SPECIFICATION OF Smart Abs

SA35-17/33bit-LPS-5V

TS5669N127

REVISIONS

No.	DATE	PAGES	DESCRIPTION	DS'D	CH'D	APP'D

参考図

Edition No.

DS'D	DATE	MODEL No.	TITLE
K. Kubota	02. 09. 30	TS5669 N127	Specification of Smart Abs
CH'D K. Tamura			
APP'D K. Kitajima			

DWG NO.	3	4	5	6	7	8	9	10	11	12	SHEET
0	5	6	6	9	0	0	2	2	S	4	0	1/24

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Specification of Smart Abs
TS5669 N127

1. Scope

This document defines the specification of the products described below.

(1) Name: Smart Abs

(2) Model number: TS5669 N127

(3) Classification of function: SA35-17/33bit-LPS-5V

2. Basic Function

This Smart Abs has basic functions as follows.

(1) This Smart Abs is a full absolute encoder that has the resolution of 17 bits per revolution and the multi-turn counting value of 16 bits, i.e. total 33 bits, and transmits the output of full absolute position data as serial digital data responding to an external request. But when an external battery power supply is not connected, it performs as an absolute encoder that transmits the absolute position data of 17 bits for one revolution as serial digital data responding to an external request.

(2) It is capable of storing the multi-turn data and actuating the multi-turn counter by mean of connecting to a battery even when the main power supply is suddenly cut off such as for a power outage.

(3) It is capable of writing the desired data into EEPROM at any time when it is needed.

3. Environmental Conditions

Items		Specification	Remarks
Operating temperature range		-10~ +100 ℃	--- ---
Storage temperature range		-20~ +100 ℃	--- ---
Humidity		90 % RH max.	at 40 ℃, 96 hours, without condensation
Vibration resistance	Test condition	5~ 58 Hz, Double amplitude 1.5 mm 58~ 2,000 Hz, 98 m/s²	2 hours for each axis, total 6 hours
Shock resistance	Test condition	1,960 m/s², 11 ms	3 timesfor each direction,total 18 times

Edition No.

DWG NO.												SHEET
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4. Mechanical Specification

Items	Specification	Remarks
Outline	056695011F30	--- ---
Protecting structure	Open frame	--- ---

Items	Specification Ta=25 ℃			Remarks	Unit
	Min.	Typ.	Max.		
Mass	---	---	0.03	For only main body, except cable	kg
Moment of inertia	---	0.17	---	$\frac{GD^2}{4}$	$\times 10^{-6}$ kg-m^2
Permissible rotational speed	---	---	6,000	--- ---	min^{-1}
Permissible angular acceleration	---	---	80,000	--- ---	rad/s^2

Edition No.

DWG NO.	3	4	5	6	7	8	9	10	11	12	SHEET
0 5 6 6 9 0 0 2 2								S	4	0	3/

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5. Electrical Specification

5.1 Definition of Terms

Items	Definition
Normal mode	The operating state of Smart Abs by the main power supply.
Power-off mode	The operating state of Smart Abs while the main power supply is off. The multi-turn data is stored and the multi-turn counter is actuated. After it returns to the Normal mode, the data can be transmitted outside.
Power-off timer	During minimum 5 seconds after the main power supply is turned off, maximum rotational speed and maximum angular acceleration that are specified in Paragraph 5.4.2 "Electrical Specification for Multi-turn Signal" are performed as the value shown in the Power-off timer operation.
Power-off operation	Maximum rotational speed and maximum angular acceleration that are specified in Paragraph 5.4.2 "Electrical Specification for Multi-turn Signal" are performed as the value shown in the Power-off operation.

5.2 Electrical Connections

Color of Lead Wires	Function	Remarks
Red	Vcc	Main power supply: DC +5 V ±5 %
Black	GND	--- ---
Brown	VB	External battery power supply (Note 1)
Brown/Black	GND	--- ---
Blue	SD	Serial data signal
Blue/Black	$\overline{SD}$	

Note 1: An external battery is needed when Smart Abs operates in the power-off mode. Refer to Paragraph 6.4 "Description of Status Flag Fuction" for details of the error flag when the main power supply is turned on without any external battery.

Edition No.

DWG NO.	3	4	5	6	7	8	9	10	11	12	SHEET
0 5 6 6 9 0 0 2 2								S	4	0	4 /

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5.3 Absolute Maximum Rating

Items	Specification	Unit
Main power supply voltage	5.5	V
External battery voltage	4.75	V

5.4 Common Electrical Specification

Items			Specification Ta=25 ℃ Min.	Typ.	Max.	Remarks	Unit
Main power supply voltage			4.75	5	5.25	--- ---	V
External battery voltage			---	3.6	---	--- ---	V
Switching voltage			4.0	4.2	4.4	Normal → Power-off mode	V
for operating mode			4.1	4.3	4.5	Normal ← Power-off mode	V
Battery error generating voltage			2.3	2.5	2.7	External battery	V
Battery alarm generating voltage			3.0	3.1	3.2	External battery	V
Current consumption							
Main power supply	Normal mode		---	60	100	No load	mA
External battery	Normal mode		---	3.6	---	--- ---	μA
Power-off mode	Power-off timer		---	210	---	--- ---	μA
	Power-off operation		---	100	110	--- ---	μA
Differential output	SD/SD	"H" level	3.5	---	---	At 5V of main power supply	V
		"L" level	---	---	1.7		V
Rise time/Fall time			---	---	100	Example of circuit in Paragraph 10	ns
Insulation resistance			20	---	---	By using DC 500 V Megohm meter, between case & GND. It is not applied for the products.	MΩ
Dielectric strength			AC 100	---	---	By using DC 500 V Megohm meter, between case & GND. It is not applied for the products.	V
Standby period at power turning-on (Note 2)			---	---	1	External battery existed	s
			---	---	1.5	No external battery	s
Electrical life time			---	24,000	—	MTBF at 85 ℃	hour

Edition No.

