KOMOTEK CO.,LTD. (MAR-M35X)	Ref.	KMS－９２ＱＳＰ２４

Referrence Material

Note that no revised edition

October, 15, 2009

Specifications

Product name：ＭＡＲ－Ｍ３５Ｘ－ＮＮ５１

(Metal disk, Battery separate cord, 17-bit full ABS)

Nikon Encoder Business Div product code：ＥＪＡ３５２１８　(Sensor)

ＥＪＢ３３０００　(Disk)

Nikon Instruments company product code: ＥＸＫ２９８５２　(Sensor)

ＥＸＫ２９８５３　(Disk)

Specification number：０６ＥＳ０３３Ａ

Your part name：

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１．Overview

This absolute encoder is a modular type 33-bit electrical multi-turn absolute encoder that outputs absolute position information within a 17-bit single turn and 16-bit multiple turn position information obtained from a battery backup counter counting a magnetic incremental pattern for 1 pulse per turn, and is mainly mounted to AC servo motor.

２．Features

- Compact design with diameter of 35mm and single PWB structure
- Approx. 0.5 mm wide gap in between pulse disk and light sensors allows for easy mounting to motor
- MR sensor is used for multi-turn detection and thus, high speed response is possible upon backup operation
  In addition, there is virtually no restriction on turn angle acceleration
- Possible to write any data into E^2PROM

３．Basic specifications

3.1 Resolution

- Single turn： 2^{17} （１３１０７２Ｐ／Ｒ） Absolute data
- Multi- turn： 2^{16} （６５５３６ turns）

3.2 Response turn speed

- Normal operation： ６０００ｍｉｎ$^{-1}$
- Backup operation： １００００ｍｉｎ$^{-1}$

3.3 Classification of operation states

Three operation states are available as below depending upon power supply.

State	Main power supply voltage Vcc (TYP)	External battery power supply voltage (TYP)	Built-in backup capacitor voltage (TYP)
Normal operation	４．７５～５．２５Ｖ	－	－
Backup operation	０Ｖ	２．７６Ｖ～４．０Ｖ	－
		２．７６Ｖ or less	２．７６Ｖ or more
Non-operation	０Ｖ	２．７６Ｖ or less	２．７６Ｖ or less

3.3.1 Normal operation states

The normal operation makes the count operation of single turn and multi-turn data and transmission/reception of data by serial communication possible.

Transmission/reception of data is possible after maximum 500ms or more elapses since main power is ON.

When the backup operation is switched over to the normal operation (upon turning on power), the switchover should be carried out with turn speed 300min^{-1} or less. When the encoder turn speed is 300min $^{-1}$ or more at the time of turning on main power, scanning of M-series pattern may not be normally conducted and in this case, the absolute position data cannot be determined and thus, BUSY flag is shown. When the turn speed is lowered and the scanning returns to normal state, BUSY flag is automatically cleared and the absolute position data is determined. However, when the normal scanning is conducted even if the turn speed is 300min^{-1} or more, BUSY flag is cleared.

(Reference：Actual value of turn speed capable of scanning: Approx. 700min $^{-1}$)

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3.3.2 Backup operation states

The backup operation permits to perform multi-turn count operation by external battery or built-in backup power source. In this case, the data is neither transmitted nor sent.

3.3.3 Non-operation states

All operations of the encoder are stopped. In this state, MT error flag is latched inside the encoder and the data is transmitted externally after main power is turned on.

4. Mechanical specifications

4.1 Moment of shaft inertia (calculation value)

４．１×１０$^{-7}$ｋｇ・ｍ^{2}（４．１ｇ・ｃｍ^{2}）

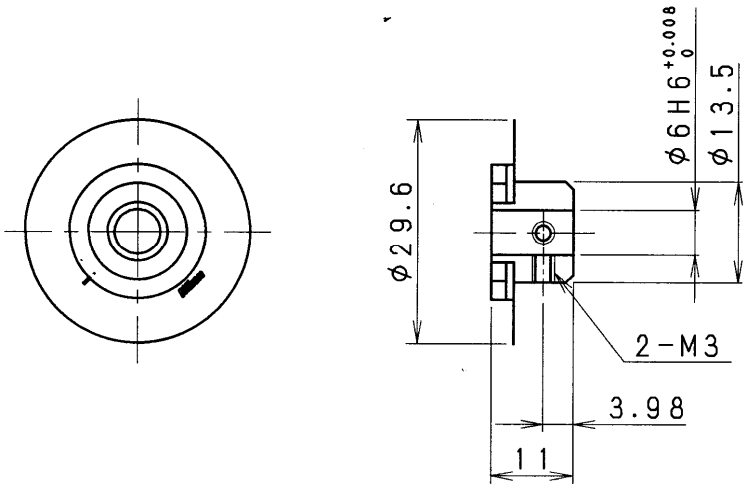
4.2 Allowable turn angle acceleration

１．０×１０^{5}ｒａｄ／ｓｅｃ^{2}

4.3 Mass ０．１ｋｇ

4.4 Outside drawing

（1）Outside drawing of pulse disk



Accessory

M3 Hexagon socket set screws（ｌ＝３）：２ pieces

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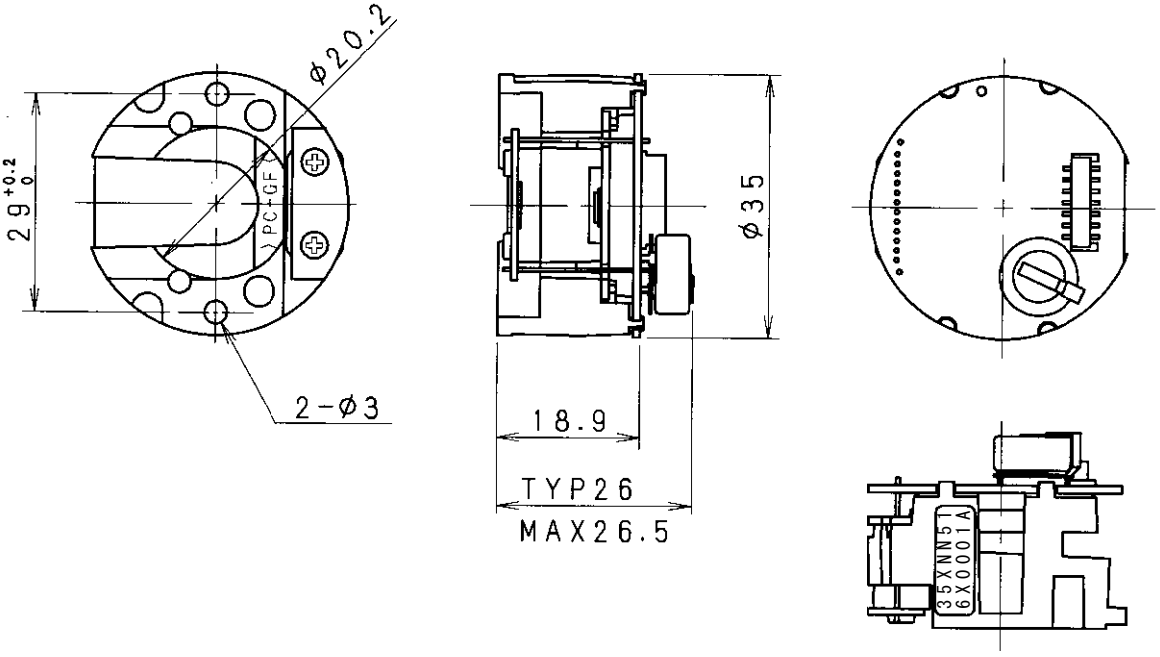
（2）Outside drawing of Sensor



