Panasonic

REFERENCE SPECIFICATIONS

M/S

MODEL

MINAS A4 series (small type)

17bit absolute encoder

MFE0017B0ME

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MOTOR COMPANY

PANASONIC CORPORATION

7-1-1 Morofuku, Daito-City, Osaka 574-0044 Japan

Checked	Checked	Checked	Designed
J. Tomoda	J. Kishi		K. shimoda

REVISIONS

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1. Scope
These specifications shall specify encoder unit of AC servo systems manufactured by Panasonic Corporation.

2. Applicable Models
Applicable motors of these specifications shall be determined by separate discussions.

3. Functions of encoder
3.1 This is a full absolute encoder for outputting the total of 33-bit absolute position data, 17-bit resolution of one revolution and 16-bit calculated multiple revolutions, as serial data at the external request. In case of external request error, no data will be output. This encoder output 17-bit resolution of one revolution as serial data at the external request, when the battery is not connected.

3.2 By connecting battery power supply, it will be possible to hold multiple revolutions data and operate multiple revolutions counter even in accidental Power-OFF state due to power failure or other.

4. Electric Specification

4.1 Definition of terms

Item		Definition
Normal Mode		Mode in which encoder operates with main power supply.
Power-OFF Mode		Mode in which encoder operates with main power supply turned off. (1) holds multiple-revolution data, and (2) operates multiple revolution counter. (When Normal Mode is restored, external data transmission will be enabled.)
	Power-OFF timer	For 5 seconds(MIN.) immediately after main power supply is turned OFF, the MAX. revolution speed and MAX angular acceleration of encoder will function with the value indicated on the Power-OFF timer in "4.4.2 Electric Specifications for multiple revolution signals".
	Power-OFF operation	The MAX. revolution speed and MAX. angular acceleration of encoder will function with the value indicated on the Power-OFF timer in "4.4.2 Electric specifications for multiple revolution signals".

*If no battery is connected, function only of Normal Mode will be enabled.

4.2 Connection table

	Lead wire	Symbol	Remarks
1	Red	BTP	External battery power supply+ (Note 1)
2	Pink	BTN	External battery power supply- (Note 1)
3	Black(thick)	SH/FG	FG wire and shielding wire are connected by the encoder side
4	Sky blue	PS	Serial Data signal
5	Violet	/PS	
7	White	E5V	DC+5V ± 5%, main power supply+
8	Black	E0V	main power supply-

Standard connector

Pin No.

1   3

7   9
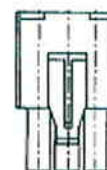
Note1: External battery power supply is required to operate encoder in Power-OFF Mode.
Refer to 5.4 Status Flag Functions for details of error flags in case Power SW is turned ON when external battery power is not connected.

4.3 Absolute maximum ratings

Item	Specification	Unit
Main power supply voltage	5.5	V
External battery power supply voltage	5.25	V

4.4 Common electric specifications

Item			Standard Ta=25 °C			Remarks	Unit
			Min.	Typ.	Max.		
Main Power supply voltage (Note 2)			4.75	5	5.25	---	V
External battery power supply voltage (Note 2)			---	3.6	---	---	V
Operation Mode selecting voltage			4.0	4.2	4.4	Normal Mode ->Power-OFF Mode	V
			4.1	4.3	4.5	Power-OFF Mode -> Normal Mode	V
System Down occurring voltage			2.3	2.5	2.7	Built-in capacitor part	V
			2.5	2.75	3.0	External battery part	V
Battery alarm occurring voltage			3.0	3.1	3.2	External battery voltage	V
Main power consuming current	Normal Mode		---	80	110	No load. (not connected receiving side lead wire of communication)	mA
External battery power consuming current (Note 3)	Normal Mode		---	3.6	---	---	µA
	Power-OFF Mode	Power-OFF timer	---	180	---	---	µA
		Power-OFF operation	---	60	80	---	µA
Power-OFF timer time			5	---	---	---	s
Power-ON stand-by time (Note 4)			---	---	1	With external battery	s
			---	---	1.5	Without external battery	

Note 2: The mode that the main power source is stopped momentarily and time is below figure.

The mode that the main power source is stopped momentarily	The time when the main power source is cut momentarily (Reference value)
1.The case which SW1 is opened	Following table
2.The case which SW2 is closed	0μs Impossible in any cases
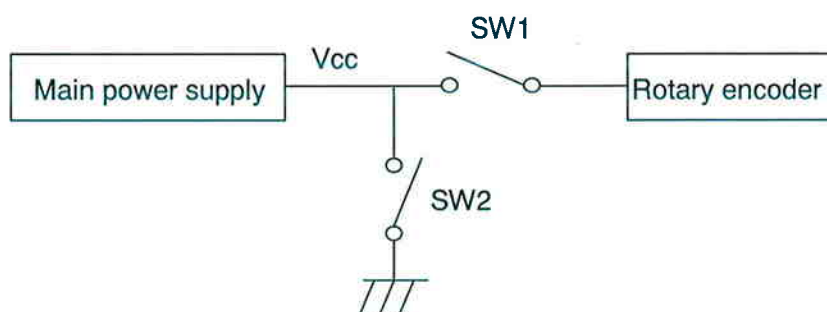
mode	Normal mode (main power supply line)	Power-OFF timer (battery line)	Power-OFF operation(battery line)
permission time when the main power source is cut momentarily : TYP (worst value)	425μs(108μs)	BA:41.8ms(22ms) SYD:71ms(32.9ms)	BA:125ms(60.4ms) SYD:213ms(90.6ms)