DWG NO.	3	4	5	6	7	8	9	10	11	12	SHEET
0 5 6 6 9 0 0 2 2								S	4	0	5/

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Note 2: The power-on standby time defines the time immediate after the main power supply voltage rises up to the minimum switching voltage of operation from the Power-off mode to the Normal mode.

During the power-on standby time any external request is not accepted.

When the main power supply is turned on with connecting an external battery, the line driver in Smart Abs holds "Hi-Z" during the power-on standby time.

When the main power supply is turned on without connecting any external battery, the output of line driver becomes indefinite state ("H", "L" or "Hi-Z") during the power-on standby time. Refer to Paragraph 5.4 "Common Electrical Specification".

Edition No.												
	DWG NO.	3	4	5	6	7	8	9	10	11	12	SHEET
	0	5	6	6	9	0	0	2	2	S	4	0 / 6

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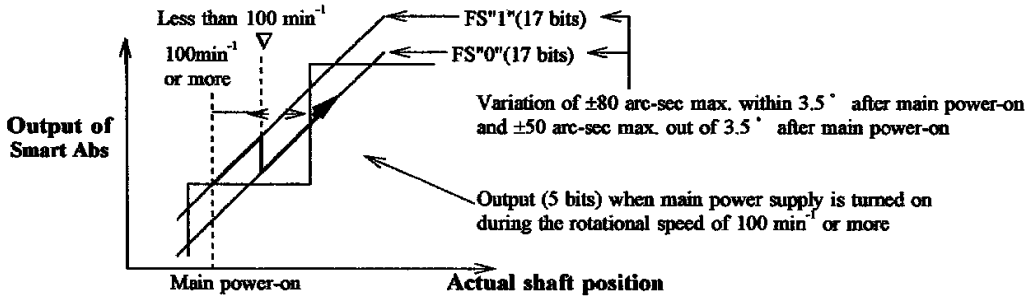
5.4.1 Electrical Specification for One Revolution Signal

Items		Specification Ta=25℃	Remarks
Resolution		2^{17}	When main power supply is turned on at the rotational speed of 100 min^{-1} or more, the accuracy is 5 bits. (Note 3)
Maximum rotational speed	Normal mode	6,000 min^{-1}	--- ---
Maximum angular acceleration	Normal mode	80,000 rad/s^2	--- ---
Output code		Pure binary	--- ---
Direction increasing		CCW	In view from the shaft end of Smart Abs
Accumulated pitch error		±80 arc-sec (±8 LSB)	In the condition of no eccentric error between motor shaft and disc unit.
Adjoining pitch error		±40 arc-sec (±4 LSB)	
Maximum accumulated pitch error		±291 arc-sec	Maximum (calculated) value in the condition of having minimum tolerance in outer diameter of motor shaft and maximum tolerance in inner diameter of disc mount.
		±184 arc-sec	Calculated root mean square value for each value in above condition.
Repeatability at main power-on	Within 3.5° after main power-on	±80 arc-sec (±8 LSB)	After rotating by 3.5° or more, the output accuracy is ±5 LSB by the compensation function.

Note 3: When one revolution data of 2^{17} is not assured, Full Absolute Status comes out as a status flag. Refer to Paragraph 6.4 "Function of Status Flag".

(I) In case where power supply is turned on while the rotational speed is 100 min^{-1} or more for one direction (FS: "1"), the operation of Smart Abs is shown in the following figure.

Example: Rotation of CCW direction in view from the shaft end of Smart Abs



(II) In case where the power supply is turned on while the rotational speed is less than 100 min^{-1} for one direction (FS: "0"), the operation of Smart Abs is increased or decreased monotonously, except the variation by the error components specified as the adjoining pitch error.

Edition No.

DWG NO.	3	4	5	6	7	8	9	10	11	12	SHEET
0 5 6 6 9 0 0 2 2	S	4	0								7

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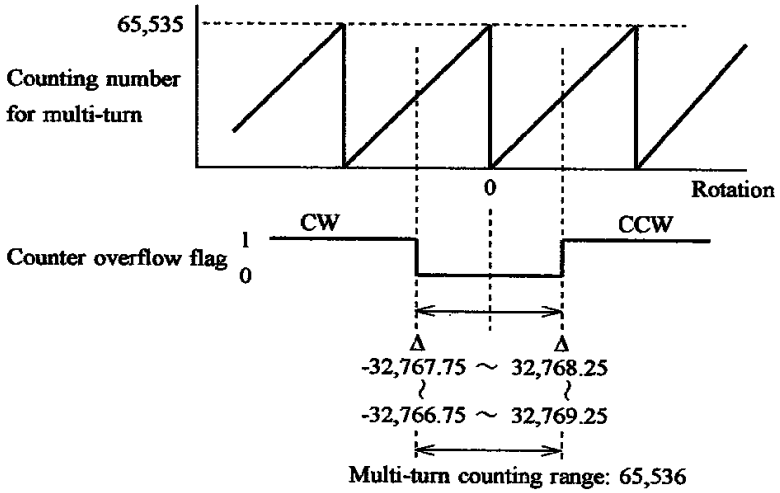
5.4.2 Electrical Specification for Multi-turn Signal

Items			Specification Ta=25 ℃	Remarks
Resolution			1 C/T	--- ---
Multi-turn counting range			2^{16}	0~ 65,535 (Note 4)
Maximum rotational speed				
	Normal mode		6,000 min^{-1}	--- ---
	Power-off mode	Power-off timer	6,000 min^{-1}	Duration is 5 seconds.
		Power-off operation	6,000 min^{-1}	--- ---
Maximum angular acceleration				
	Normal mode		80,000 rad/s^2	--- ---
	Power-off mode	Power-off timer	80,000 rad/s^2	--- ---
		Power-off operation	4,000 rad/s^2	--- ---
Output code			Pure binary	--- ---
Direction increasing			CCW	In view from the shaft end of Smart Abs

Note 4: When the battery error (BE) occurs, Counter Overflow is returned to operate normally by resetting its multi-turn data.