Accessory
M2.6 Hexagon socket set screws（l＝6）：2 pieces

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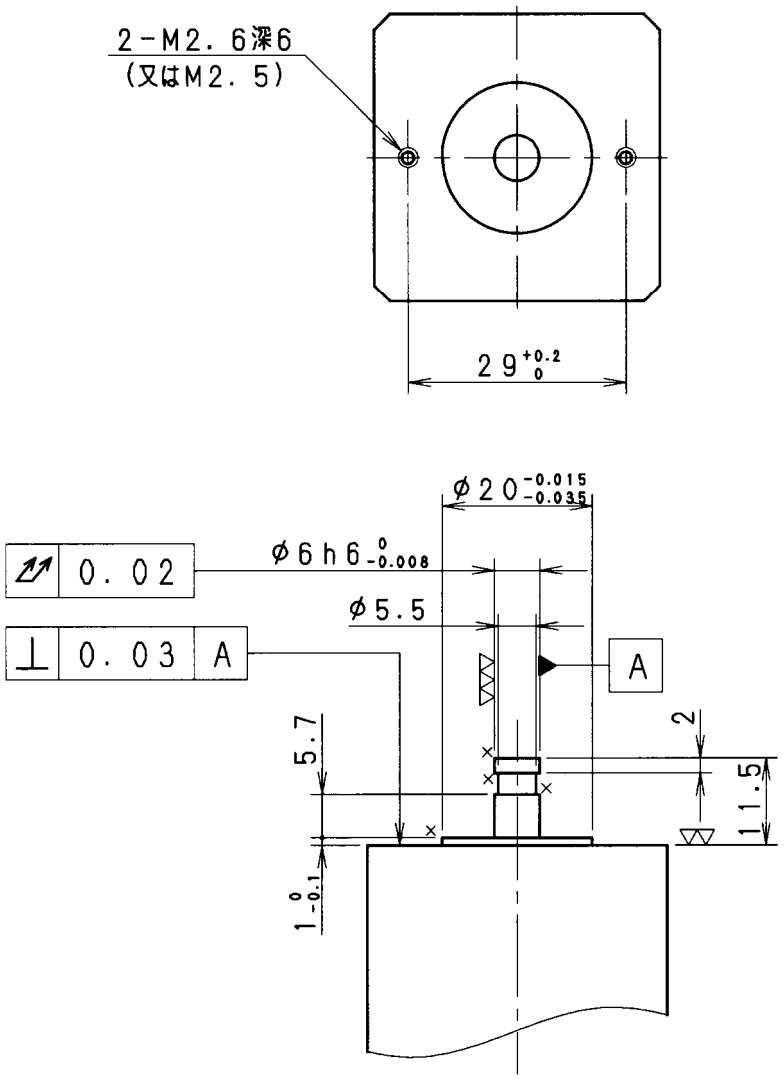
4．５ Specification for mounting shaft



X: Chamfering with 0.2 through 0.3 is required.
Thrust variation must be ±0.2 or less.

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５． Electrical specifications

5.1 Maximum absolute rating (Temperature range on the PWB : －20～＋85℃)

Item	Mark	Rating	Unit
Main power supply voltage	Vcc	−0.3 ～ 6.0	V
External battery power supply voltage	Vbat	−0.3 ～ 6.0	V

5.2 Electrical characteristics (Temperature range of undesignated PWB : －20～＋85℃)

Item	Condition	Rating			Unit
		MIN	TYP	MAX	
Main power supply voltage	Normal operation (ripple 1% or less) *5)	4.75	5.0	5.25	V
External battery power supply voltage	Backup operation *5)	3.0	3.6	4.0	V
Normal operation⟷ Backup operation	Normal→Backup *5)	4.05	4.15	4.25	V
	Backup→Normal *5)	4.14	4.31	4.47	V
MT error occurrence voltage	*1)	2.66	2.76	2.93	V
Battery alarm occurrence voltage	External battery voltage *5)	2.94	3.0	3.06	V
Possible Data transmission start time	Power impedance = 0 After switching from backup→normal operation			0.5	sec
Response turn speed	Non-operation → Normal Backup→Normal *2)			300	min^{-1}
	Normal operation			6000	min^{-1}
	Backup operation			10000	min^{-1}
Current consumption in normal operation (VCC=5.0V when line is opened)	Capacitor discharge *3)		130	170	mA
	Normal operation		120	160	mA
Normal operation Current consumption of external battery			1.0	3.4	μA
Backup operation Current consumption of external battery	After charged for more than 10 minutes at 20℃ ambient temperature and Vcc=5V		30	35	μA

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Backup time	After charged for more than 3 hours at Vcc=5V *4)	３．５			hour

＊1）MT error is occurrence by higher voltage value of backup built-in capacitor voltage or external battery voltage

＊2）It is the turn speed value that does not turn on BUSY flag when main power is ON while turning.

＊3）The current consumption is the instantaneous maximum current when main power is turned on with internal backup capacitor fully discharged and when internal backup capacitor is charged, the operation is changed to normal. Internal backup capacitor is not discharged even if Vcc terminals are short-circuited.

＊4）The value is one upon product shipment as well as upon shaft stop.
Life of built-in capacitor is subject to change depending upon ambient temperature. Beware of high humidity atmosphere.

＊5）The value is the voltage value at power supply terminals on encoder side.

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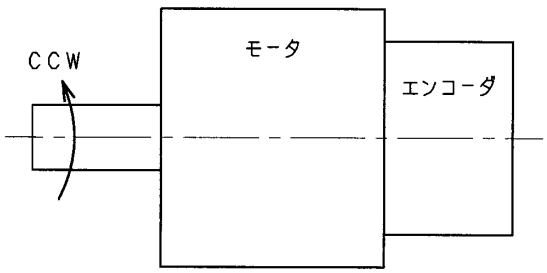
5.3 Electrical specifications within single turn

Item		Specification	Remarks
Resolution		2^{17} ST[16:0]	Addresses０ ～ ＋１３１０７１
Max turn speed	Normal operation	6000 min^{-1}	
Max angle acceleration	Normal operation	1.0×10^{5} rad/s^{2}	Due to mechanical restriction
Output code		Pure binary code	
Direction of increase		CCW	Please refer to following diagram
Margin of error for interpolation (after interpolation correction is determined)		±１０″	Phase interpolation corrective operation works when approx. 3.5° or more is turned after main power is turned on.
Position reproducibility Repeat accuracy with main power turned on		±１ＬＳＢ	Position reproducibility upon power ON-OFF turns out ±１２０″ (max).

5.4 Multi-turn signals electrical specifications

Remark		Specification	Remark
Resolution		1 Count/Turn	－
Max multi-turn count		2^{16} MT[15:0]	65536 turns
Max turn speed	Normal operation	6000 min^{-1}	－
	Backup operation	10000 min^{-1}	
Max angle acceleration	Normal operation	1.0×10^{5} rad/s^{2}	Due to mechanical restriction
	Backup operation		
Output code		Pure binary code	
Direction of increase		CCW	Please refer to following diagram



CCW denotes the direction when motor shaft or encoder shaft is turned in the anti-clock direction with motor kept stationary.

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5.5 Backup power supply

5.5.1 Internal backup power supply (electric double layer capacitor)

(1) Definition of backup time

The backup time means a state of the battery being not connected. More specifically, it denotes the time until Vcc terminals are opened and data of multi-turn count amount cannot be stored (changed to non-operation state) since the normal operation is getting under way with DC5V supplied to Vcc for more than 3 hours.

(2) Capacitor charging circuit

Capacitor is charged from the main power supply (DC5V) and external battery power through diode・resistor.

(3) Capacitor life

Life of the electrical double layer capacitor is subject to change depending upon ambient temperature. Beware of high humidity atmosphere.

5.5.2 External backup power supply (External battery)

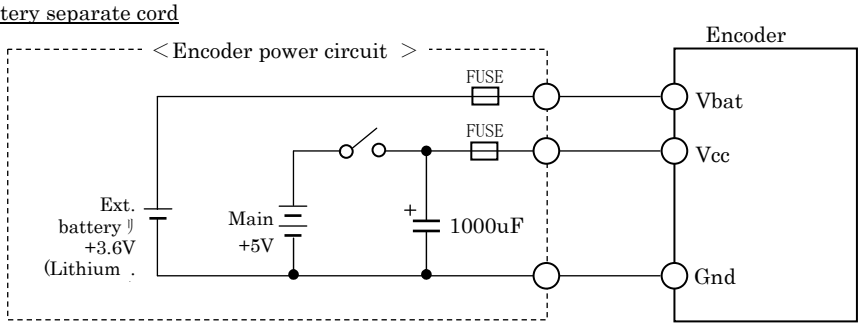
(1) Battery guaranteeing proper operation : 2000mAh Lithium battery ER6 (3.6V) made by Toshiba

(2) Recommended power supply circuit (for reference)

For fail safe against voltage delay (※VD) of lithium battery, electric capacity with approx. 1000μF is recommended to be provided at Vcc line (5V) of the encoder power supply circuit (please refer to following block diagram.

※What is all about VD・・・When the battery has not been in use for a long period of time or has been used with feeble electric current, film is generated on anode surface, thereby producing the phenomenon that the voltage will temporarily fall when the large current is supplied.

・Battery separate cord



5.5.3 Backup power supply switchover

The power is supplied in order of higher voltage of Vcc, external battery and internal backup capacitor. Unless difference in voltage exceeds over a forward voltage of switching diode of switching circuit, however, the power is not properly switched over.

