Smart Abs Specification

SA35-11/24bit-LPS-5V

TS5643N100

FOR REFERENCE ONLY

REVISIONS

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

ED'N No.

DS'D	DATE	MODEL No.	TITLE
S. Shigawa	'96.10.17	TS5643N100	Smart Abs Specification
CH'D K. Tamura			
APP'D			

DWG NO.												SHEET
3	4	5	6	7	8	9	10	11	12			
0	5	6	4	3	0	0	1	1	S	4	E	1/15

1. SCOPE

The smart Abs is a low cost versatile multi-turn absolute encoder. The encoder generates incremental and absolute output signals. The absolute signal is converted from parallel format to serial format by an internal LSI resulting in a serial signal (manchester code) output.

2. TYPE

FUNCTION NAME : SA35 - 11/24bit - LPS - 5V.
MODEL : TS5643N100

3. FUNCTIONS

3.1 Multi-Turn Function

The SA35 has multi-turn function by having an internal LSI counter.
The data is stored and the counter operates by an internal capacitor or an external battery, even when power supply is off.

3.2 Operation Mode

A) Normal operating mode:

The encoder is ready to transmit data in 0.8 second max. after power supply is on, and the encoder responds up to $84s^{-1}$ (5000RPM) max.

B) Timer operating mode at power failure:

For 10 seconds max. after power supply suspends, the encoder still responds up to $100s^{-1}$ (6000RPM) max. and 8000 rad/s^2 max. of angular acceleration if the external battery is supported.
The data is not transmitted under this operatin mode.

C) Power failure operatin mode:

The encoder responds up to $100s^{-1}$ (6000RPM) max. and 4000 rad/s^2 max. of angular acceleration if the external battery is supported.
Under this operating mode, the data is not transmitted.

D) In case the encoder operates over rotating speed and angular acceleration specified above, the encoder malfunctions.

3.3 Pre-load Operation

Pre-load operation is to set the encoder to initiation by rotating the encoder shaft in CW or CCW direction approximalily 2 degree(mechanical) after the encoder is powered.

This operation sets absolute data to 11 bit from 5 bit which is the maximum absolute data per turn before the pre-load oparation completes.

3.4 Operation at decrease of power

A) When the supply power drops to 4.2V(typical), the external battery supplies power to the encoder and the encoder operates under the power failure mode. The data is not transmitted under this operation.

B) When the supply power is resumed to 4.3V(typical), the encoder automatically operates under the normal operating mode.

C) The pre-load operation is needed even when the power is instantaneously suspended.

3.5 Status Flag

Data"1" or "0" described below denotes the manchester Data code.

A) Battery Error (BE)

When the voltage of the internal capacitor drops to 2.5V(typical), BE signal "1" is generated.

When the power is on under this status, the following data is indefinite:

1) Multi-turn data
2) Over-speed error
3) Over-flow error

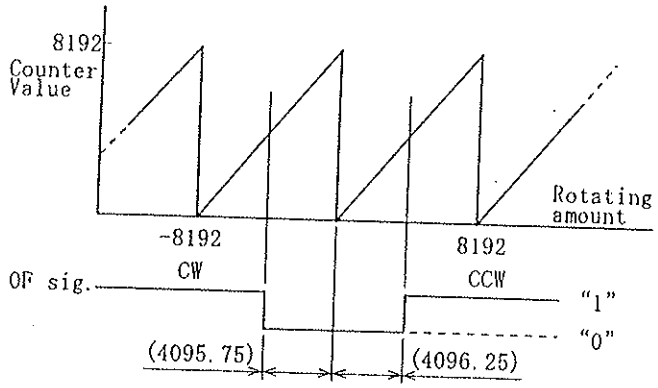
B) Over-Flow(OF)

When the multi-turn counter overflows, OF signal "1" is generated.

Once the over-flow is detected, the signal is held until the reset operation is made.