Valid condition of Counter Overflow flag

Edition No.

DWG NO.	3	4	5	6	7	8	9	10	11	12	SHEET
0 5 6 6 9 0 0 2 2								S	4	0	8 /

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Note 5: Occurence condition of Over-speed error

The logic "1" is transmitted when the rotational speed of shaft exceeds the responsible speed.

In case where the rotational speed of input shaft exceeds the tracking speed of internal circuit of Smart Abs during Power-off operation, the relation of rotational speed versus Over-speed error is as Table A.

Table A. Relation of Rotational Speed vs. Over-speed Error

Rotational speed of Smart Abs shaft	Over-speed error
0~ 6,000 min^{-1}	"0"
6,000~ 14,000 min^{-1} (Calculated value)	"0": Normal detection of multi-turn data "1": Wrong detection of multi-turn data
More than 14,000 min^{-1} (Calculated value)	Indefinite

In case where the rotational speed (Calculated value) is 0~ 14,000 min^{-1}, the detection of multi-turn data are normal for the logic "0" of Over-speed error. However the reset is needed because it may be abnormal for the logic "1" of Over-speed error. Therefore it is recommended to use within the rotational speed of 0~ 6,000 min^{-1}.

During the Power-off operation, in case where the angular acceleration exceeds 4,000 rad/s^2 even when the rotational speed is less than the specified tracking speed, the relation of rotational speed versus Over-speed error is as Table B.

Table B. Relation of Rotational Speed vs. Over-speed Error

Angular acceleration of Smart Abs shaft	Over-speed error
0~ 4,000 rad/s^2	"0"
4,000~ 28,000 rad/s^2 (Calculated value)	"0": Normal detection of multi-turn data "1": Wrong detection of multi-turn data
More than 28,000 rad/s^2 (Calculated value)	Indefinite

In case where the angular acceleration (Calculated value) is 0~ 28,000 rad/s^2, the detection of multi-turn data are normal for the logic "0" of Over-speed error. However reset is needed because it may be abnormal for the logic "1" of Over-speed error. Therefore it is recommended to use within the angular acceleration of 0~ 4,000 rad/s^2.

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6. Specification for Serial Communication

6.1 General Specification

Items	Specification	Remarks
Communication code	NRZ	--- ---
Transmitting circuit	Differential line driver	Equivalent to RS 485
Receiving circuit	Differential line receiver	Equivalent to RS 485
Transmission data	One revolution data	17 bits
	Multi-turn data	16 bits (0~ 65,535)
	Status flag	(1) Over-speed (2) Full absolute status (3) Counting error (4) Counter overflow (5) Multi-turn error (6) Battery alarm (7) Battery error
Synchronizing method	Synchronizing step by step	--- ---
Modulation method	Base band NRZ (No modulation)	
Transmission rate	2.5 Mbps	Permissible jitter:±100 ns
frame format	See details in & after para. 6.2	--- ---

6.1.1 Specification of EEPROM

Items	Specification	Remarks
Available address to be accessed	0~ 79	All data is "0" at shipping.
Allowable times to rewrite	Total 100,000 times	1 writing for each access

Edition No.

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0	5	6	6	9	0	0	2	2	S	4	0	10 /

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6.2 Frame Format

6.2.1 Data Readout from Smart Abs

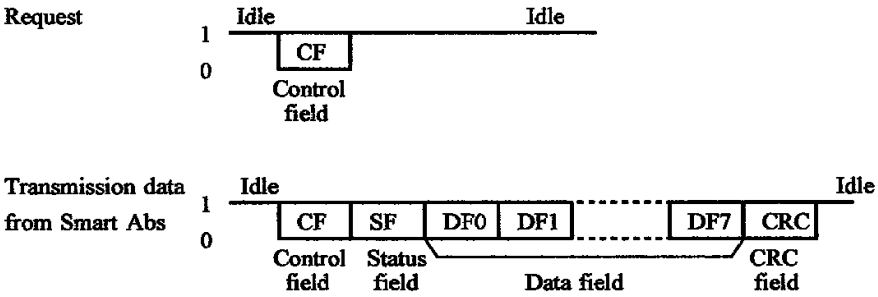

Figure 1. Frame Format for Reading-out Smart Abs Data

Edition No.

DWG NO.	3	4	5	6	7	8	9	10	11	12	SHEET
0 5 6 6 9 0 0 2 2								S	4	0	11

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6.2.2 Access (Writing) to EEPROM