Note 3:   The MAX. instantaneous current 400μA when the main Power SW is turned ON (or OFF).

Note 4:   During Power-ON stand-by time, no external request will be accepted. In case Power SW is turned ON when the external battery is connected, encoder line driver is Hi-Z during Power-ON Stand-by time.
In case Power SW is turned ON when the external battery is not connected , encoder line driver output will be undefined ("H","L" or "Hi-Z") during Power-ON Stand-by time.

4.4.1 Electric specifications for one revolution signals

Item		Specification Ta=25 °C	Remarks
Resolution		2^{17}	Accuracy will be 5-bit when Power SW is turned ON at the speed more than 100r/min. (Note 5) (Note 6)
MAX. revolution speed	Normal Mode	6000r/min	----
MAX. angular acceleration	Normal Mode	80000 rad/s^2	----
Output Code		Pure binary	----
Increasing direction		CCW	As viewed from the encoder shaft end.
Accumulative pitch error		±80" (± 8LSB)	----
Adjacent pitch error		±40" (± 4LSB)	----
Maximum accumulative pitch error		±291"	motor shaft tolerance : min. disk mount tolerance : max. maximum value in above condition (calculation value)
		±184"	2 square average value in above condition (calculation value)
Accuracy in repeating of turning ON of main Power supply	Within 3.5 ° revolution after Power SW is turned ON	±80" (± 8LSB)	After the shaft revolves more than 3.5 °, the accuracy becomes ±5LSB because of improvement of accuracy of correction.

Note 5: In case one revolution data 2^{17} cannot be assured, "Full Absolute-Status" will occur as status flag. (Refer to 5.4 Status Flag Functions.)

(1) In case power SW is turned ON during encoder shaft is revolving to a certain direction in higher speed than 100r/min(FS"1"), encoder operates as below.

(ex.) Revolving to CCW direction as viewed from the encoder Shaft.
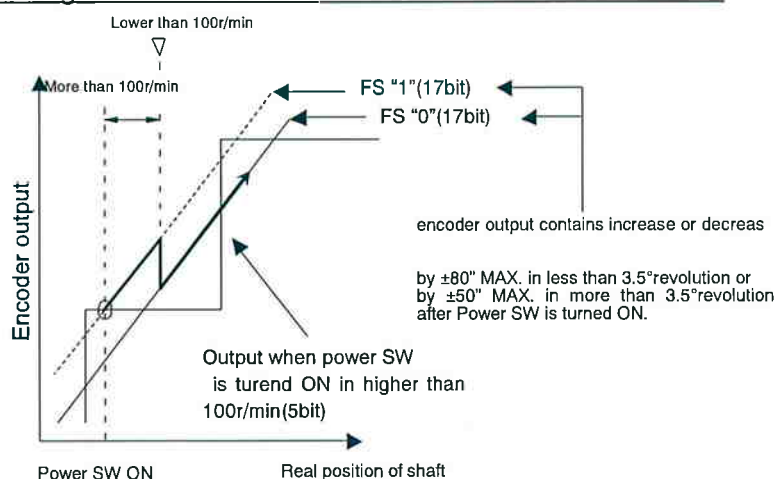
(2) In case Power SW is turned ON during encoder shaft is revolving to a certain direction in lower speed than 100r/min (FS"0"), encoder output increase (or decrease) monotonously.

Note 6: In case revolving direction of encoder shaft is in simple harmonic motion, use encoder in the hatched area shown in the following graph.(Simple harmonic motion at 100r/min as converted to instantaneous MAX. r/min.
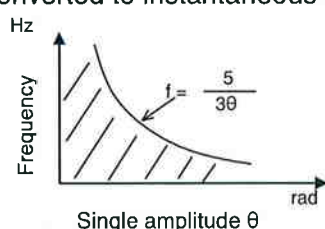
4.4.2 Electric specifications for multiple revolution signals

Item			Specification Ta=25 °C	Remarks
Resolution			1 C/T	---
Multiple revolution count			2^{16}	0 - 65535 (Note 7)
MAX. revolution speed	Normal Mode		6000r/min	---
	Power-OFF Mode	Power-OFF timer	6000r/min	Time on Power-OFF timer is 5 second Calculated value: 7031r/min
		Power-OFF operation	6000r/min	---
MAX. angular acceleration	Normal Mode		80000 rad/s^2	---
	Power-OFF Mode	Power-OFF timer	80000 rad/s^2	---
		Power-OFF operation	4000 rad/s^2	---
Output Code			Pure binary	---
Increasing direction			CCW	As viewed from the encoder shaft end.

