9600bps
Operation temperature	-10 to 55°C	
Operating power voltage	3.6-5V	
Supply current	36mA	TX mode
	26mA	RX mode
Dimensions	53x35x12mm	
Weight	34g	

• Transmission section characteristics

Item	Rating	Conditions
Transmitter type	PLL synthesizer	
RF output power	9.0mW±1.0mW	10mW
Frequency stability	±4ppm	-10 to +55°C
Spurious emission	<-60dBm	<1GHz
	<-50dBm	>1GHz
Deviation	±1.9 to 2.1KHz	*1
S/N ratio	>25dB	*1
Adjacent channel power	>40dB	Spectrum analyzer act, *1
Carrier sense level	-107dBm	Fixed
Transmitter start-up time	<30msec	PLL data setting
Channel switching time	<15msec	25KHz
	<30msec	100KHz

\*1: 9,600bps, 511bit (Pseudo Noise)

• Receiving section characteristics

Item	Rating	Conditions
Receiver mode	Double super heterodyne	
Sensitivity	<-117dBm	25°C, *2
Spurious response	>45dB	*3
Selectivity	>45dB	*3
Local frequency stability	±4ppm	-10 to +55°C
Radiation from local oscillator	<-65dBm	<1GHz
	<-60dBm	>1GHz
Output level	350mVp-p	100kohms terminate *4
Carrier sense level	-113dBm	Fixed
Carrier sense response time	<30msec	PLL data setting
Channel switching time	<15msec	25KHz
	<25msec	100KHz
Bit error rate	1 x 10 <sup>-2</sup>	Less than -110dBm
	1 x 10 <sup>-4</sup>	Less than -107dBm

\*2: AF=1kHz, fmod=2kHz, CCITT filter ON

\*3: Jamming waves AF=400Hz, fmod=40%

\*4: Dev:=2kHz, AF=1kHz

\*5: 2556bit / 4800bps