Below is illustrated the position of detection.

The multi-turn counter still functions a cyclic counter even after OF signal "1" is generated.



C) Over-Speed Error(OS)

OS signal "1" is generated when the encoder shaft rotates over the operating speed.

OS signal is also generated even below the operating speed, depending on the angular acceleration under the power failure operating mode.

Angular acceleration at power failure	OS signal
0 to 4000 rad/s^2	"0"
4000 to 28,000 rad/s^2	"1"
over 28,000 rad/s^2	indefinite

D) Battery Alarm(BA)

The BA signal "1" is generated when the external battery drops to 3.25V (typical).

When the battery voltage resumes to the normal, the signal "0" is generated.

E) Pre-load Status (PS)

The PS signal "1" is held until the pre-load operation completes.

When the pre-load operation completes, the encoder is set to generate 11 bit per turn and then the pre-load status code is "0".

F) Counter Error Status (CE)

When the signal turn absolute data is beyond detecting capability, the CE signal "1" is generated.

Rotating Speed	Detecting Capability	Detecting Frequency
Up to 6000 RPM	±360 /1024(±0.352°)	per 2°
Over 6000 RPM	±360/16 (±22.5°)	per 45°

(Degree denotes the mechanical degree)

G) Battery Error and Over-Speed OR gated signal (BE + OS)

3.6 RESET FUNCTION

A) The following error is reset when a reset signal is supplied for more than four(4) seconds to the power supply under the normal operating mode:

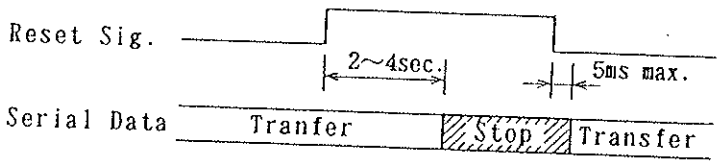
(1) Battery Error

(2) Over-Flow

(3) Over-Speed Error

(4) Multi-turn Counter data

B) The reset signal and serial data timing is illustrated below:



When the reset is activated, data transfer stops.
The data transfer restarts from the first frame.

C) The single turn absolute data is not affected by the reset operation.

D) The reset operation is effective only when the supply power is on.
No reset operation should be made at the power failure.