Note 7: When System Down occur, reset multiple revolutions data and Counter Overflow operates normally.
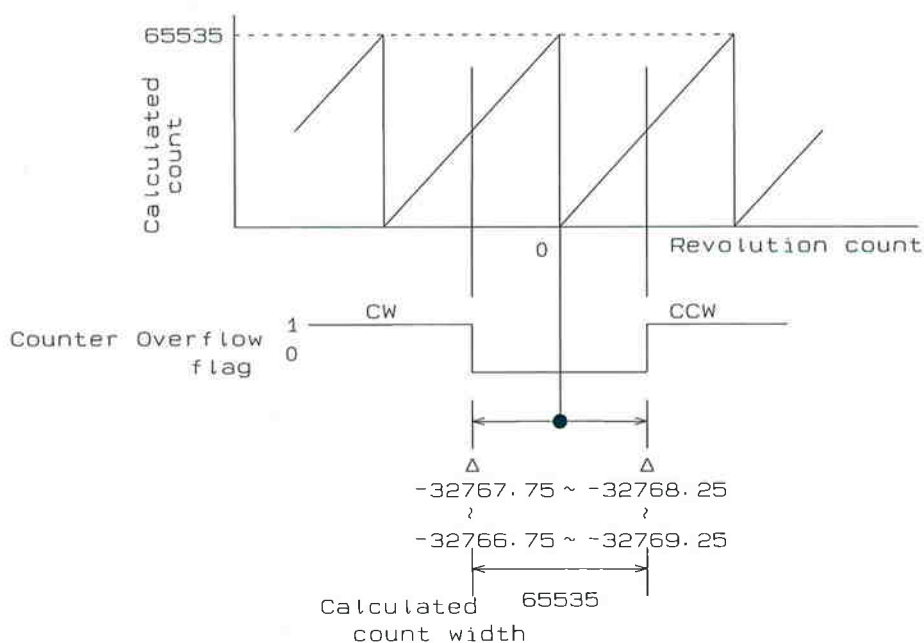
Condition of occurrence of Counter Overflow flag

4.5 Backup unit
  4.5.1 External backup power source (External battery)
      Recommended battery: Lithium battery ER6 (3.6V), Toshiba; Capacity of 2000mAh
        <recommend>
          Electric double layer capacitor is connected with battery in parallel against voltage delay
          of a lithium battery.
  4.5.2 Switching of the backup battery
      Out of the Vcc, external battery, they are changed from one that has higher voltage
      in order.   However, it is necessary that the voltage
      difference is higher than the forward voltage of the switching diode in the switching
      circuit to switch the power supply source perfectly.
  4.5.3 Battery replacement
   This encoder does not have an electrical double layer capacitor.
      When replacing the battery, leave the main power supply for the encoder ON.

<Reference>.
  An example of battery life calculation is shown below.
   *The voltage delay phenomenon of a battery is not taken into consideration.
   Temperature of battery circumference is normal temperature.

The operation state of equipment	
Mon.- Sat. 313days/365days	Sunday 52days/365days
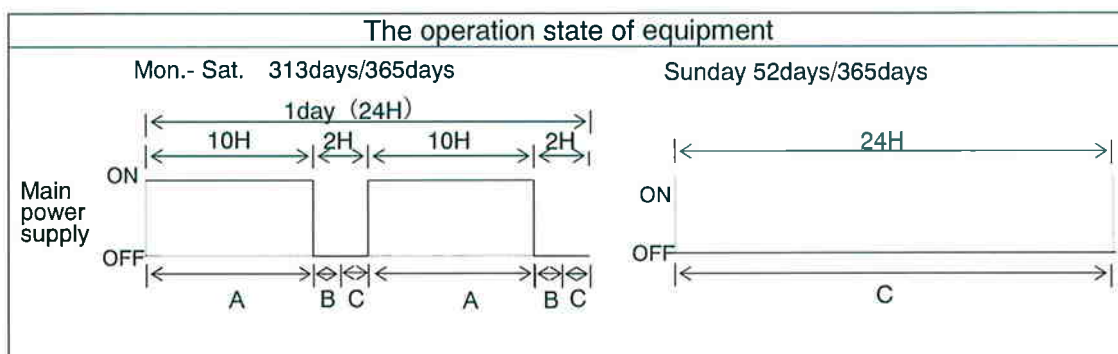
Capacitor of nominal valueof battery (Litium battery)is 2000mAH.
However, it has calculated by 1800mAH this time.