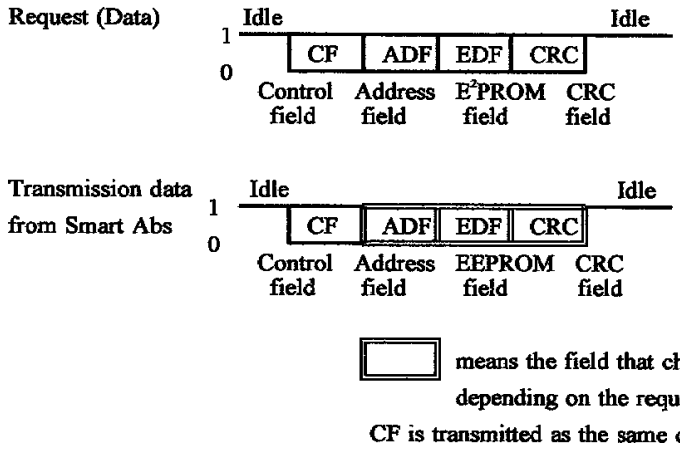

Figure 2. Frame Format for Writing to Smart Abs

6.2.3 Access (Readout) from EEPROM

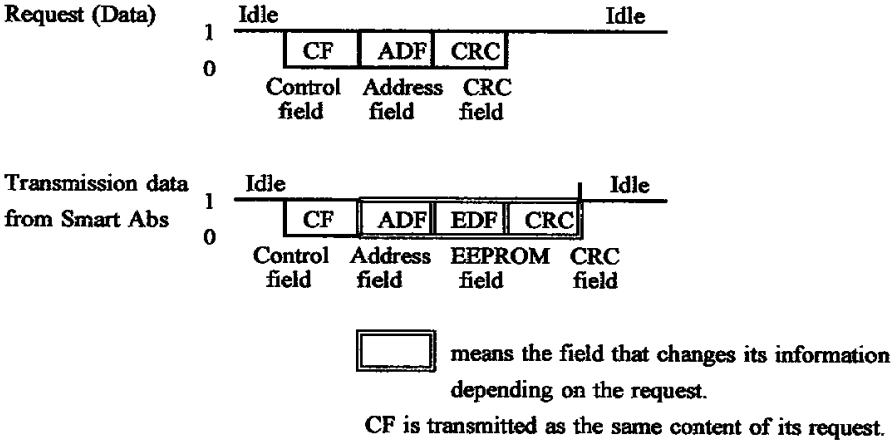

Figure 3. Frame Format for Readout from Smart Abs

Edition No.

DWG NO.	3	4	5	6	7	8	9	10	11	12	SHEET
0 5 6 6 9 0 0 2 2								S	4	0	12

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6.3 Details of Each Field

6.3.1 Control Field (CF)

The structure of Control field is shown in Figure 4.

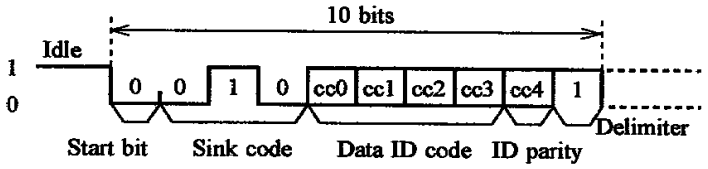

Figure 4. Structure of Control Field

(1) Start bit: Fixed.
(2) Sink code: Fixed.
(3) Data ID code: By means of designating one of Data ID code shown in Table 1, the data shown in Table 2 is transmitted from Smart Abs.
Designate the Data ID code according to the application shown in Table 1. For example, never use Data ID code for Reset instead of Data ID code for Readout.
(4) ID parity: It is a Parity for Data ID code.
(5) Delimiter: Fixed.

Table 1. List of Data ID Code

Application	Data ID	Code				Parity
		cc0	cc1	cc2	cc3	cc4
Data readout	Data ID 0	0	0	0	0	0
	Data ID 1	1	0	0	0	1
	Data ID 2	0	1	0	0	1
	Data ID 3	1	1	0	0	0
Writing to E²PROM	Data ID 6	0	1	1	0	0
Readout from EEPROM	Data ID D	1	0	1	1	1
Reset	Data ID 7	1	1	1	0	1
	Data ID 8	0	0	0	1	1
	Data ID C	0	0	1	1	0

Edition No.

DWG NO.	3	4	5	6	7	8	9	10	11	12	SHEET
0	5	6	6	9	0	0	2	2	S	4	0	13 /

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6.3.2 Status Field (SF)

The structure of Status field is shown in Figure 5.

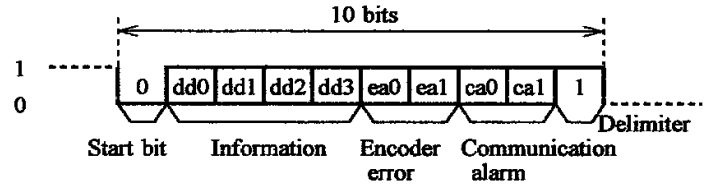

Figure 5. Structure of Status Field

(1) Start bit: Fixed.

(2) Information: All are fixed to "0".

(3) Encoder error: Logic "1" is transmitted when each error is occurred in Smart Abs.

Bit	ea0	ea1
Logic when the error occurs	1	1
Description of error	Counting error	OR Logic of Multi-turn error, Battery error or Battery alarm

When the error occurs in bit of ea1, request "Data ID 3" and confirm the content of ALMC in the data frame. Because full absolute status, Over-speed and Counter overflow are not included in ea1, confirm them in ALMC.

(4) Communication alarm: Logic "1" is transmitted when each error occurs in Smart Abs.

Bit	ca0	ca1
Logic when the error occurs	1	1
Description of error	Logic "1" is transmitted when parity error in Request frame occurs. Parity bit in Request Frame is located at cc4 of Data ID code.	Logic "1" is transmitted when delimiter error in Request frame occurs.

When the Communication alarm is occurred, the received data should be invalid without fail, and transmit the same Request signal again. When the Communication alarm occurs, the data of "Data ID 3" is transmitted from Smart Abs in spite of any kind of Transmission request.

(5) Delimiter : Fixed.

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6.3.3 Data Field (DF0~ DF7)

The relation between Data ID code and Data field is shown in Table 2.