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年	月	日	△×

6．Serial communication

6.1 Overview

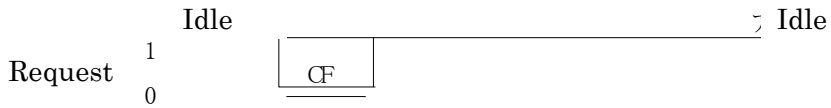
Item	Specifications	Remarks
Communication code	Binary code	—
Transmission system	Differential line driver	Based upon RS 485
Reception system	Differential line receiver	Based upon RS 485
Transmission data	Single turn data	17 bit
	Multi-turn data	16 bit (0～65535)
	Status flag	(1) Overspeed (2) BUSY flag (3) ST error (4) Overflow flag (5) PS error (6) Battery alarm (7) MT error
Synchro system	Baseband NRZ	—
Baud rate	2.5 Mbps	—
Frame format	Detail shown at paragraph 6.2 and on	—

6.1.1 E²PROM

Item	Specifications	Remarks
Accessible addresses	0 through 79	Data is unassigned upon shipment
Number of allowable writings	100000 in total	One access for writing = single writing

6.2 Frame format

6.2.1 Encoder data capture



Control field

年	月	日	△×
年	月	日	△×
年	月	日	△×

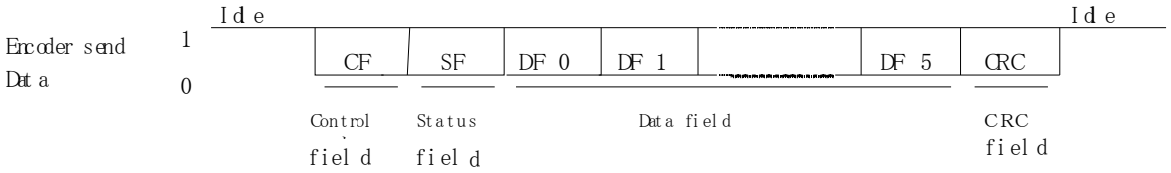


FIG. 1　Encoder data capture frame format

6.2.2　E²PROM access（writing）

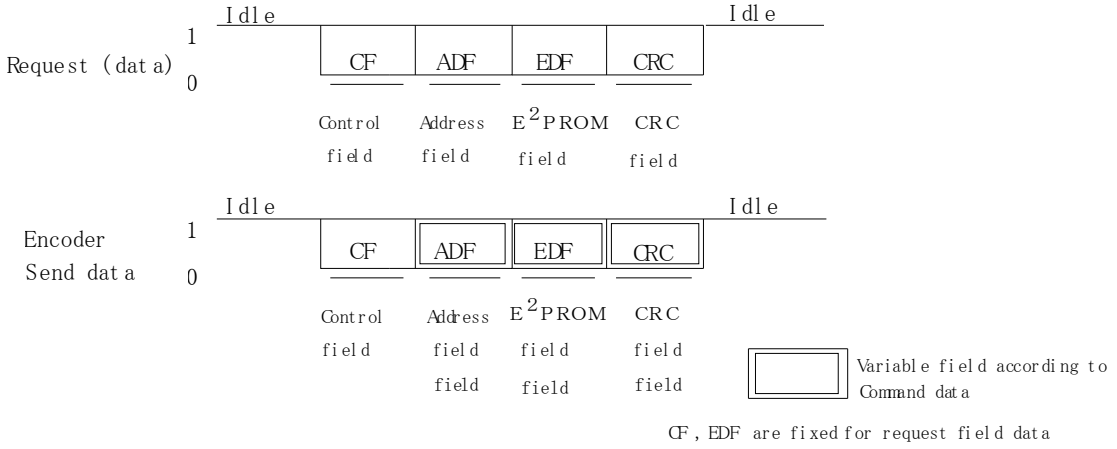


FIG. 2　Writing frame format

6.2.3　E²PROM access（reading）

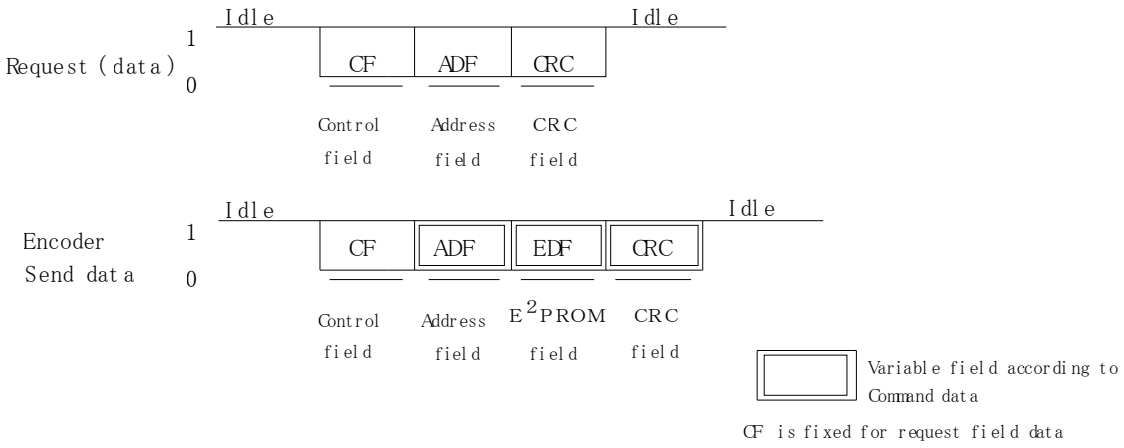


FIG. 3　Reading frame format

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年	月	日	△×
年	月	日	△×

6.3 Field detail

6.3.1 Control field (CF)

Configuration of control field is as shown in FIG.4.

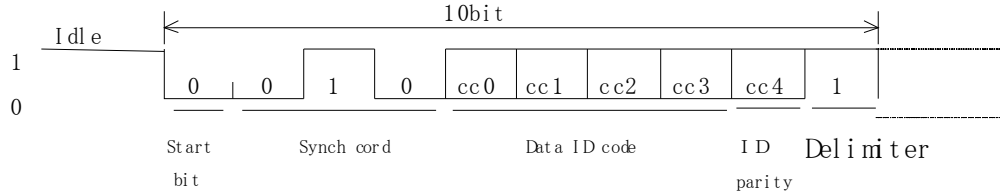

FIG.4 Configuration of control field

① Start bit : Fixed
② Synch cord : Fixed。
③ Data ID code : Data shown in Table 2 is outputted from encoder by specifying data ID code shown in Table 1.
When specifying data ID code, please follow the application of Tabel 1. (For example, data ID code for reset should not be used for data capture.)
④ ID parity : Parity of data ID code
⑤ Delimiter : Fixed

Table 1 Data ID code chart

Application	Data ID	Content of code				Parity
		cc0	cc1	cc2	cc3	cc4
Data capture	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
Data writing	Data ID 6	0	1	1	0	0
Data reading	Data ID D	1	0	1	1	1
Resetting	Data ID 7	1	1	1	0	1
	Data ID 8	0	0	0	1	1
	Data ID C	0	0	1	1	0

6.3.2 Status field (SF)

Configuration of status field is as shown in FIG. 5.

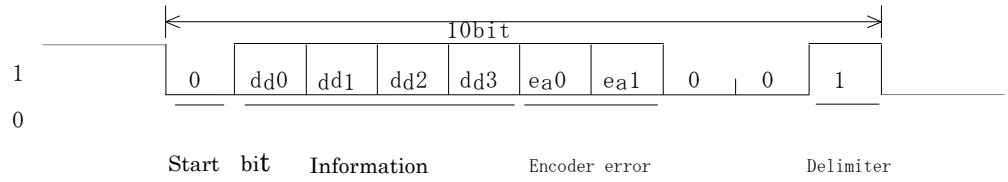

FIG. 5 Configuration of status field

① Start bit : Fixed
② Information : All fixed to “０”.
③ Encoder error : Logical value “１” is outputted respectively upon each error occurrence.

Bit	ea0	ea1
Logic upon error occurrance	1	1
Content	ST error	PS error, Battery alarm, MT error and BUSY flag are outputted in OR logic.

④Delimiter : Fixed

6.3.3 Data field (DF0～DF5)

Relationship between data ID code and data field is as shown in Table 2.

Table 2 Data field chart

Data ID	DF 0	DF 1	DF 2	DF 3	DF 4	DF 5	DF6	DF7
Data ID 0	ABS 0	ABS 1	ABS 2					
Data ID 1	ABM 0	ABM 1	ABM 2					
Data ID 2	ENID							
Data ID 3	ABS 0	ABS 1	ABS 2	ENID	ABM0	ABM1	ABM2	ALMC
Data ID 7	ABS 0	ABS 1	ABS 2					
Data ID 8	ABS 0	ABS 1	ABS 2					
Data ID C	ABS 0	ABS 1	ABS 2					

Blank denotes no transmission data avaialble.

