

# Smart Abs®

## Application Note

TAMAGAWA SEIKI CO.,LTD. JAPAN

### ① What is Smart Abs®?

- ... Smart Abs® is a small multi-turn absolute encoder backed up by external batteries.  
The number of signal leads is minimized to only 2 by serial data communication.

### ② What types of Smart Abs® are there?

- ... Full Abs is an encoder which can work with normal resolution without preloading when power is supplied.

Full Abs	Normal resolution
TS5667, TS5668, TS5669, TS5679 series	17, 13, 11 bit/turn

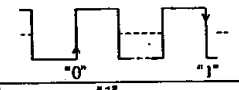
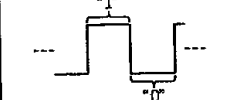
### ③ What types are there in serial data communication?

- ... There are two types. One-way communication and two-way communication.

One-way communication	A method to send data consecutively from an encoder at set time intervals. TS5667 series ⇒ every 84µ sec
Two-way communication	A method to send data on the same line by request signals on the controller side. (Transmission / Reception on the same line)

## ④ What is the difference between RZ and NRZ in serial communication?

...RZ (Return Z) and NRZ (Non Return Z) are provided as serial communication.

Communication Format	Transmission signal	Description
RZ (Manchester)		Read a rise as "0" Read a fall as "1"
NRZ		Read L-state as "0" Read H-state as "1"

Therefore, the communication speed of NRZ is twice as fast as that of RZ because NRZ can get double information (data) that RZ can get in the same "H" or "L" rectangle. For example, when the communication rate of RZ is 1Mbps, the rate of NRZ is 2Mbps.

## ⑤ What is backed up batteries?

... Even during power outage, multi-turn data is stored, being backed up by external batteries.

When main power recovers, the data is transmitted.

Model	Current consumption during power outage	
	Right after power outage	Thereafter
TS5667, TS5669, TS5679 series	From 0 to 5 sec. (TYP) 300 $\mu$ A	100 $\mu$ A

A Lithium battery 3.6V is recommended for external battery.

When the external battery voltage falls below, a battery alarm will be broken out and it is required to replace with new external battery.

Smart Abs does not have an internal back-up capacitor so that the external battery should be replaced in the following method.

1. The external battery should be replaced during Main power on condition.
2. Verify that the battery alarm should be disappeared.
3. Set the error reset when you observe a battery error during changing the external battery.
4. In case of observing the battery error before changing the battery, the multi-turn data should be erased so that [Return to Original position] command should have done.

## ⑥ What is the lineup of Full Abs?

...As follows:

Model	Resolution	Form		
		OD	ID(Shaft)	
TS5667, TS5679 series	17, 13, 11 bit / single-turn	Hollow shaft type	φ35(SA35)	φ6, φ8
	6, 13, 11 bit / multi-turn		φ48(SA48)	φ8
φ100(SA100)			φ30	
φ135(SA135)			φ65	
TS5668, TS5669 series		Built-in type	φ35(SA35)	φ6

## ⑦ What function does Full Abs have?

- Super compact (φ35, Out Dia.) and high resolution (17bit/turn)
- NRZ communication (Baud rate : 5Mbps max.)
  - RZ communication (Option)
- Storage function is built-in (NRZ Communication only)
- Bus communication (NRZ Communication, resolution : 13bit/turn) is optional.

⑧ **What is the storage function of Full Abs like?**

...→ E<sup>2</sup> PROM is built in the encoder.

Storage capacity is 640bit (8bit x80 address).

Reading / Writing is possible by request signals.

Data on motors, Controllers, etc. can be stored.

⑨ **Are there receiving ICs for serial communication?**

... There are receiving ICs as follows :