Table 2. List of Data Field

Data ID code	DF0	DF1	DF2	DF3	DF4	DF5	DF6	DF7
Data ID 0	ABS0	ABS1	ABS2					
Data ID 1	ABM0	ABM1	ABM2					
Data ID 2	ENID							
Data ID 3	ABS0	ABS1	ABS2	ENID	ABM0	ABM1	ABM2	ALMC
Data ID 7	ABS0	ABS1	ABS2					
Data ID 8	ABS0	ABS1	ABS2					
Data ID C	ABS0	ABS1	ABS2					

Note: Blank in above table means no data to be transmitted.

ABS0~ ABS2: Absolute data in one revolution.

ABS0 is located to lower bite and ABS2 is located to higher bite in total 24-bit frame. Higher 7 bits in ABS2 is always logic "0", then the valid data consists of total 17 bits.

ABM0~ ABM2: Multi-turn data

ABM0 is located to lower bite and ABM2 is located to higher bite in total 24-bit frame. ABM2 is always logic "0", then the valid data consists of total 16 bits.

ENID: Encoder ID (= Fixed as 11H)

ALMC: Encoder error (Refer to Table 3.)

Table 3. ALMC

Bit	d_{70}	d_{71}	d_{72}	d_{73}	d_{74}	d_{75}	d_{76}	d_{77}
Logic when the error is occurred	1	1	1	1	---	1	1	1
Name & its symbol	Over-speed	Full absolute status	Counting error	Counter overflow	"0"	Multi-turn error	Battery error	Battery alarm
	OS	FS	CE	OF		ME	BE	BA

Edition No.

DWG NO.	3	4	5	6	7	8	9	10	11	12	SHEET
0 5 6 6 9 0 0 2 2								S	4	0	15 /

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The structure of each Data field is shown in Figure 6.

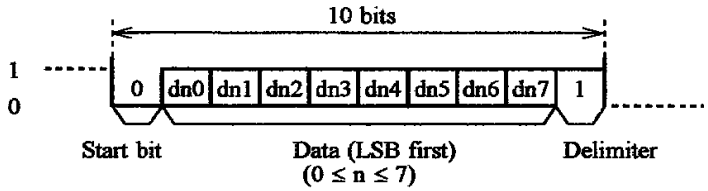

Figure 6. Structure of Data Field

(1) Start bit: Fixed.
(2) Data: Arranged with LSB first.
(3) Delimiter: Fixed.

Edition No.												
DWG NO.	3	4	5	6	7	8	9	10	11	12	SHEET
0 5 6 6 9 0 0 2 2	S	4	0	16/

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6.3.4 CRC Field (CRC)

The structure of CRC field is shown in Figure 7.

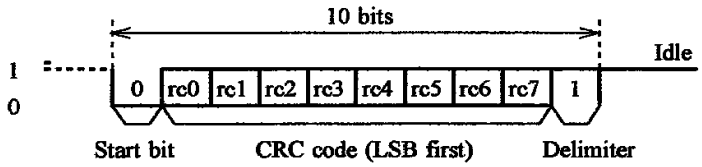

Figure 7. Structure of CRC Field

(1) Start bit: Fixed.

(2) CRC code: This code conforms to the equation of $G(X) = X^8 + 1$ (X = rc0~ rc7). The data is arranged in LSB first.

The code is calculated from all bits without Start bit and Delimiter of all fields except CRC field.

(3) Delimiter: Fixed.

Edition No.												
DWG NO.	3	4	5	6	7	8	9	10	11	12	SHEET
0 5 6 6 9 0 0 2 2	S	4	0	17

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6.3.5 Address Field (ADF) and EEPROM Field (EDF)

The structure of ADF field is shown in Figure 8.

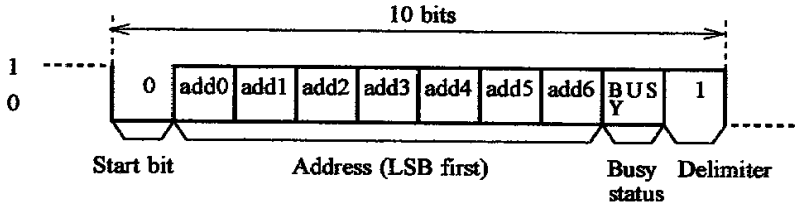

Figure 8. Structure of ADF Field

(1) Start bit: Fixed.

(2) Address: Address of EEPROM (0~ 79). LSB is first.

(3) Busy status: Accessing state to EEPROM can be checked by Busy status. The relation between Busy status and the data transmitted from Smart Abs is shown in Table 4.

Table 4. Busy Status and Data transmitted

	Request	Transmission data from Smart Abs			Description
	Busy	Busy	ADF	EDF	
Read-out	0	0	ADF of Request	Proper Data of E²PROM	Readout was properly completed.
		1	ADF of Request	00 [HEX]	Writing is in practice, and any request for Readout is invalid.
Writ-ing	0	0	ADF of Request	EDF of Request	Request for Writing was accepted.
		1	ADF of Request	00 [HEX]	Writing is in practice, and any request for Writing is invalid.

When the logic of Busy status in the data transmitted from Smart Abs is logic "1", Writing is in practice. Writing by Request cannot be performed.

In order to confirm that Writing to EEPROM is properly completed, transmit the Readout request (Data ID D), because it is not possible to confirm by the response data of Writing request (Data ID 6).

(4) Delimiter: Fixed.

(5) EDF: 8 bits data (LSB first)

The structure of Data field is equivalent to Figure 6.

Error output depending on connecting battery during main power-on.