     A:battery consumption at nomal mode(3.6μA),
     B:battery consumption at Power OFF timer mode(180μA)
     C:battery consumption at Power-OFF operation mode(60μA)

Consumption capacity per year = (10H×A＋0.0014×B＋2H×C) ×2×313day+24H×C×52day=172.7mAH
Battery life = 1800mAH/172.7mAH=10.4 years

The above is a calculation value to the last, and is not a guarantee value.
A life becomes short according to the environmental conditions of the circumference of a battery.
moreover, since a voltage delay phenomenon (a temporary voltage drop:generate notably
in high temperature storage and low temperature use) peculiar to a Lithium battery occurs,
it is cautious of the environmental conditions of the circumference of a battery.

5. Serial Communication

5.1 Outline

Item	Specification	Remarks
Communication Code	Binary code	---
Sending method	Differential line driver	Subject to RS485
Receiving method	Differential line receiver	Subject to RS485
Transmission data	One revolution data	17-bit
	Multiple revolution data	16-bit (0 - 65535)
	Status flag	(1) Over Speed (2) Full Absolute-Status (3) Count Error (4) Counter Overflow (5) Multiple Revolution Error (6) Battery Alarm (7) System Down
Synchronizing method	Base band NRZ	---
Transmission rate	2.5 Mbps	tolerance level of change : ± 100ns
Frame format	Details are shown in Sections after 5.2	---

5.2 Frame format
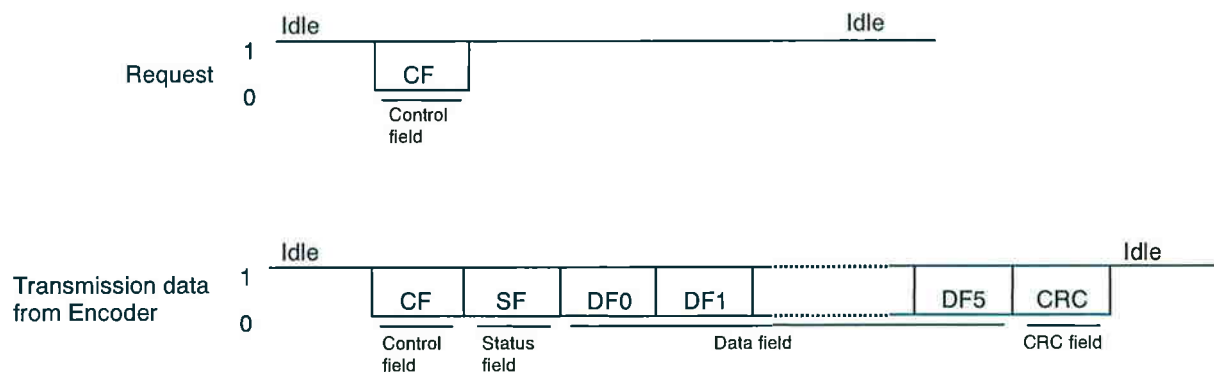
5.2.1 encoder data acquiring

Fig.5-1 Frame Format for acquiring encoder data

5.3 Details of fields
5.3.1 Control field (CF)
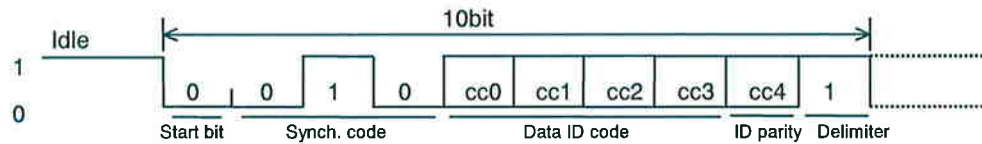Structure of the control field is as shown in Fig.5-2.

Fig.5-2 Structure of Control Field

1. Start bit   : Fixed
2. Synch. Code : Fixed
3. Data ID Code : By specifying data ID Code shown in Table 5-1, data shown in Table 5-2 will be output from encoder.
    To specify Data ID Code, follow the application in Table 5-1.
    (For example, do not use data ID Code for Resetting for acquiring data.)
4. ID Parity   : Parity of data ID code.
5. Delimiter   : Fixed

Table 5-1 List of Data ID Codes

Purpose	Data ID	Contents of Code				Parity
		cc0	cc1	cc2	cc3	cc4
Data acquiring	Data ID 4	0	0	1	0	1
	Data ID 5	1	0	1	0	0
	Data ID A	0	1	0	1	0
Resetting	Data ID 9	1	0	0	1	0
	Data ID B	1	1	0	1	1
	Data ID E	0	1	1	1	1
	Data ID F	1	1	1	1	0

5.3.2 Status field (SF)
Structure of status field is as shown in Fig.5-3
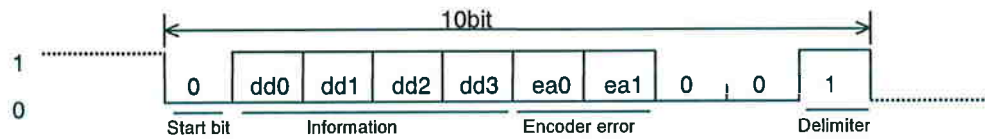
Fig.5-3 Structure of Status Field

1. Start bit   : Fixed
2. Information   : All fixed to "0".
3. encoder error : At occurrence of an error, the logic "1" will be output respectively.