ABS0～ABS2：Absolute value data within single turn
Of all 24-bit frames, let ABS0 be low byte and ABS2 be high byte.
High 7-bit of ABS2 is 17-bit data of full-time logical value “０”.

ABM0～ABM2：Multi-turn data
Of all 24-bit frames, let ABM0 be low byte and ABM2 be high byte.
ABM2 is 16-bit data of full-time logical value “０”.

ENID ：Encoder ID（＝２３Ｈ **fixed**）

ALMC ：Encoder error（Please refer to Table 3）

Table 3 ＡＬＭＣ

Bit	$d_7$0	$d_7$1	$d_7$2	$d_7$3	$d_7$4	$d_7$5	$d_7$6	$d_7$7
Logic upon error occurrance	1	1	1	1	－	1	1	1
Naming	Overspeed OVSPD	BUSY flag BUSY	ST error STERR	Overflow flag OVF	Fixed to ‘0’	PS error PSERR	MT error MTERR	Battery alarm BATT

Configuration of each data field is as shown in FIG.6.

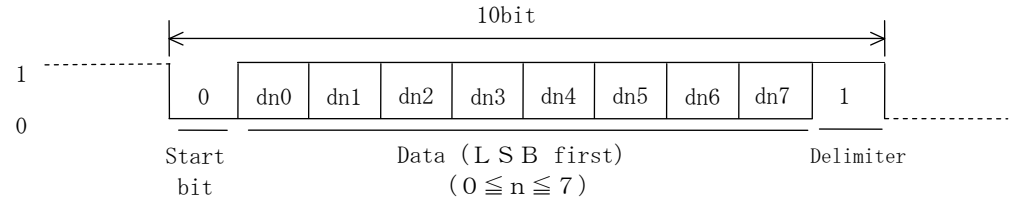

FIG.6 Configuration of data filed

① Start bit : Fixed
② Data : Configured in accordance with LSB first.
③ Delimiter : Fixed

6.3.4 CRC field (CRC)

Configuration of CRC field is as shown in FIG.7.

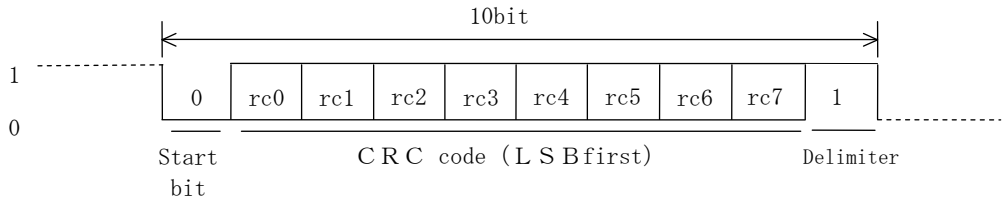

FIG.7 Configuration of CRC field

① Start bit : Fixed
② CRC code : Generation algorithm in accordance with $G(X)=X^8+1$ (X= rc0～rc7)
Data is configured in accordance with LSB first.
Calculation is executed to all bits except for Start bit and Delimiter of fields rather than CRC.
③ Delimiter : Fixed

＜CRC calculation example＞

When encoder data (ＣＦ～ＤＦ３) is as shown in Table Ｃ, ＣＲＣ value is following value.

Table C

Field name	CF	SF	DF0	DF1	DF2	DF3	CRC
Encoder transmission data (LSB first)	01001100	00001000	10000000	00010100	00001101	00010000	11001101

年	月	日	△×
年	月	日	△×
年	月	日	△×

6.3.5 Address field (ADF) and E²PROM field (EDF)

Configuration of ADF field is as shown in FIG.8.

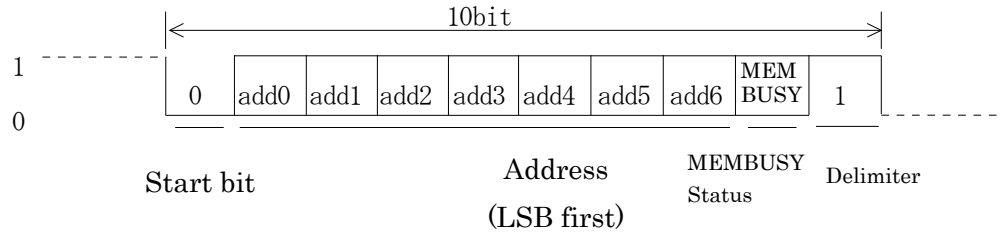

FIG.8 Configuration of ADF field

①Start bit : Fixed

②Address : E²PROM address（０～79） LSB first

③MEMBUSY status : Access status to E²PROM can be judged by MEMBUSY status. Relationship between MEMBUSY status and the transmission data from the encoder is referred to Table 4.

Table 4 MEMBUSY status and transmission data

	Request	Encoder transmission data			内 容
	MEMBUSY	MEMBUSY	ADF	EDF	
Reading	0	0	ADF of request	E²PROM Normal data	Reading is normally executed
		1	ADF of request	00[HEX]	Writing is in action Request for reading is invalid
Writing	0	0	ADF of request	EDF of request	Request for writing is received
		1	ADF of request	00[HEX]	Writing is in action Request for writing is invalid.

When MEMBUSY status of transmission data from encoder is logical value "１", [Writing is in action.] [Writing] process based upon request is not executed.

For checking out that writing process of data into E²PROM was normally completed, the check is to be conducted by transmitting [Request for reading (data ID D)].

④Delimiter : Fixed

⑤ＥＤＦ : 8 - bit data (LSB first)

Configuration of data field is in conformance with FIG.6.

7. Functional explanation of status flags

Naming	Explanation	How to clear
BUSY flag (BUSY)	Function: Flag denotes that determination work of absolute value within single turn is under way. More specifically, when scan data of M-sequential scan data is logically wrong or three-time detected scan data are not identical, logical value "1" is outputted. All position data for this period are fixed to '0'. After determination work thereof is over, logical value is returned to"0". Detection timing : Upon normal operation (when main power is turned on) Output : Non latch	Auto clear (turn speed is lowered to 300min^{-1} or less.)
PS error (PSERR)	Function : It is to monitor matching of "Multi-turn count block" and "Single turn count block". More specifically, ①multi-turn count amount calculated by magnetic encoder ②multi-turn count amount pseudo- calculated by Carry/Borrow of absolute value within single turn Said ① and ② are compared and when (difference between ① and ②) ≧ (single turn), alarm is turned on. Detection timing : Upon normal operation Output : Latch	Turn on main power (+5V) twice or、 error resetting (ID7, IDC)
ST error (STERR)	Function : It is to monitor matching of "ABS block" and "INC block". More specifically, ① specific 1 bit among absolute sensors ② specific 1 bit among shift registers in ASIC (generated from M-series polynominal expression) Said ① and ② are compared and when data is different, alarm is turned on. Detection timing : In normal operation Output : Latch	Turn on main power (+5V) twice or、 error resetting (ID7, IDC)
Overspeed alarm (OVSPD)	Function : When turn speed exceeds over 6600min^{-1} (MN) in normal operation, alarm is turned on. In backup operation, when it exceeds over 10000min^{-1} (MN), alarm is turned on. Detection timing : Upon normal operation and backup operation Output : Latch	Turn on main power (+5V) twice or、 error resetting (ID7, IDC)
Battery alarm (BATT)	Function : When external battery voltage falls below 3.0V (TYP), alarm is turned on. Detection timing : In normal operation Output : Latch	Error resetting (ID7, IDC)
MT error (MTERR)	Function : When encoder is in non-operation state and cannot fulfill its function as encoder, alarm is turned on. More specifically, when higher voltage of built-in encoder backup capacitor voltage or external battery voltage falls below 2.76V (TYP), alarm is turned on. Detection timing : Upon backup rotating operation Output : Latch	Error resetting (ID7, IDC)
Overflow flag (OVF)	Function : When count amount exceeds over -32766～+32765, logical value "1" is outputted. Multi-turn counter works as cyclic counter of 0～65535 even after overflowed. Detection timing : Upon normal operation and backup operation Output : Latch	Error resetting (ID7, IDC)

Note)

・As to error resetting, please read [10. Precautions in request transmission].

・When main power is turned on (300min^{-1}or less) in the condition that the external battery is not connected and internal backup capacitor is fully discharged, the status is as shown below.