6.4 Description of Status Flag

Name	Function	Battery Exist	Battery No	Action
Over-speed OS (Latched)	During the external battery drive after main power supply is turned off, logic "1" is generated when the shaft of Smart Abs is rotated over the specified speed of the Power-off mode in Paragraph 5.4.2 "Electrical Specification for Multi-turn Signal". After main power supply is turned on, it can be transmitted outside. But this flag should be only its aim, because it may not detect in some cases. (Note 9)	←	*	Reset error. (Refer to Para. 9.)
Full absolute status FS (Non-latched)	Logic "1" is transmitted when main power supply is turned on while the shaft of Smart Abs is rotated at 100 min^{-1} or more. The accuracy of one revolution data is 5 bits while logic "1" is transmitted. When one revolution data is switched to the resolution of 17 bits, the flag is automatically released.	←	←	Make the rotational speed slow down to less than 100 min^{-1}, and wait until the flag is automatically released.
Counting error CE	Logic "1" is transmitted in the case I , when one revolution data is deviated by any mulfunction or defect at main power-on.			Stop the servo system immediately.
	I (Non-latched): When the shaft of Smart Abs is rotated at 100 min^{-1} or more, error is detected every 45° in mechanical angle. The flag is automatically released at every 45° when the deviation of one revolution data is reduced to less than ±22.5° (typ.).	←	←	Error status is automatically released. Turn off and on the power supply.
Multi-turn error, ME (Latched during main power-on)	Logic "1" is transmitted when a bit-jump in multi-turn signal occurs during main power-on. During power-off it is not detected. This bit-jump check is performed every 12.8 µs.	←	←	Return to the origin position. Reset error. (Refer to Para. 9.)
Counter overflow OF (Latched)	Logic "1" is transmitted when the multi-turn counter is overflowed. In case where it is detected, it can be transmitted outside. The flag detected once is held until reset in spite of main power-on/off and counting value, but the multi-turn counter continues to operate as a cyclic counter of 0~ 65,535. When Battery error occurs, Counter overflow is normally operated by resetting the multi-turn data.	←	*	Reset error. (Refer to Para. 9.)
Battery alarm BA (Non-latched)	Logic "1" is generated when the external battery voltage is 3.1 ±0.1 V or less (Refer to Paragraph 5.4 "Common Electrical Specification".), and it can be transmitted after main power-on. Error is automatically released when the external battery voltage is returned to normal value.	←	←	Error status is automatically released. (Refer to Para. 9.) It is necessary to check or replace the external battery.
Battery error BE (Latched)	Logic "1" is generated when the external battery voltage is 2.5 ±0.2 V or less (Refer to Paragraph 5.4 "Common Electrical Specification".), and it can be transmitted after main power-on. When this flag occurs immediately after main power-on, the multi-turn data may be abnormal at the same time.	←	←	Reset error and multi-turn data. (Refer to Para. 9.) It is necessary to check or replace the external battery.

Note: Even if the battery is existed, it operates as same as no battery when the battery [illegible] means [illegible] state.

Edition No.

DWG NO.	3	4	5	6	7	8	9	10	11	12	SHEET
0 5 6 6 9 0 0 2 2								S	4	0	19

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7. Detecting Data Readout Frame

7.1 Detection of Starting Frame

In the Control field (CF) the first logic "0" after the idle is detected as starting of frame, and if the following 3 bits are conformed to Sink code, it is judged as a true Starting frame. If they are not conformed to Sink code, it continues to search and detect another first logic "0".

The Data frame is transmitted at 3 micro-seconds (typ.), after receiving the Delimiter signal of Request frame.

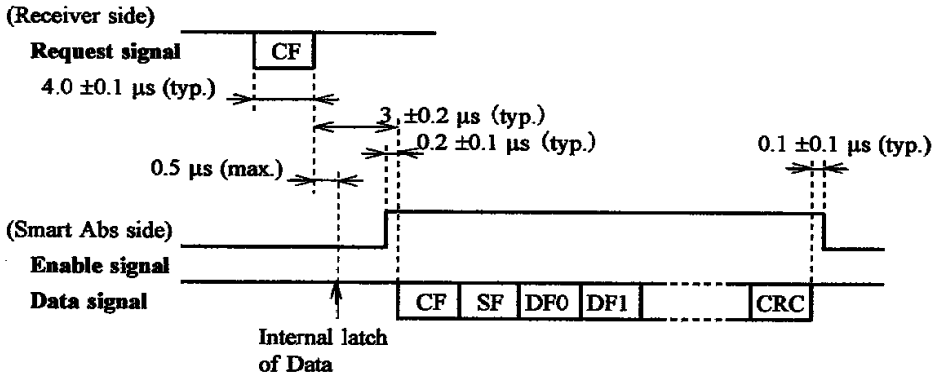

Figure 9. Detection of Frame

7.2 End of Frame

After the Starting frame is detected, if there is no Start bit after the Delimiter, End of Frame is judged. Therefore there is no field that means the end of frame.

7.3 Idle

Idle means a space between each frame and its next frame. The logic of output in transmission side is fixed to "1".

7.4 Transmission Data at Abnormal Request

When any received Request is abnormal, the transmission data from Smart Abs is shown in Table 5.

Table 5. Transmission Data at Abnormal Request

No.	Condition	Transmission Data
1	Logic of Sink code is abnormal.	Data is not transmitted.
2	Data ID code is not 0, 1, 2, 3, 7, 8 or C.	The data as same as Data ID 3 is transmitted. (Refer to Table 2.)
3	Logic of Parity is abnormal.	
4	Logic of Delimiter is abnormal.	

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8. Detecting Access Frame to EEPROM

8.1 Detection of Start Frame

The first logic "0" after the idle is detected as starting of frame, and if the following 3 bits are conformed to Sink code, it is judged as a true Starting frame. If they are not conformed to Sink code, it continues to search and detect another first logic "0".