Bit	ea0	ea1
Logic at error occurrence	1	1
Contents	System Down	Multiple Revolution Error, Battery Alarm, Full Absolute-Status, Count Error, Counter Overflow, Over Speed will be output by OR logic.

4. Delimiter   : Fixed

5.3.3 Data field   (DF0- DF5)
Relations between data ID Code and data field are as shown in Table 5-2.

Table 5-2 List of Data Fields

Data ID code	DF 0	DF 1	DF 2	DF 3	DF 4	DF 5
Data ID 4	ABS 0	ABS 1	ABS 2	ALMC		
Data ID 5	ABS 0	ABS 1	ABS 2	ABM 0	ABM 1	ABM 2
Data ID A	ABS 0	ABS 1	ABS 2	ENID 1	ENID 2	ALMC
Data ID 9	ABS 0	ABS 1	ABS 2	ALMC		
Data ID B	ABS 0	ABS 1	ABS 2	ALMC		
Data ID E	ABS 0	ABS 1	ABS 2	ALMC		
Data ID F	ABS 0	ABS 1	ABS 2	ALMC		

Blanks indicate that there are no send data.

ABS 0 - ABS 2: Absolute data for less than one revolution.
Among the total 24-bit frames, ABS0 is set as lower byte and ABS2 as upper byte.
The upper 7 bits of ABS2 are always 17-bit data of the logic "0".

ABM 0 - ABM2: Multiple revolution data.
Among the total 24-bit frames, ABM0 is set as lower byte and ABM2 as upper byte.
ABM2 are always 16-bit data with the logic "0".

ENID 1   : encoder ID (= Fixed to 11H.)
ENID 2   : Product maker use (8-bit).
ALMC   : encoder error (Refer to Table 5-3)

Table 5-3 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 at error occurrence	1	1	1	1	---	1	1	1
Name	Over Speed OS	Full Absolute-Status FS	Count Error CE	Counter Overflow OF	"0"	Multiple Revolution Error ME	System Down SYD	Battery Alarm BA

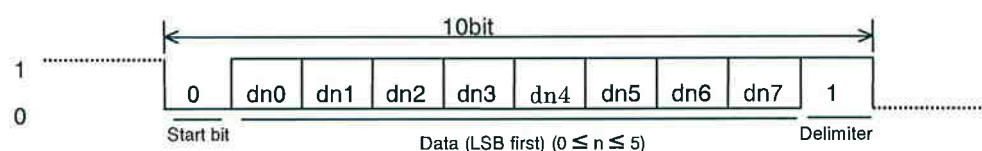Structure of each data field is as shown in Fig.5-4.

Fig.5-4 Structure of Data Field

1. Start bit   : Fixed
2. Data   : Made up from LSB first
3. Delimiter   : Fixed

5.3.4 CRC field (CRC)
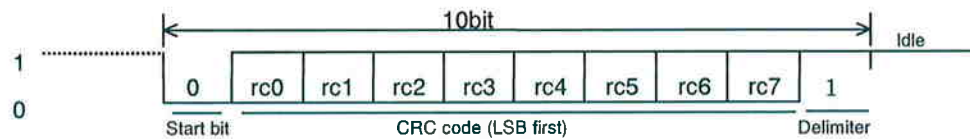Structure of CRC field is as shown in Fig.5-5.

Fig.5-5 Structure of CRC Field

1. Start bit   : Fixed
2. CRC Code   : Subject to the generating equation: $G(X) = X^8 + 1$ ($X = rc0 - rc7$)
                  Data is made up from LSB first.
                  All the bits excluding Start bit and delimiter in all the fields except
                  for CRC will be calculated.
3. Delimiter   : Fixed

< example of CRC calculation >
In case encoder data (CF - DF3) is as shown in Table C, CRC data becomes as shown as below.

Table 5-4

Field	CF	SF	DF0	DF1	DF2	DF3	CRC
Transmission data from encoder (LSB first)	01001100	00001000	10000000	00010100	00001101	00010000	11001101