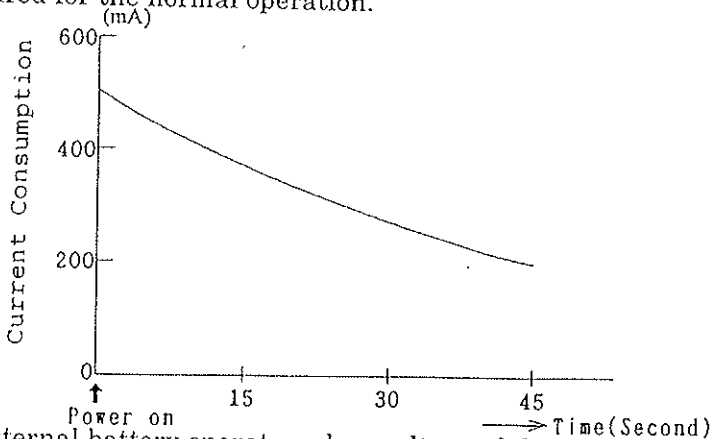
4. ELECTRICAL CHARACTERISTICS

4.1 ELECTRICAL SPECIFICATIONS

Characteristics	Condition		Rating Ta=25℃			Unit
			MIN.	TYP.	MAX.	
Power Supply Voltage (Vcc)	Ripple: 5% max.		4.75	5.0	5.25	V
Power supply Current	Normal operation				150	mA
	Operation of external battery				*2,3 300	mA
	Discharge of internal capacitor				*1 500	mA
Power supply operation *4 & Battery supply operation	Power supply to battery supply		4.0	4.2	4.4	V
	Battery supply to power supply		4.1	4.3	4.5	V
Reset time	5 seconds min.		2.0		4.0	Sec.
Battery Alarm Voltage	Alarm: On		3.1	3.25	3.4	V
	Alarm: Off		3.2	3.4	3.6	V
Battery Error Voltage	Capacitor voltage		2.3	2.5	2.7	V
	Battery voltage		2.5	2.75	3.0	V
Battery current *3 Consumption	Normal operation(5V)			3.6		μA
	Power failure timer operation			15		mA
	Power failure operation or no ration of shaft			90	100	μA
Time to start data transmission after power is on.	Vcc=4.75V Power supply impedance=0 Ω	Internal capacitor fully charged			0.1	sec.
		Internal capacitor free discharged			0.8	sec.
Time to hold data in capacitor	Charge for 3 hr. min. at Vcc=5V				*5 1	hr.

Operating speed	Normal opration			84 (5000)	S^{-1} (RPM)
	Power failure timer operation	*6		100 (6000)	
	Power failure operation				
Operating speed at pre-load	Time to generate "0" code after encoder is powered			10 (600	S^{-1} (RPM)
Amount of rotation during pre-load	Till pre-load operation completes after encoder is powered(in one direction)	12			LSB
Time of power failure timer operation	Time that angular acceleration is below 4000 rod/s² after power is shut off	10			sec.

*1: The values indicate the maximum current right after power is on.
As time goes, the current consumption decreases.
When the capacitor is fully charged, the current consumption is the values required for the normal operation.

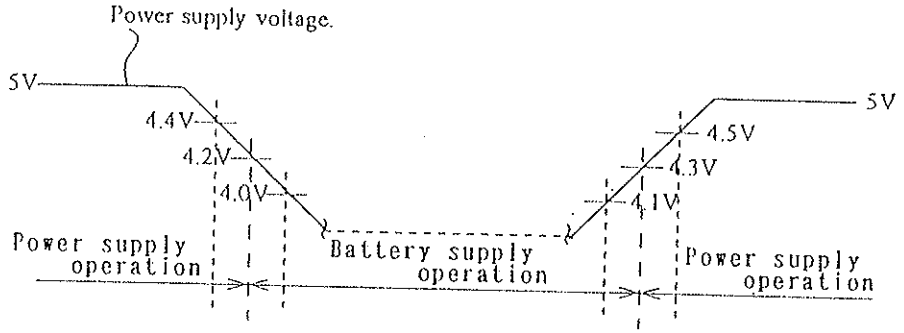


*2: The external battery operates when voltage of the internal capacitor gets to the same voltage of the battery.
(about 30 minutes after power suspends)

*3: Be aware that the great amount of the current (120mA max. impedance: 0) is supplied to the encoder if the battery is connected to the encoder when the capacitor is fully discharged.

Slew Speed	Battery Comsumption (Typ.)
$0 \sim 7.5S^{-1}$ (0~450rpm)	90μA
$7.5 \sim 15S^{-1}$ (450~900rpm)	120μA
$15 \sim 100S^{-1}$ (900~ 6000rpm)	210μA

*4:



*5: The values indicate at the time of shipment.
Capacity is decreased to 15 minutes max. in 10 years.
The life of the internal capacitor varies depending on temperature of operation and storage.

*6: If the operating speed exceeds $100s^{-1}$(6000 RPM) or the angular acceleration exceeds 4000 rad/s² under the power failure operation, the encoder may malfunction, resulting in error status flag.
For 10 seconds min. after power suspends, the encoder responds up to $100s^{-1}$ (6000 RPM) and 8000 rad/s² .