BUSY、PSERR、STERR ---------- "0"

BATT,MTERR ---------- "1"

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OVF、OVSPD---------- "X" (indefinite)

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年	月	日	△×

8．Detection of data capture frame

8.1 Detection of frame start

In control field (CF), initial logical value “０” next to idle is deemed to be frame start and when sucessive 3 bits match the synch code, said frame start is [Frame start]. When the synch code is not mached, frame detection will be executed again. In addition, data frame will be transmitted 3 μ sec.(TYP) later after receiving delimiter signal of request frame.

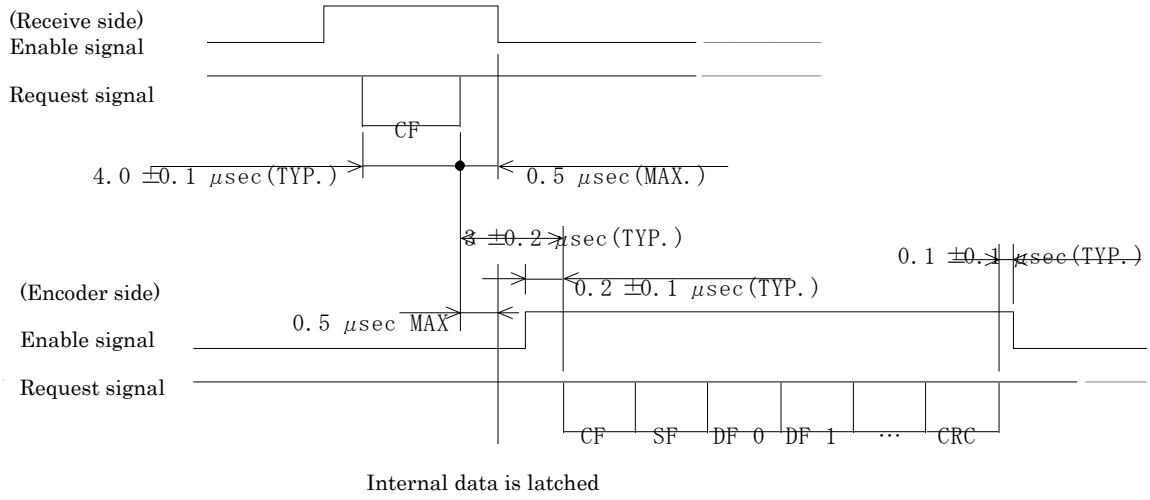

FIG.5 Frame detection

8.2 Frame end

Frame is deemed to be end unless there is start bit next to delimiter after frame start is detected. Thus, there is no filed specifically denoting frame end.

8.3 Idle

In between frame and frame is idle. Transmitting side has the output logic fixed to “１”.

8.4 Request invalid conditions

Request is invalid when the condition is as shown in Table 5. In this case, there is no data transmission from encoder.

Table 5 Request invalid conditions

No.	Conditions
1	Logic of synch code is abnormal
2	Data ID code is other than 0,1,2,3,7,8,C
3	Logic of parity is abnormal
4	Logic of delimiter is abnormal

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9． Detection of access frame to E²PROM

9.1 Detection of frame start

Intial logical value “０” next to idle is deemed to be frame start and when sucessive 3 bits match synchro code, said frame start is [Frame start].

When synchro code is not mached, frame detection will be executed again.

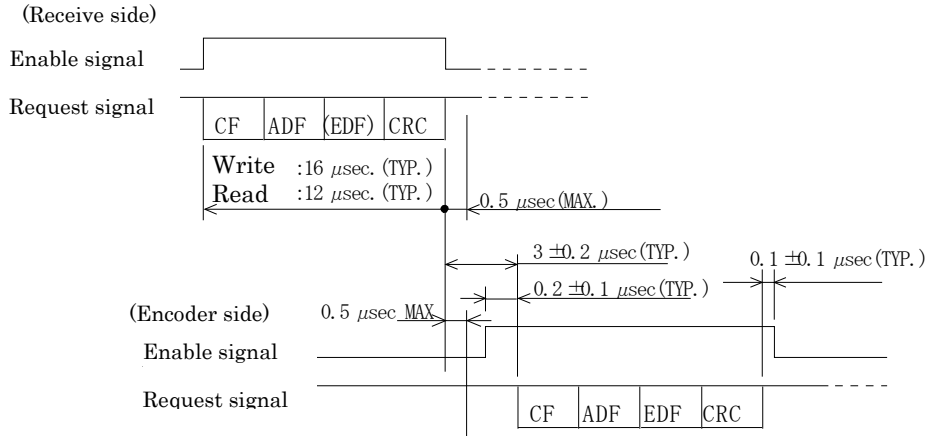

FIG.10 Frame detection

＊ Encoder starts data transmission 3μsec. (TYP) later after receiving request for access to E²PROM (data ID６ and７). However, it should be noted that the data returned of request for writing (data ID６) denotes reception of data ID 6 and writing process is not always completed.. Data writing process takes 18m sec. (MAX) to complete after receiving request.

9.2 Frame end

Frame is deemed to be end unless there is start bit next to delimiter after frame start is detected. Thus, there is no filed specifically denoting frame end.

9.3 Idle

In between frame and frame is idle. Output on transmitting side is fixed to logical value “１”.

9.4 Request invalid conditions

Request is invalid when the condition is as shown in Table 6. In this case, there is no data transmission from encoder.

Table 6 Request invalid conditions

No.	Conditions
1	Logic of synch code is abnormal.
2	Address other than area open to user is specified.
3	Data ID code is other than ID ６ and Ｄ.
4	Logic of parity is abnormal.
5	Logic of delimiter is abnormal.
6	Logic of CRC is abnormal.

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１０．Precautions in request transmission

Function	Data ID	Precaution
Data capture	0,1,2,3	In accordance with data field chart (Table 2), data ID code (Table 1) is to be transmitted to encoder. Encoder is loaded with RS485 receiver IC, so data ID code should be transmitted by driver IC (equivalent of SN65LBC176) in conformity with RS485.
Single turn data resetting	8	Data ID is to be sucessively transmitted to encoder 10 times at transmission intervales of 40 μ sec. or more when shaft is stopped. ※ Single turn data is reset to mechanical angle 0°. Once shaft position is reset, its position is kept even after main power is turned off, whether external battery is connected or not.
Multi-turn data And all errors resetting	C	Data ID is to be sucessively transmitted to encoder 10 times at transmission intervales of 40 μ sec. or more. ※ Multi-turn data is reset.(Single turn data is not reset.) In addition, all latch errors(Overspeed, Overflow flag, PS error, ST error and MT error) are reset at the same time.
All errors resetting	7	Data ID is to be sucessively transmitted to encoder 10 times at transmission intervales of 40 μ sec. or more. ※ All latch errors(Overspeed, Overflow flag, PS error, ST error and MT error) are reset at the same time.
Access to E^2PROM	6	8-bit user data is writable into specified address. After data writing, it is recommendable to specify [data ID D] and check that writing was normally executed.
	D	8-bit user data is readable from specified address. Transmission of request for reading is referred to paragraphs 6.2.3 as well as 6.3.5.

※・Encoder returns data shown in Table 2 every one request is received. However, Error information about the data returned will not be reset until resetting is executed.

・When the Error is reset by data ID C or ID 7, resetting should be executed with the encoder shaft being stopped (turn speed 300min^{-1} or less). In addition, after 10-time reception, the encoder outputs BUSY flag for max 2ms in order to operate resetting process.

・Single turn resetting takes 18m sec. (Max) to execute the resetting after 10-time ID 8 is received because the process of writing data into E^2PROM is executed.

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１１．Environmental Conditions

11.1 Temperature

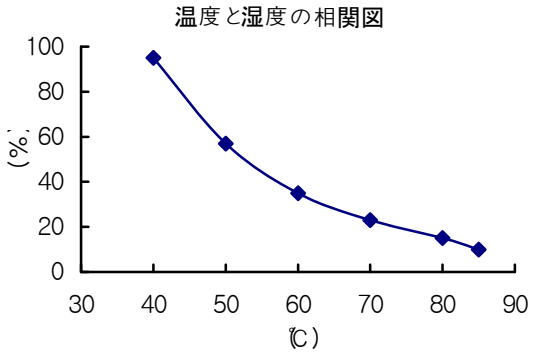
・Operation： Base plate temperature －２０℃～８５℃

・Non-operation： Base plate temperature －２０℃～８５℃

11.2 Humidity (non condensing)

・９５%RH or less (＋４０℃)
・５７%RH or less (＋５０℃)
・３５%RH or less (＋６０℃)
・２３%RH or less (＋７０℃)
・１５%RH or less (＋８０℃)
・１０%RH or less (＋８５℃)

Detail is referred to diagram at right.