5.4 Status flag functions

Name	Function		Battery (Note 8)		Measure to be taken
			Connected	Unconnected	
Over Speed OS (Latch)	In case encoder shaft revolves at speed exceeding the value specified for Power-OFF Mode when encoder is driven with battery power supply after the main Power SW is turned OFF, the logic "1" will be generated. External transmission will be enabled when the main Power is turned ON. However, there are cases in which this detection is failed. Use this error as reference. (Note 9)		←	Undefined	Reset error. (Refer to 7)
Full Absolute-Status FS (Non-latch)	In case the main Power SW is turned ON while encoder shaft is revolving at more than 100r/min, the logic "1" will be output. Accuracy of one revolution data while the logic "1" is output will be 5-bit. When one revolution data is switched to 17-bit resolution, the error will be automatically reset.		←	←	Set encoder shaft revolution speed less than 100r/min and wait until the error is automatically reset.
Count Error CE	In case one revolution data is shifted due to operation error or failure when the main Power SW is ON, the logic "1" will be output by the following I, II OR.				Immediate stop of servo system.
	I (Non-latch)	In case encoder shaft is revolving at more than 100r/min, error detection will be conducted at every 45° mechanical angle. When shift of one revolution data is reduced to the mechanical angle $\pm 22.5°$ (TYP.), the error will be automatically reset.	←	←	Error will be automatically reset. Power SW OFF/ON
	II (Latch)	In case encoder shaft is revolving at less than 100r/min, error detection will be conducted all the time. When shift of one revolution exceeds the mechanical angle $\pm 0.7°$ (TYP.), the logic "1" will be output.	←	←	Reset error. (Refer to 7) Power SW OFF/ON
Multiple Revolution Error ME (Latch)	In case the abnormalities in multiple revolution data occurs when the main Power SW is turned ON, the logic "1" will be output. (This does not operate when the main Power SW is turned OFF.) Bit jumping check will be executed every 12.8μs.		←	←	Origin return. Reset error. (Refer to 7)

(to be continued)

Name	Function	Battery (Note8)		Measure to be taken
		Connected	Unconnected	
Counter Overflow OF (Latch)	In case the multiple revolution counter overflows, the logic "1" will be output. (However, in case this error is detected when the main Power SW is turned OFF, external output will be enabled when the main Power SW is turned ON.) Once this error is detected, the error will be sustained until it is reset but the multiple revolution counter will continuously operate as cyclic counter for 0 - 65535.	←	Undefined	Reset error. (Refer to 7)
Battery Alarm BA (Latch)	In case external battery power supply voltage becomes less than 3.1 ± 0.1V (Refer to 4.4 Common Electric Specifications.) irrespective of power supply ON/OFF, the logic "1" will be generated and external transmission will be enabled when the main Power SW is turned ON. Once this error is detected, the error will be sustained until it is reset.	←	←	Reset error. (Refer to 7) Check or replacement of external battery power supply is required.
System Down SYD (Latch)	In case voltage of encoder built-in capacitor becomes less than 2.5 ± 0.2V (Refer to 4.4 Common Electric Specifications.) when the main Power SW is turned OFF, the logic "1" will be generated and external transmission will be enabled when the main Power SW is turned ON. When this error occurs, it is possible that multiple revolution data error is also occurring.	←	←	Reset error and reset multiple revolution data. (Refer to 7) Check or replacement of external battery power supply is required.

Note 8: Even if external battery is connected, in case external battery power supply voltage becomes less than 2.5 - 3.5V (TYP.) and System Down (SYD) occurs, error flags operate in the same case as in case external battery is unconnected.

Note 9:   Over Speed Error occurring condition
In case the input shaft revolves exceeding the responding revolution speed, "1" will be output. In case the input shaft revolves exceeding the follow-up speed of the internal circuit of encoder during Power-OFF operation, the output will be as shown in the following Table 5-5.

Table 5-5 Relations between revolution speed and Over Speed Error

encoder revolution speed	Over Speed Error
0 - 6000r/min	"0"
6000 - 14000r/min: Calculated value	"0": Detection of multiple revolution data is normal. "1": Detection of multiple revolution data is wrong.
14000r/min or more: Calculated value	Undefined

In case revolution speed is 0 - 14000r/min (calculated value) if Over Speed Error logic is "0", detection of multiple revolution data is normal and multiple revolution data is normal. If the logic is "1", it is possible that multiple revolution data is shifted and resetting operation will be required.   Therefore, the use in the range of 0 - 6000r/min is recommended.

During Power-OFF operation, even if revolution speed is lower than responding revolution speed, the output will be as shown in the following Table 5-6 if the angular acceleration exceeds 4000rad/s^2.

Table 5-6 Relations responding revolution speed and Over Speed Error

Angular acceleration	Over Speed Error
0 - 4000 rad/s^2	"0"
4000 - 28000 rad/s^2 : Calculated value	"0": Detection of multiple revolution data is normal. "1": Detection of multiple revolution data is wrong.
28000 rad/s^2 or more: Calculated value	Undefined

In case angular acceleration is 0 - 28000 rad/s^2 (calculated value) if Over Speed Error logic is "0", detection of multiple revolution data is normal and multiple revolution data is normal. If the logic is "1", it is possible that multiple revolution data is shifted and resetting operation will be required.   Therefore, the use in the range of 0~4000 rad/s^2 is recommended.