4.2 Output Signals:

1) Incremental Signal:

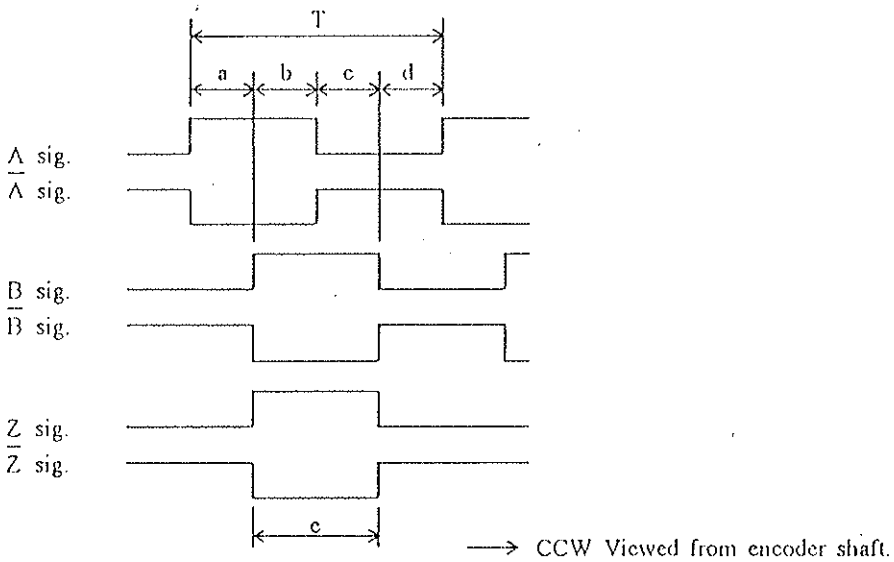
Resolution : 2048C/T per turn

Output Signal : Two channel outputs (A andB) in phase quadrature with index signal.

Output Driver : AM26C31 (RS-422A)

source/sink current : 20mA max.

Output Format : see below



Symmetry : 180° ± 36° Electrical

Quadrature : 90 ° ±45 ° Electrical

Index : 1/2± 1/10 cycle

The tolerance specified above is under the following conditions:

Operating Temperature : -10℃ to + 85℃

Operating Speed : 0 to $84s^{-1}$ (5000 RPM)

Supply Power : 4.75 to 5.25V

2) Absolute Signal:

Output Code : Pure Binary

Total count : 2^{24}

Single Turn : 2^{11}

No. of Turn : 2^{13}

Count : Increasing count for CCW rotation as viewed from mounting surface.

3) Status Flag:

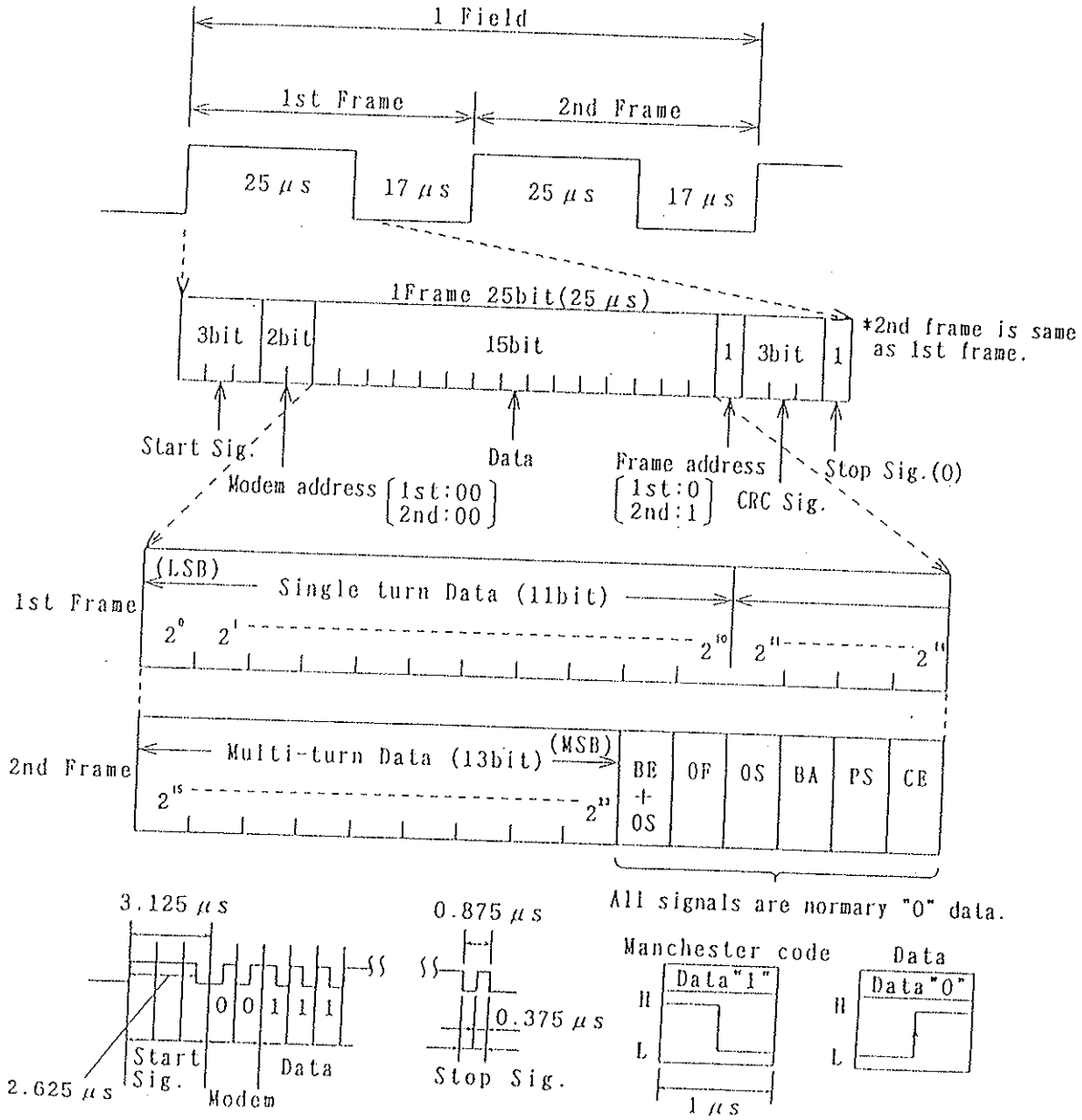
STAT 0 : Battery Error & Over-Speed (BE + OS)
STAT 1 : Counter Over-Flow (OF)
STAT 2 : Over-Speed (OS)
STAT 3 : Battery Alarm (BA)
STAT 4 : Pre-Load Status (PS)
STAT 5 : Count Error Status (CE)

Absolute signals and status flags are serial signals.

4.3 Serial Data Transmission

Output Driver : AM26C31 (RS-422A)
Data Code : Manchester Code
Data Transmission Rate : 1 M bps
Date Transmission cycle : 84 μ s
Data Transmission Distance : 50 meters max..
Transmission Data : (1) 2^{13} multi-turn
(2) 2^{11} single-turn
(3) Status Flag

Serial Frame Format



A) The one frame starts with the start signal comprising "H" with 2.625 μ s width and "L" with 0.5 μ s width.

Then, the modem address, transmission data, frame address and CRC signals are transmitted.

The one frame stops with the stop signal comprising "L" (0.5 μ s wide) and "H" (0.375 μ s wide).

Then, "L" signal (17 μ s wide) is generated until the next frame starts.