11.3 Vibration

3000Hz or less at 98m/sec^2
Direction：X, Y and Z directions
Time：48 hours in each direction
Frequency： Non damage at 100 ～ 3000Hz/Sweep 15min

11.4 Impact

980m/sec^2 6m sec. or less
Direction：X, Y and Z directions
Number of impacts：Non damage at a rate of 10-time impacts or less in each direction

11.5 Noise resistance

No displacement occurs in noise tests below.

（１）Power supply noise
Common mode (between frame and power supply)
Normal mode (between 0V and 5V)
±100V for both modes (pulse width 50n sec and 1μsec; polarity ±)

（２）Cable radiation noise 2kV (pulse width 50n sec and 1μsec; polarity ±)

（３）Magnetic noise 0.01 tesla

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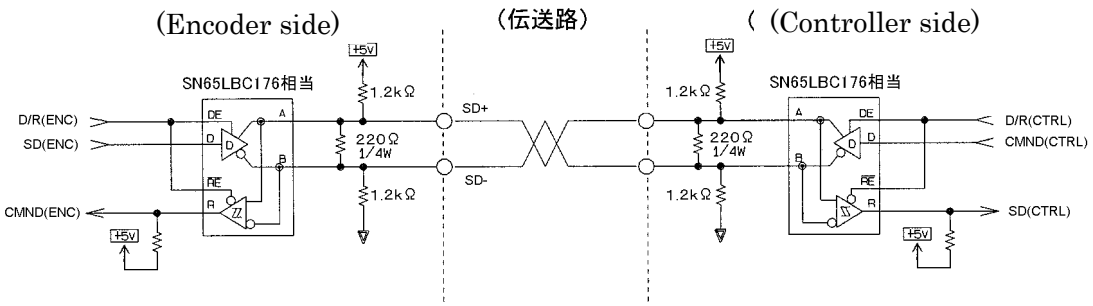
１２．Transmission/reception circuit configuration examples



Do not transmit request signal to encoder while encoder is tranmitting data. If data is inadvertently transmitted, encoder I/O may be damaged.
When data is being transmitted from encoder, normally encoder is in reception mode.

１３．Input/output signals

Pin number	Function	Remarks
1	VB	Battery power （Note１）
2	SD	Serial data signal
3	／SD	
4	VCC	Main power DC＋5V±5%
5	GND	Signal ground
6	GND	Signal ground
7	N.C.	(Unassigned)

Note１) External battery power is required for backup operation of encoder.
As to status flag when external battery power is not connected and main power is turned on with built-in capacitor fully discharged, please see [7. Functional explanation of status flags].

13.1 Base plate connector (receptacle and header)

・Model name : 8-917570-7 (made by AMP, 7- Pole 1.5mm mini VP connector)

※Adaptable connector

Plug housing : 917572-7

Pin contact : 917571-4

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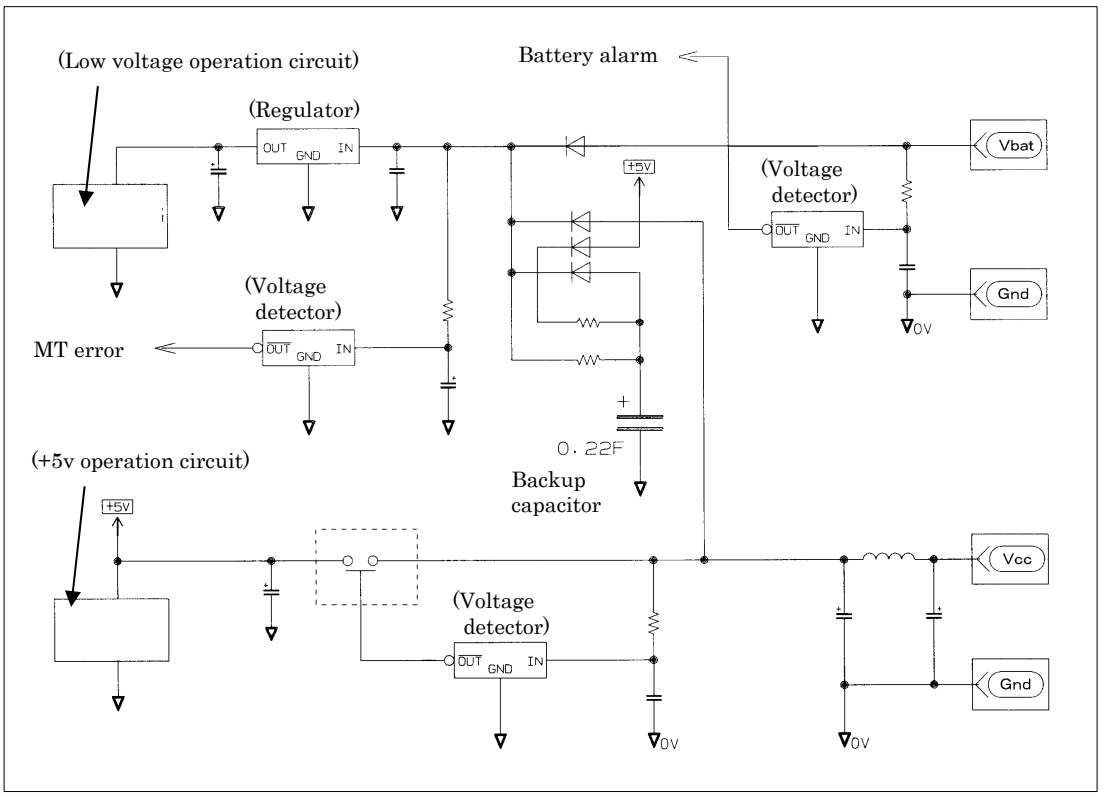
１４．Power supply circuit (for reference)



１５．Serial number plate

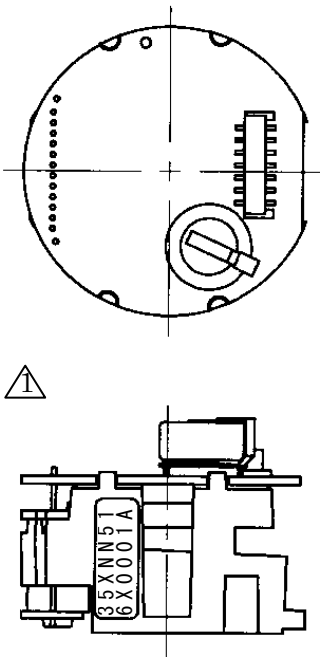
15.1 Location for serial number plate
On side facet of mold (please refer to diagram at right)

15.2 Descriptive items

（１）Model name：35XN51
([3] in sixth digit from right shows that the product complies with RoHS Directive.)

（２）Product serial number：6X0001A
First digit from left corresponds to last one digit of a production year, second digit a production month (Oct.: X, Nov.: Y and Dec.: Z) and then serial number comes in four digits and alphabet (A, B, C・・・) showing design revision record comes after 4-digit serial number.

15.3 Plate material
Paper label



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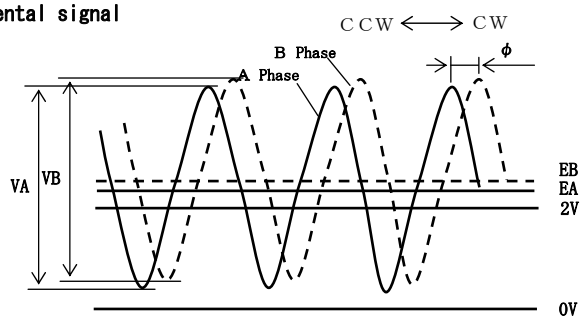
１６. Signal adjustment standard

Signal	Item	Condition	Adjustment standard value (upon shipment from Nikon) (*)	Final standard value (on finish product)
Incremental signal (A、B)	Amplitude (VA, VB)	700/6000 min^{-1}	2.0～3.0Vpp : 700 min^{-1} 1.4～3.0Vpp : 6000 min^{-1}	1.9～3.2Vpp : 700 min^{-1} 1.3～3.2Vpp : 6000 min^{-1}
	Level (EA, EB)	700 min^{-1}	-------	-------
	Phase difference (ϕ)	700 min^{-1}	90±10 degrees	90±10 degrees
Absolute signal (ABS)	Amplitude (V1, V2)	700 min^{-1}	0.75V or more	0.7V or more
	Center level (V1－V2)	700 min^{-1}	±0.2V or less	±0.3V or less
	Amplitude (V3)	700 min^{-1}	-------	-------
	Amplitude (V4)	700 min^{-1}	-------	-------
Multi-turn signal (MA、MB)	Phase (a, b, c, d)	700 min^{-1}	1/4±1/10P	1/4±1/8P
	Duty	700 min^{-1}	1/2±1/20P (50±5%)	1/2±1/20P (50±5%)

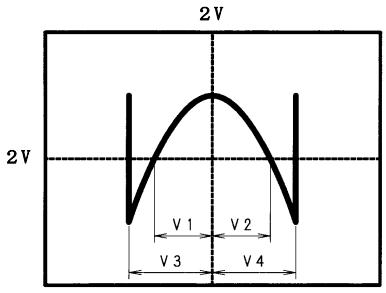
*) This value is applied to any combination of base plate and disk upon shipment from Nikon.