6. Detection of Data Acquiring Frame

6.1 Detection of frame start

In Control Field (CF), regarding the first logic "0" after Idle as frame start, if the subsequent 3 bits match with Synch. Code, it is "Frame start".   In case the 3 bits do not match with Synch. Code, frame detection will be executed again.

In 3μs (TYP) after receiving delimiter signal of Request Frame, encoder will start data frame transmission.
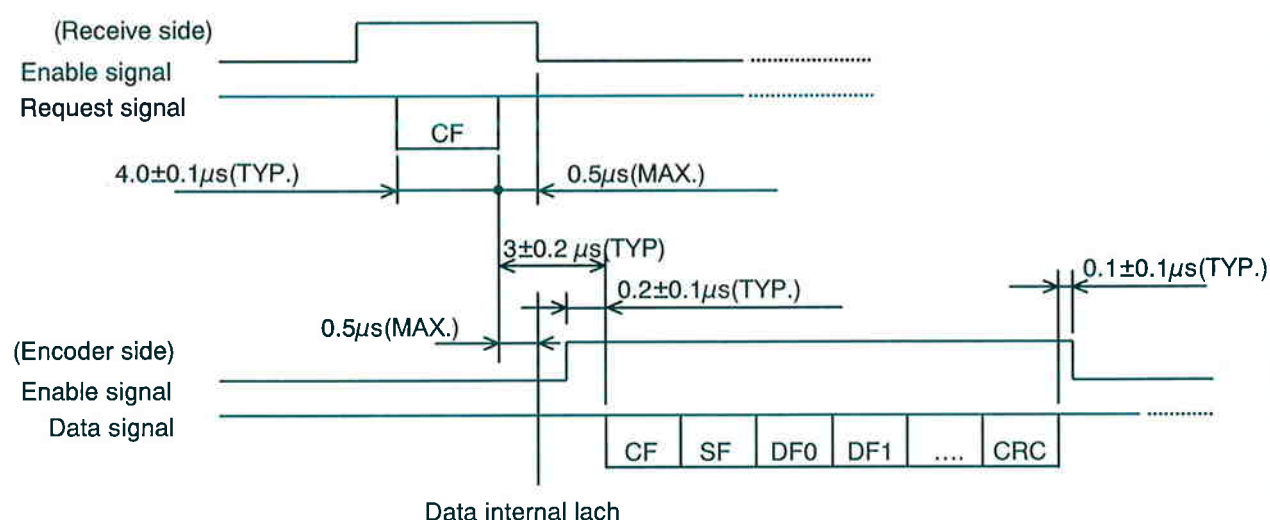
Fig.6-1 Frame detection

6.2 Frame end

After detecting frame start, if there is no start bit after delimiter, it will be regarded as frame end. Therefore, there is no particular field indicating frame end.

6.3 Idle

Space between frames is idle. Output logic on sender side is fixed to "1".

6.4 Request invalidating condition

In case of condition shown in Table 6-1, requests will be invalid.   In this event, no data transmission from encoder will be made.

Table 6-1 Request invalidating condition

No.	Condition
1	Synch Code logic is abnormal
2	Data ID Code is anything other than 4, 5, 9, A, B, E or F
3	Parity logic is abnormal
4	Delimiter logic is abnormal

7. Notes for Request Transmission

Function	Data ID	Description
Data acquiring	4, 5, A	Send Data ID Code (Table 5-1) to encoder according to Data Fields List (Table 5-2). As encoder is provided with RS485 receiver IC, send code using the driver IC complying with RS485.
One revolution data resetting	F	When the shaft stops, send data ID to encoder 10 consecutive times at the intervals of more than 40μs. * One revolution data will be reset at the mechanical angle 0° ±0.35° degrees (MAX).　Once reset shaft position will be sustained regardless of connection of external battery after the main Power SW is turned OFF.
Multiple revolution data and all errors resetting	B	Send data ID to encoder 10 consecutive times at the intervals of more than 40μs. * Multiple revolution data will be reset.　(One revolution data will not be reset.)　All the latch errors (Over Speed, Counter Overflow, Multiple Revolution Error, Count Error II, Battery Alarm and System Down) will be simultaneously reset.
All errors resetting	E	Send data ID to encoder 10 consecutive times at the intervals of more than 40μs. * All the latch errors (Over Speed, Counter Overflow, Multiple Revolution Error, Count Error II, Battery Alarm and System Down) will be reset.
Error resetting	9	Send data ID to encoder 10 consecutive times at the intervals of more than 40μs. * Counter Overflow and Battery Alarm will be reset.

*Every time encoder receives a request, it will send back data in Table 5-2.
(Error information in response data will not be reset until Reset is executed.)
One revolution data reset takes 18ms (MAX) until reset is performed after 10 times reception
in the request data ID F in order to perform processing which writes data in E^{2}PROM.

Note10 : One revolution data resetting command is used for adjustment of motor induction voltage and
encoder revolution data in a factory. In completion motor, if this command is carried out,
the above-mentioned adjustment will be canceled. So a motor will perform unusual operation.
Therefore, please do not carry out this command in completion motor.