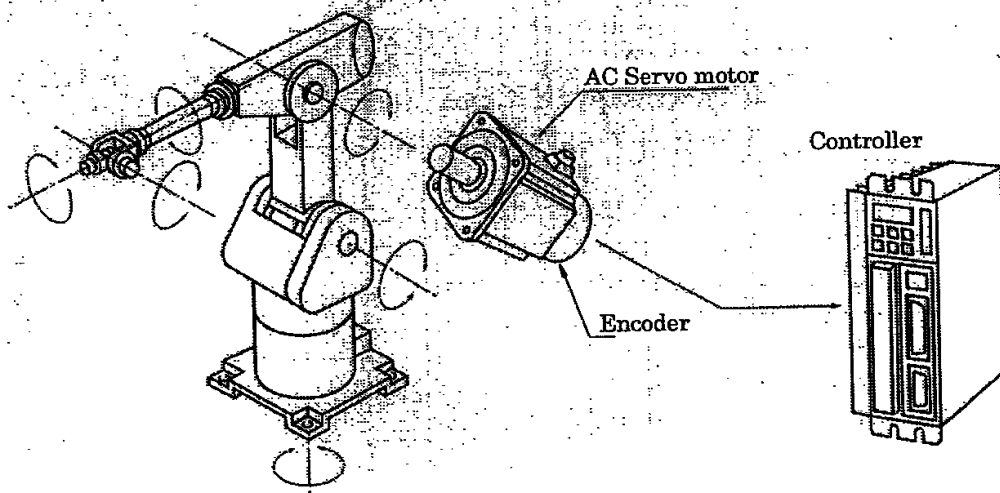
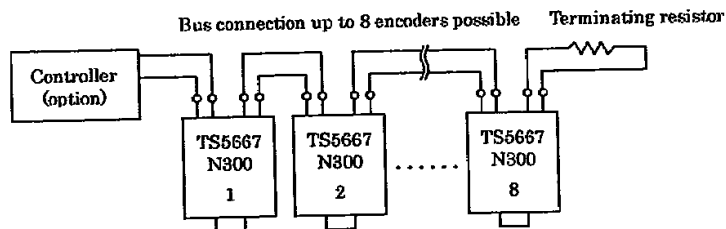
Model	Receiving IC	Communication Format
TS5667, TS5668, TS5669, TS5679 series [ Receiving IC differs depending on factory setting of changeover concerning encoder function. ]	AU5561N1 ..	· NRZ communication (E <sup>2</sup> PROM Access is impossible)
	AU5688	RZ

## ⑩ What should be done to lessen the number of leads further?

... Please use Smart bus®. It enables bus connection for up to 8 encoders in series with only four leads.

→ Encoders with bus function ——— TS5667N300

→ Connection method



An example of application to a 6axis robot

**⑩ Can the positioning of an encoder shaft when attached to a motor be made easily?**

...Positioning of an encoder shaft can be reset by request signals.

Applicable model	
TS5667, TS5668, TS5669, TS5679 series	NRZ communication only

**⑪ Can the accuracy of absolute angle be enhanced?**

...Function to correct angular accuracy is provided. (Option)

Angular correction is conducted at our factory and shipped.

Applicable model		Standard accuracy	Enhanced accuracy (Option)
TS5667 series	SA35	± 80sec. TYP.	± 5sec.
	SA48	± 80sec. TYP.	

13 Can encoder errors be identified?

...The encoder is provided with a Fail-check operation.

When an abnormality is detected, the contents of the detection are transmitted as Alarm / Error.

Examples in case of TS5667

Contents of Alarm / Error	Function	Countermeasures
Over Speed OS	Logic "1" is generated when the encoder shaft, being backed up by battery after the main power supply is turned off, rotates at the speed exceeding the specified value and then when the main power is turned on, the signal "1" is transmitted. Take this error to be tentative because there are cases it can't be detected.	Reset the error
Full Abs Status FS	Logic "1" is outputted when the main power is turned on while the encoder shaft is rotating. Single-turn data while logic "1" is on can't be guaranteed. When the single-turn data is switched to 17bit resolution, the error is automatically cleared.	Stop the encoder shaft and wait till the error is automatically cleared.
Counter Overflow OF	Logic "1" is outputted when the multi-turn counter overflows. (But when detected during main power off, the logic is outputted after the main power is turned on.) Though the error, once detected, is retained till it is reset, the multi-turn counter keeps working as a cyclic counter from 0 to 65535.	Reset the error
Count Error CE	Logic "1" is outputted when single-turn data deviates more than 22.5 degrees mechanical angle (TYP) due to malfunction or breakdown. The detection is conducted at every 45 degrees mechanical angle and when the deviation is more than 22.5 degrees (TYP), the error is automatically cleared.	Stop servo system immediately.
Multi-turn Error ME	Logic "1" is outputted when bit jumps in multi-turn signals during main power ON. (When main power is OFF, this function does not work.) The bit jump check is conducted at every 204.8μ seconds. The error, once detected, is retained till it is reset.	Return to origin. Reset the error
Battery Alarm BA	Logic "1" is outputted when the external battery voltage gets less than 3.25±0.15V during main power ON. The error is automatically cleared when the battery source voltage gets normal.	Check the battery source and replace it if necessary.
Battery Error BE	Logic "1" is generated when the external battery voltage gets less than 2.75±0.25V during main power OFF and it is transmitted after the main power is turned on. When this error occurs, a multi-turn data error may arise because the data backup system does not function normally.	Reset both the error and multi-turn data. Check the battery source and replace it if necessary.