Incremental signal



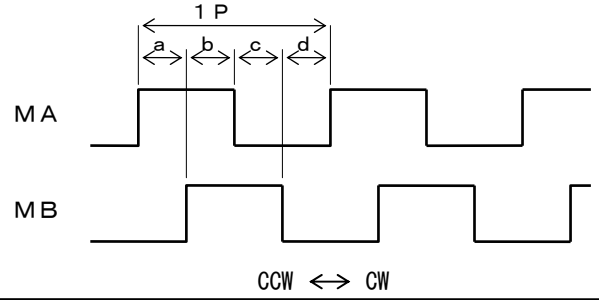
VA,VB : A phase, B phase amplitude (peak to peak voltage)
EA,EB : A phase, B phase level (2V standard)

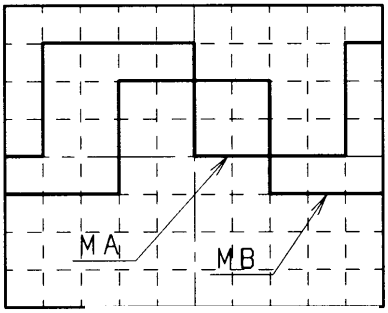
ＡＢＳ－Ａ Lissajous signal



X-axis : ＡＢＳsignal (0V standard)
Y-axis : A signal (0V standard)

Multi-turn signal (MA,MB)





Multiple turn signal

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１７. Assembling adjustment procedure

Wrist strap has to be used when working on assembly. Moreover, power supplies like adjustment tools are sure to be grounded.

17.1 Mounting pulse disk

Spacer is inserted so that there is spaced at 4.12±0.03 between motor datum face and shaft under surface of pulse disk, and then pulse disk is mounted to motor shaft. Adhesive agent (thread locking agent) is applied to hexagon socket set screws (M3 x 4) and the set screws are tightly fastened by clamp torque 0.49N・m.

Beware of handling pulse disk.
・Disk should be treated carefully so that it is not bended.
・Disk should be treated carefully, otherwise you may be injured.

17.2 Mounting base plate

Base plate is mounted to motor so that it does not come into contact with pulse disk and adhesive agent(thread locking agent) is applied to thread portion of hex socket head cap screws M2.6 X 6, and the head cap screws are temporarily tightened by screw and M2.6 flat washer.

Recommended adhesive agent : LOCTITE 242

17.3 Signal adjustment

・Encoder is connected to counter and signal switching tool, and the probe for taking signal is mounted to base plate.

・Counter and signal switching tool should not be turned on until encoder power cable and probe for taking signal both are securely mounted.

If counter and signal switching tool are turned on with only the probe mounted, encoder may be damaged.

・Signal switching tool is switched over to ABS・A, motor turn speed is set to 700min^{-1} and then sensor is aligned. The alignment of the sensor is conducted in the radius direction of the base plate so that convex portion of signal waveform is overlapped as much as possible and the signal becomes large in the X and Y directions.

・After the sensor is aligned, screws are fastened by torque 0.49N・m and secured.

・Be sure to check out that upon excitation of the motor, display of ST in the counter falls within the standard.

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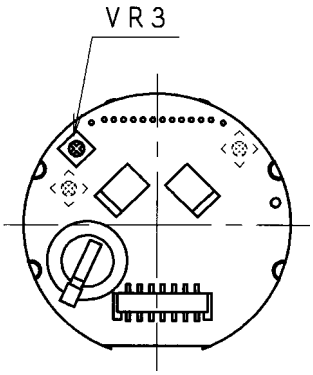
17.4 CS adjustment (when M35 counter is used)

Original point is set, depressing down ST-CLR_SW presetting absolute position within single turn of the counter with the motor excited.

17.5 Signal check

・absolute signal (ABS)

The signal switching tool is switched over to ABS・A. Oscilloscope is switched over to lissajous to check out the amplitude of V1, V2 and |V1－V2|. The adjustment of |V1－V2| is made by volume (VR3). As to the location of VR3 and the signal standard, please refer to diagram at right and [14. Signal adjustment standard], respectively.



1) The volume adjustment is required to make under load of 4.9 [N] or less.

2) Following recommended driver is required to use for volume adjustment.

Recommended driver : VESSEL-made Ceramic adjustment driver No.9000 (-1.8×30)

※ VR adjustment should be made so that the driver does not come into contact with any of parts other than VR.
If there is any crack in the contacted parts, please stop use of the product in question.

・Incremental signal (A, B)

The signal switching tool is switched over to A and B to check out that the signal falls within the standard.

・Multi-turn signal (MA, MB)

The signal switching tool is switched over to MA and MB to check out that the signal falls within the standard. The check must be conducted in both directions of CW and CCW.

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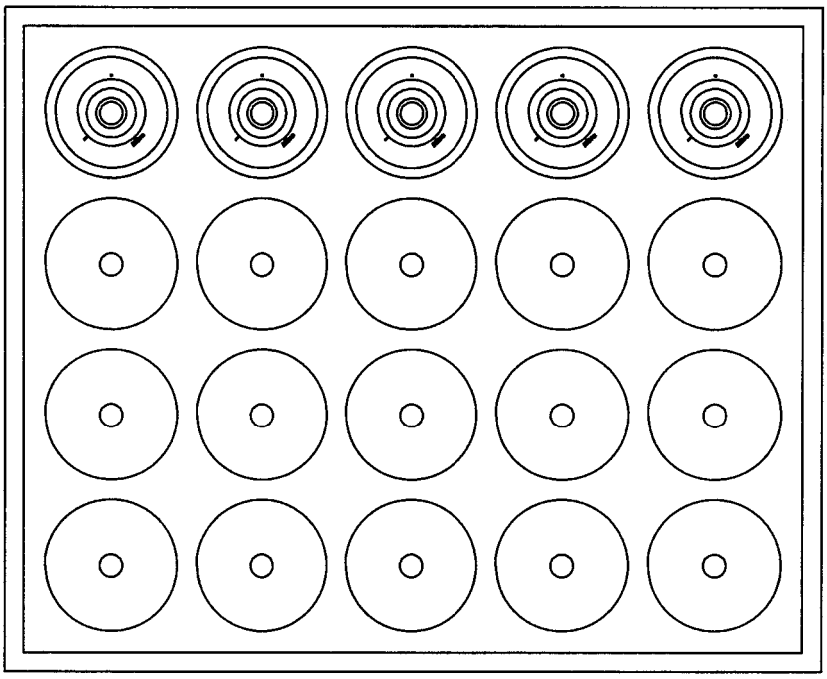
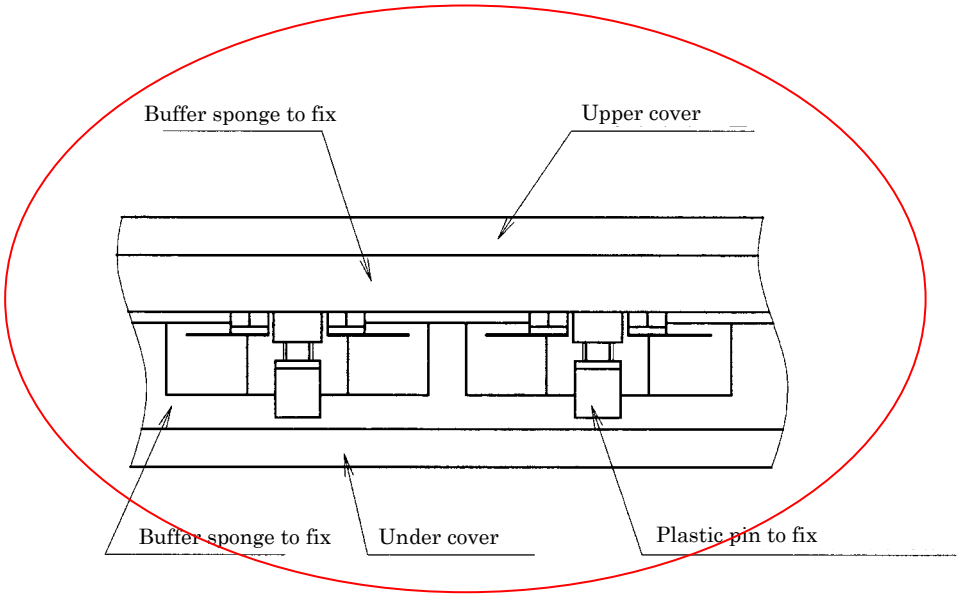
１８. Packing specifications

18.1 Pulse disk (Returnable container)





When transported, this returnable container is housed into cardboard box.
Following buffer material and lid must be used.