8. Example of Sending/Receiving Circuit Configuration
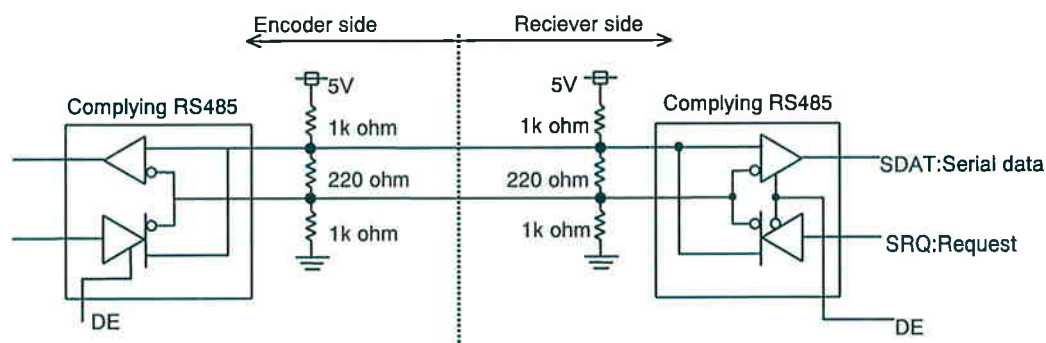
While encoder is sending data, do not send and request signal to encoder.   If a request signal is sent by mistake, encoder I/O may break down. Encoder is normally set to receive Mode.

9. Environment condition(reference)

9.1 Temperature

Temperature range of operation :-10°C ~ +85°C
(Circumference temperature, However, LED surface temperature is made into 85°C or less.
Temperature range of storage :-20°C ~ +90°C

9.2 Humidity

It is 85%RH or less at the temperature range of operation.

*Refer to the motor specifications about the environmental conditions of motor.
The use beyond the temperature range of operation affects lives, such as LED of an encoder.
Moreover, since there is a possibility of causing malfunction, please use it by temperature within the limits of operation.

< Reference>
Encoder life
An electric life (LED life): 30000 hours
Even if lighting power of LED becomes half, this encoder is designed so that specification may be satisfied.Therefore, time to halve lighting power of LED is electric life at the time of usual operation(FULL lighting) by power supply voltage 5V.

10. Guarantee term

Refer to the motor specifications about the term of a guarantee and the guarantee range.

11. Notes

(1) If there are any items to be specified in particular besides those mentioned in these Specifications, please contact this company.

(2) Within the range satisfying these Specifications, parts and partial changes may be changed for improvement of performance.

(3) Please check conformity of the finished product to standards and laws on your own.

(4) In case of trouble occurrence, trouble shall be resolved and measures shall be taken after discussions are held between both parties according to these Specifications.

(5) Every possible measure is taken to secure quality of the product.
However, it is possible that your finished product may perform abnormal operation due to failure of our product (disconnection of signal line, absence of signal phase, etc.) or operation outside the setting range caused by unexpected high external noise or static application.
You are to give considerations to secure safety in the operable range in the operating place as well as fail-safe designing.

(6) This product is not provided with any safety devices. Give appropriate protection using overcurrent protector, leakage breaker, overheat protector and emergency stop device.

(7) Noise-proof performance may be affected according to a wiring situation (grounding method, cable length, shield situation of a signal line etc.). Therefore, please check noise-proof perfomance also in your company completion equipment.

(8) Should not transmit a request signal to an encoder during data transmission. If a request signal is transmitted accidentally, there is a possibility of destroying encoder I/O.

(9) Since the built-in capacitor for backup is not carried in this encoder.
Therefore, at the time of battery exchange, in the state where main power supply of an encoder is turned ON, please carry out battery exchange.

(10) Be sure not use the product in a place where the product may come in contact with foreign matter such as liquid like grinding oil, oil mist, and file dust, nor in an atmosphere of corrosive gas (such as H_2S, SO_2, NO_2, Cl_2) or flammable gases, nor in a place near inflammable material.

(11) We have been putting maximum effort to ensure the quality of this product. But since the possibility of the occurrence of the product's abnormal behavior not in accordance with the setting still exists due to the unexpectedly strong exogenous noise (including radiation and the like), the application of static electricity, or the rare event such as abnormality in the input power source, the wiring, and the parts, we ask our customers to take measures against the occurrence of unexpected behavior to fully ensure the safety.

12. Notes for using motor

(1) When using a motor, check specifications of the motor.

(2) When wiring motor lead wires and encoder lead wires, be careful not to mis-connect them.

(3) This product was designed to be used with general industrial products or the like. It is not designed to be used with a machine dealing with human life or as an equipment to be used in unusual circumstances such as nuclear power management, use with aerospace instruments, use in transportation, use with medical equipments, use with various types of safety devices, or use with a equipment for which high level of cleanliness is required.