B) Modem address:

Code: 0 for 1st and 2nd frame

C) Data:

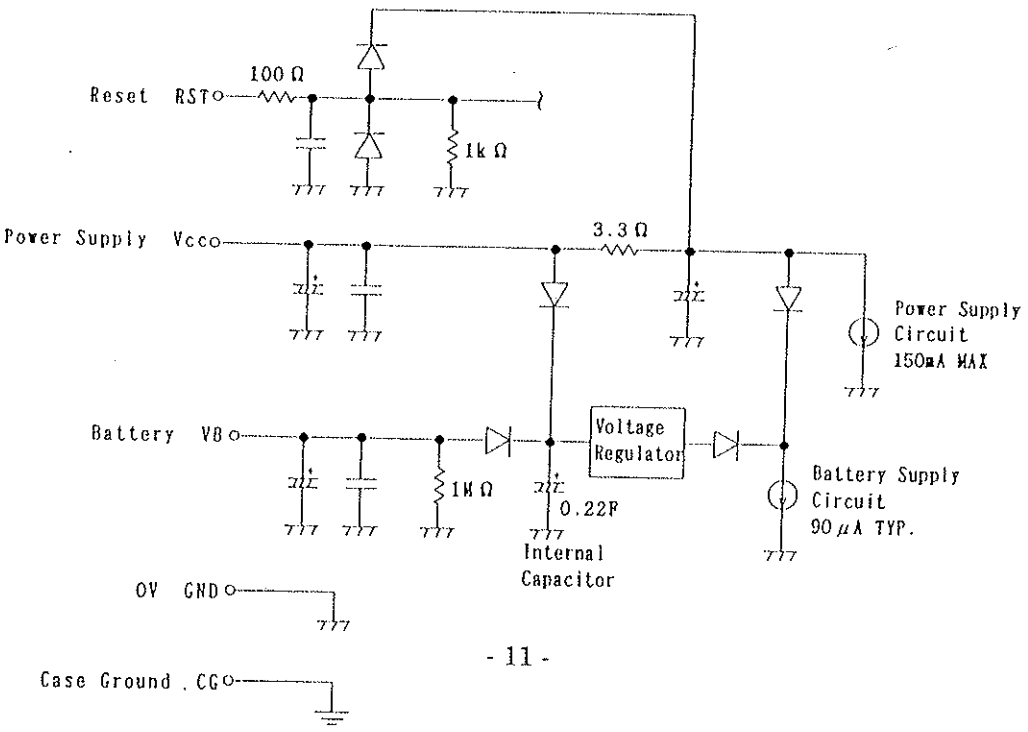
The single-turn data (11 bit) and the multi-turn data (4 bit) are transmitted at the first frame, and then the balance of the multi-turn data (9 bit) and the status flag (6 bit) are transmitted at the second frame.

D) Frame address:

1st frame : 0

2nd frame : 1

4.4 POWER & BATTERY SUPPLY CIRCUIT



5. MECHANICAL SPECIFICATION:

Characteristics	Condition	Value			
		MIN.	TYP.	MAX.	
Starting Torque	at 20℃			5.9 (60)	$x10^{-3}$N.m (g.cm)
Moment of Inertia	-		$1x10^{-6}$ (10)		$Kg.m^2$ ($g.cm^2$)
Mounting tolerances	Radial			0.05	mm
	Axial			0.2	mm
	Perpendicularity			0.1	deg.
Slew speed	-			100 (6000)	S^{-1} (rpm)
Acceleration	-			$8x10^4$	rad/s^2
Mass	Without cable			0.3	Kg
Protection	-	IP=40			-

6. ENVIRONMENTAL SPECIFICATION:

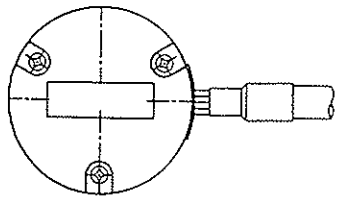
Parameter	Condition	Value
Operating temperature	-	-10℃ to +85℃
Storage temperature	-	-20℃ to +90℃
Humidity	at 40℃, 96Hr Non-condensing	90% RH MAX.
Vibration	5～2000Hz 3 direction, 2hr each.	10G
Shock	11ms 6 direction for 3 times	200G