・Buffer material : Lightlon® board 25 fold (antistatic material)

・Lid : Cardboard plastic

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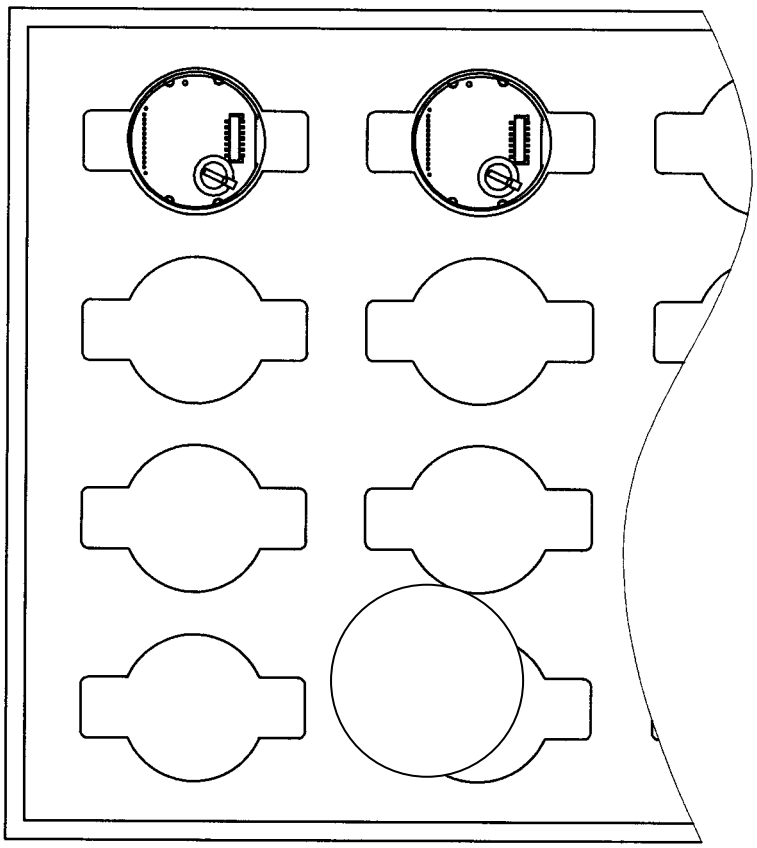
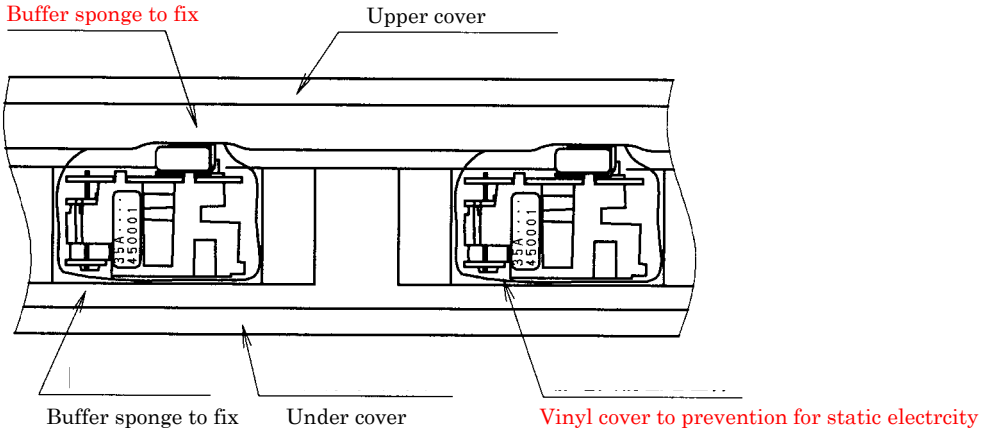
18.2 PWB (returnable container)





When transported, this returnable container is housed into the cardboard box.

18.3 Other parts

Other parts except for the disk and base plate are delivered in bags.

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１９. Precautions

19.1 Usage precautions

In order to prevent product failure and malfunction, important precautions below should always be followed when using this product.

Precautions in keeping・transportation・installation

This product should not be kept or installed in the following environment.

- Area or place exposed to direct sunshine
- Area or place where ambient temperature exceeds over temperatures for keeping and installing condition
- Area or place where relative humidity exceeds over humidity for keeping and installation condition
- Area or place where temperature suddenly changes and thereby dew condensation is generated
- Area or place adjacent to corrosive gas※1 (such as hydrogen sulfide, sulfurous acid, hydrochloric acid, ammonia, etc) and flammable gas
- Area or place with many dusts, salts and metallic powders
- Area or place which is soaked by water, oil and chemical, etc
- Area or place where excessive vibration and/or impact get through the body

※1 Rather than ambient normal environment, volatilization of ingredients like grease, etc applied around the encoder may generate the corrosive gas. Much attention to the corrosive gas is required.

Precautions in mounting

- Pay careful attention to the installing location so that the oil, foreign object, etc never get inside the encoder.
- The pulse disk requires careful handling. Especially, the foreign object should not be adhered to the disk and the disk should not be bended. Furthermore, since the edge of the disk is sharp in form, the disk should be carefully handled so as not to injure the hand and/or palm.
- Antistatic measures in the installation environment are ensured to take so that the overvoltage is not applied to electric parts.
- Careful attention to the installing location has to be paid since the vibration and/or impact against the encoder account for the malfunction.
- Since the noise passed on to the encoder causes the malfunction, mounting environment must be fully checked out when housing the encoder into the case and routing the motor cable for wiring.

※1. As for the encoder housing case, the metallic case capable of electromagnetic shield should be used to maintain the stabilized electric potential. In this case, aerial spacing between the encoder and the electric parts in the base plate should be sufficiently secured. In addition, when the housing case undergoes magnetic field from the motor adjacent to the encoder and/or the magnetic field arising from welding current, as a material of the encoder housing case, the soft magnetic body (like soft iron) should be used.

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※2. The motor power line should not be gotten close to the encoder.

※3. FG line of motor and FG of the machinery are ensured to be grounded.

・Once the encoder is mounted, the encoder must be fully evaluated as a system ahead of usage.

Precautions in wiring

・Wiring should be properly and surely carried out.

・Wiring should be carried out with power turned OFF.

・Specified power voltage should be used for wiring. Decrease in voltage of the power due to the wiring length should be taken into consideration, too.

・Encoder wiring and other power lines should not be guided through the same duct and/or not used, binding them in parallel with each other.

・Twisted pair line should be used for signal line and power supply line of the encoder wiring.

・A cable for encoder wiring should use braided shield wire. Also, the braided shield wire is ensured to be grounded both on the encoder side and opponent side (controller side).

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Operational precautions

- The system should not be run until the system safety design with regard to the encoder failure and/or malfunction is fully reviewed and checked in advance.
- When alarmed, the cause is to be removed and once the safety is secured, the alarm is rest to resume the operation.
- Do not strain the cable.

19.2 General precautions

- This product is designed to be used by being incorporated into a part of the general electronic equipment (like office automation machinery, communication equipment, electronic home appliances, amusement equipment, measuring equipment, general industry-use equipment, etc). It should be noted that this product is not intended for use in application requiring extremely high reliability as well as safety (such as transport equipment, aircraft・space instruments, nuclear energy control system, medical equipment for life saving, etc).
- Nikon is keeping on making utmost effort to improve the product quality and reliability, but generally speaking, the malfunction of the semiconductor chips and/or the occurrence of the product failure cannot be completely prevented. Well before starting use of this product, users are requested to think up the safety measures for the purpose of avoiding the possible troubles, considering possible situations arising from the product malfunction, etc. If the malfunction, failure and/or product life related to this product damage or adversely affect other person's life or property, or the equipment, facility or machine tool incorporating or utilizing this product breaks down, Nikon shall not be liable for any product malfunction, failure and/or life, whether its nature or extent.

  It should be noted that it is your responsibility to prepare the safety design for the entire system on yourself.

20. Design revision record

Revision	What is revised	

年	月	日	△×
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