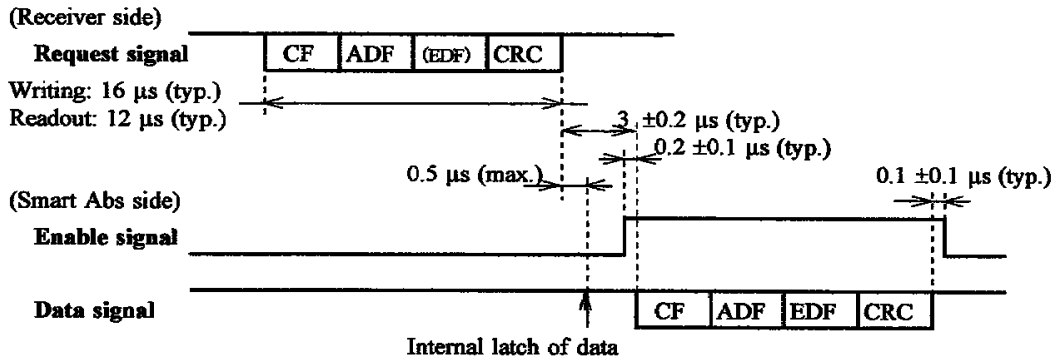

Figure 10. Detection of Frame

Note: Smart Abs starts to transmit the response data at 3 µs (typ.) after it receives a Access request to EEPROM (Data ID 6, D). Note that the response data for Writing request (Data ID 6) means only to receive a Data ID 6 but not to complete its writing process. (The completion of writing data to EEPROM is at 18 ms max. after receiving its Request.)

8.2 End of Frame

After the Starting frame is detected, if there is no Start bit after the Delimiter, End of Frame is judged. Therefore there is no field that means the end of frame.

8.3 Idle

Idle means a space between each frame and its next frame. The logic of output in transmission side is fixed to "1".

8.4 Transmission Data at Abnormal Request

When any received Request is abnormal, the transmission data from Smart Abs is shown in Table 6.

Table 6. Transmission Data at Abnormal Request

No.	Condition	Transmission Data
1	Logic of Sink code is abnormal.	Data is not transmitted.
2	Address area not to be open for user is designated.	The data as same as Data ID 3 is transmitted. (Refer to Table 2.)
3	Data ID code is not 6 or D.	
4	Logic of Parity is abnormal.	
5	Logic of Delimiter is abnormal.	
6	Logic of CRC is abnormal.	

9. Note for Transmission Request

Function	Data ID	Description
Readout of data	0, 1, 2, 3	Transmit Data ID code (Table 1) on the basis of the List of Data Field (Table 2) to Smart Abs. Because the receiver IC conformed with RS-485 is used in Smart Abs, transmit by the driver IC that is conformed with RS-485 (for example, ADM485) or equivalent.
Resetting one revolution data	8	Transmit 10 times in one sequence to Smart Abs with the interval of 40 ms or more at stationary of the shaft. (*) One revolution data can be reset at 0 ±0.35° (max.) in mechanical angle position. The angle position that is reset once is kept even after the power supply is turned off.
Resetting multi-turn data and all error	C	Transmit 10 times in one sequence to Smart Abs with the interval of 40 ms or more. (*) Multi-turn data is reset but one revolution data is not reset. Additionally all latched error (Over-speed, Counter overflow, Multi-turn error, Counting error II and Battery error) is reset at the same time.
Resetting all error	7	Transmit 10 times in one sequence to Smart Abs with the interval of 40 ms or more. (*) All latched error (Over-speed, Counter overflow, Multi-turn error, Counting error II and Battery error) is reset.
Access to EEPROM	6	"User Data" of 8 bits can be written to the address designated. It is recommended to confirm that the writing was properly performed by means of designating "Data ID D". (For confirming the data, it is not needed to turn off and on the main power supply and battery.)
	D	"User Data" of 8 bits can be read out from the address designated. Regarding the transmission method for Readout request, refer to Paragraphs 6.2.3 and 6.3.5.

Note (*): Smart Abs transmits the response data described in Table 2 at the time when each Request is received. However any error information in the response data is not reset until reset is executed.

For resetting one revolution data, it takes maximum 18 ms until the reset is executed after Request data ID 8 is received 10 times, because the writing process to EEPROM should be carried out.

Edition No.

DWG NO.	3	4	5	6	7	8	9	10	11	12	SHEET
0 5 6 6 9 0 0 2 2								S	4	0	22 /

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10. Circuit Diagram of Transmitter and Receiver

An example of circuit diagram of the transmitter and receiver is shown in Figure 11.

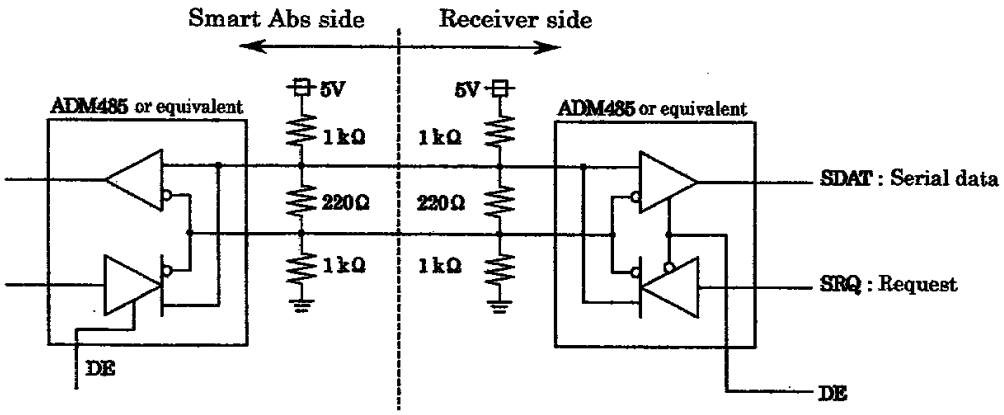

Figure 11. Example of Transmitter and Receiver Circuit

Never transmit any Request to Smart Abs while it transmits the data. The interface circuit of Smart Abs may be broken down if any Request is transmitted to it by mistake during this period.

