| | |
|---|---|
| Manufacturer | Shandong HOACO Automation Technology Co., Ltd. |
| Test subject | Product: **Rotary Die Cutting Machine**<br>Type: HW2500C16 (Ser. No. missing) |
| Test specification | EN ISO 13855:2010 |
| Purpose of examination | Test according to the test specification |
| Test result | Passed: The test subject was found to be in compliance with the mentioned test specification |

# Contents

## 1、Basic information

This report calculates the minimum distances of ESPDs employing Safety Light Curtain System of Rotary Die Cutting Machine according to the test specification. The detailed information and procedure should follow EN ISO 13855:2010.

### 1.1 Related documents

The following documents are provided by the manufacturer as input documents for this report:
Annex 1 Safety light curtain GL-R_CN
Annex 2 G9SP-series Safety Controller Operation Manual
Annex 3 OMRON Servo driver
Annex 4 Siemens SIRIUS 3RT60 Product Information

### 1.2 Acronyms & terms

| Acronyms | Terms | Unit |
|---|---|---|
| ESPE | Electro-sensitive protective equipment | |
| AOPD | Active opto-eletronic protective device | |
| S | Minimum distance | mm |
| T | Overall system stopping performance | s |
| K | Approach speed parameter | |
| C | Instruction distance, not less than 0 | mm |
| d | Detection capability of Safety light curtain | mm |

### 1.3 Calculation Equation with a sensor detection capability of ⩽40mm in diameter

$$S = (K \times T) + C$$

Where
$K = 2000mm/s$;
$C = 8(d - 14), but\ not\ less\ than\ 0.$

## 2 Detection Capability of Safety Light Curtain

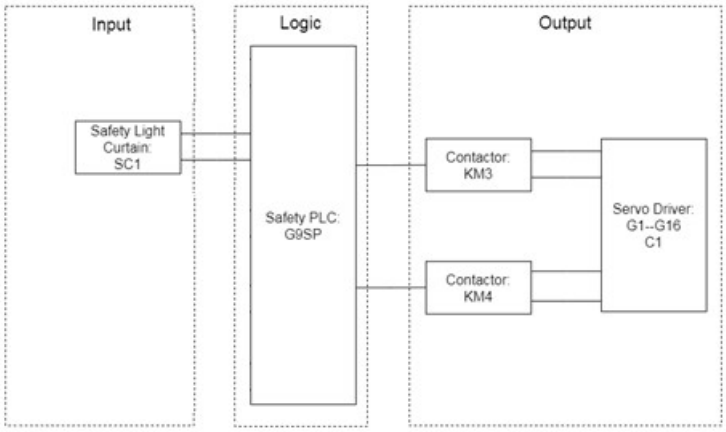
| Type | **Detection capability (Minimum Detection objects)** | Detection Height | Manufacturer |
|---|---|---|---|
| GL-R80H(G) | **Ø25mm** | 1580mm | KEYENCE |

**GL-RH(G)**

[Detection Objects ø25 mm (Hand detection)]

| Type | 光轴数目 | 总长 (mm) | Detection Height | Protection Height | Detection Distance(m) |
|---|---|---|---|---|---|
| GL-R08H(G) | 8 | 160 | 140 | 185 | |
| GL-R12H(G) | 12 | 240 | 220 | 265 | |
| GL-R16H(G) | 16 | 320 | 300 | 345 | |
| GL-R20H(G) | 20 | 400 | 380 | 425 | |
| GL-R24H(G) | 24 | 480 | 460 | 505 | |
| GL-R28H(G) | 28 | 560 | 540 | 585 | |
| GL-R32H(G) | 32 | 640 | 620 | 665 | |
| GL-R36H(G) | 36 | 720 | 700 | 745 | |
| GL-R40H(G) | 40 | 800 | 780 | 825 | |
| GL-R44H(G) | 44 | 880 | 860 | 905 | 0.2 到 15 |
| GL-R48H(G) | 48 | 960 | 940 | 985 | |
| GL-R52H(G) | 52 | 1040 | 1020 | 1065 | |
| GL-R56H(G) | 56 | 1120 | 1100 | 1145 | |
| GL-R60H(G) | 60 | 1200 | 1180 | 1225 | |
| GL-R64H(G) | 64 | 1280 | 1260 | 1305 | |
| GL-R72H(G) | 72 | 1440 | 1420 | 1465 | |
| GL-R80H(G) | 80 | 1600 | 1580 mm | 1625 mm | |
| GL-R88H(G) | 88 | 1760 | 1740 | 1785 | |
| GL-R96H(G) | 96 | 1920 | 1900 | 1945 | |