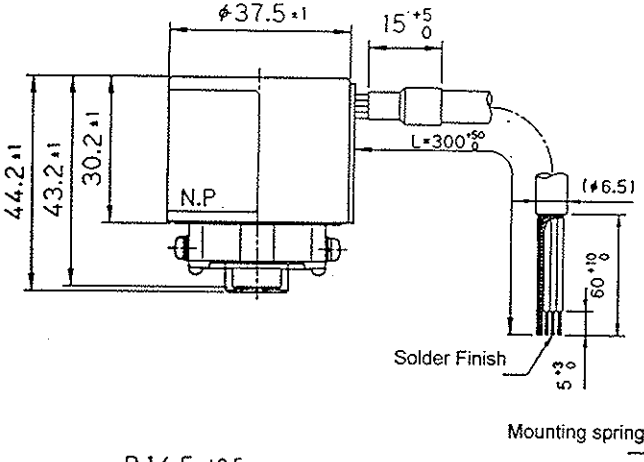
7. ELECTRICAL CONNECTIONS:

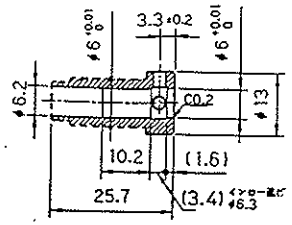
Signal	Function	Color
Rx	Serial Data	Brown
$\overline{Rx}$		Brown/Black
A	Incremental	Blue
$\overline{A}$	A sig.	Blue/Black
B	Incremental	Green
$\overline{B}$	B sig.	Green/Black
Z	Index sig.	Yellow
$\overline{Z}$		Yellow/Black
Vcc	DC + 5V	Red
GND	0V	White/Black
VB	Battery(+3.6V)	White
GND	0V	Black
RST	Rest	Gray
CG	Case Ground	Gray/Black
Shield		Not connected

常備図面

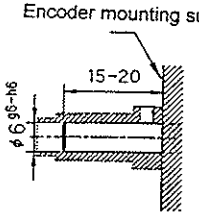
REVISIONS			
No.	DESCRIPTION	DATE	SIGN
⚠	付属品訂正(本体別体) 注記事項追加	96. 3.14	







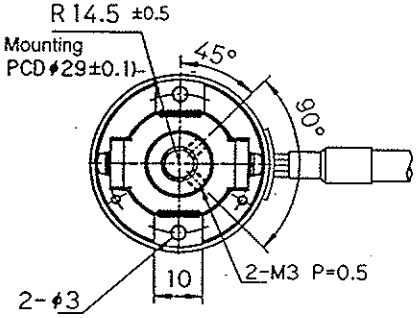
Encoder shaft



Motor shaft

Notes:

1. Z is generated when hub is oriented as shown above.
2. Shaft length 20mm max. from mounting surface.
3. Pulling the cable causes disconnection of the leads from the encoder.
4. Tightening torque of hex socket set screw: 7.6 ~ 10 Kgf · cm.
5. ⚠ Dimensional tolerance: ± 0.5mm (unless specified otherwise)
6. Inside bearing: VV Seal type
7. This drawing shows encoder with mounting spring assembled.



Attachments

Item	Qty.
Hex socket set screw with cup point. M3x3. Attached to encoder	2
Mounting spring	1
Mounting screw M2.6x5 phillips pan head machine screw with flat and spring washer, assembled.	

ITEM NO.	PART NO.	PART NAME	QTY	MATERIAL / SPEC
		LIST OF MATERIAL		

DS'D B. Shiozawa	DATE 96. 1.18	MODEL NO. TS5643N100	TITLE 外形図
CH'D K. Tsuno	SCALE 1/1	3RD ANGLE PROJECTION	
APP'D	DWG NO. 0 5 6 4 3 5 0 0 0 F 3 0		SHEET /

JIS A3(297X420) A