Smart Abs is always receiving mode except it is transmitting data.

Edition No.												
DWG NO.	3	4	5	6	7	8	9	10	11	12	SHEET
0 5 6 6 9 0 0 2 2								S	4	0	23 /

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11. Guarantee of Products

Guaranteed term of these products without payment is within one year after delivery, except the case of defect or deterioration of quality caused by disassembling, changing, re-assembling, mis-using, or other intention or fault by customer.

However we, Tamagawa Seiki Co., Ltd., could continue to maintain the products properly even after above guaranteed term to keep performances of the products with payment by request.

The predicted Mean Time Before Failure (MTBF) of these products will be enough long, but the failure rate is not zero. Therefore we would request the customers of these products that the customer should assume all troubles resulted when the products may be failed, and put some multiple measures for them into the customer's products, systems and/or equipment for preventing to extend to a serious system failure.

Edition No.

DWG NO.	3	4	5	6	7	8	9	10	11	12	SHEET
0	5	6	6	9	0	0	2	2	S	4	0	24

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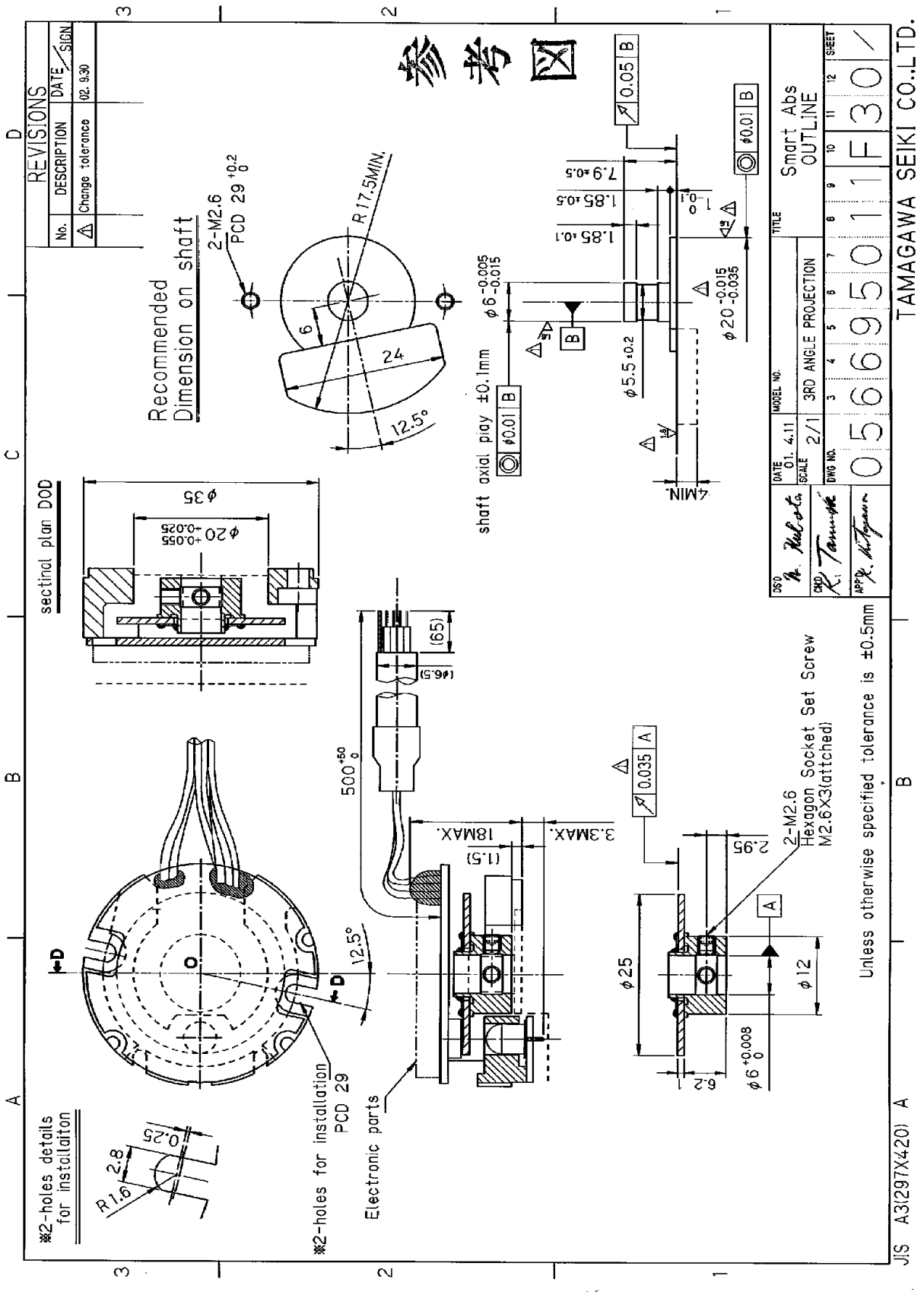
REVISIONS
No. DESCRIPTION DATE SIGN
Change tolerance 02. 9.30
Recommended Dimension on shaft
2-M2.6 PCD 29 +0.2 0
R17.5MIN.
12.5°
shaft axial play ±0.1mm
sectional plan DOD
Electronic parts
※2-holes for installation PCD 29
※2-holes details for installaiton
2-M2.6 Hexagon Socket Set Screw M2.6X3(attched)
Unless otherwise specified tolerance is ±0.5mm
TAMAGAWA SEIKI CO.,LTD.
Smart Abs OUTLINE
3RD ANGLE PROJECTION
TAP301F1169505
JIS A3(297X420)