## 3 Calculation Overall System Stopping Time T




### 3.1 Response Time of Safety Light Curtain SC1

| Type | Response time | Manufacturer |
|---|---|---|
| GL-R80H(G) | 13.1ms | KEYENCE |

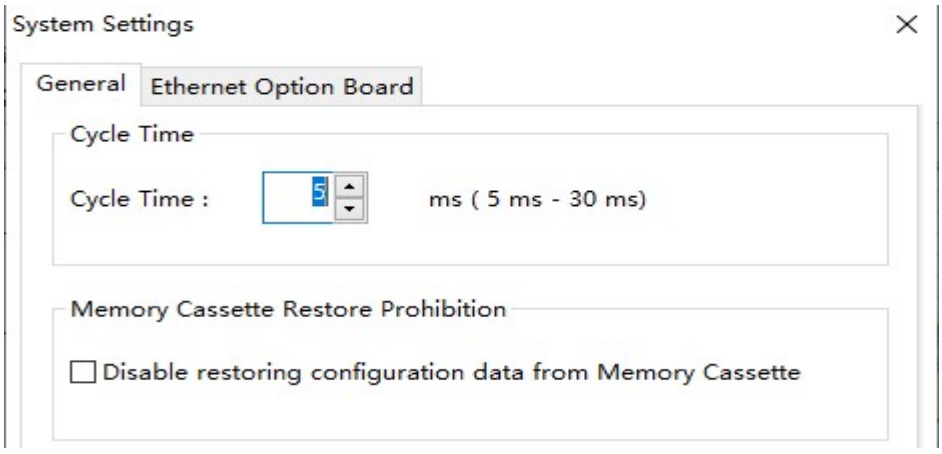
**GL-RH(G)**

Unit : ms

| Type | Response Time(OSSD) | | | | | |
|---|---|---|---|---|---|---|
| | 有线同步或光同步（频道 0）时 | | | 光同步（频道 A 或 B）时 | | |
| | ON→OFF | OFF→ON*1 | 非同步→ON*2 | ON→OFF | OFF→ON*1 | 非同步→ON*2 |
| GL-R08H(G) | 6.6 | 48.7 | 63.1 | 6.9 | 49.1 | 64.2 |
| GL-R12H(G) | 6.6 | 48.7 | 63.1 | 7.4 | 49.9 | 66.3 |
| GL-R16H(G) | 6.6 | 48.7 | 63.1 | 8.1 | 50.9 | 69.1 |
| GL-R20H(G) | 6.6 | 48.7 | 63.1 | 8.8 | 52.0 | 71.9 |
| GL-R24H(G) | 7.0 | 49.3 | 64.9 | 9.5 | 53.0 | 74.7 |
| GL-R28H(G) | 7.4 | 50.0 | 66.6 | 10.2 | 54.0 | 77.5 |
| GL-R32H(G) | 7.9 | 50.6 | 68.3 | 10.9 | 55.1 | 80.2 |
| GL-R36H(G) | 8.3 | 51.3 | 70.0 | 11.6 | 56.1 | 83.0 |
| GL-R40H(G) | 8.7 | 51.9 | 71.8 | 12.3 | 57.2 | 85.8 |
| GL-R44H(G) | 9.2 | 52.6 | 73.5 | 12.9 | 58.2 | 88.6 |
| GL-R48H(G) | 9.6 | 53.2 | 75.2 | 13.6 | 59.3 | 91.4 |
| GL-R52H(G) | 10.0 | 53.9 | 77.0 | 14.3 | 60.3 | 94.2 |
| GL-R56H(G) | 10.5 | 54.5 | 78.7 | 15.0 | 61.4 | 96.9 |
| GL-R60H(G) | 10.9 | 55.2 | 80.4 | 15.7 | 62.4 | 99.7 |
| GL-R64H(G) | 11.3 | 55.8 | 82.1 | 16.4 | 63.4 | 102.5 |
| GL-R72H(G) | 12.2 | 57.1 | 85.6 | 17.8 | 65.5 | 108.1 |
| GL-R80H(G) | 13.1 | 58.4 | 89.1 | 19.2 | 67.6 | 113.7 |
| GL-R88H(G) | 13.9 | 59.7 | 92.5 | 20.6 | 69.7 | 119.2 |
| GL-R96H(G) | 14.8 | 61.0 | 96.0 | 22.0 | 71.8 | 124.8 |

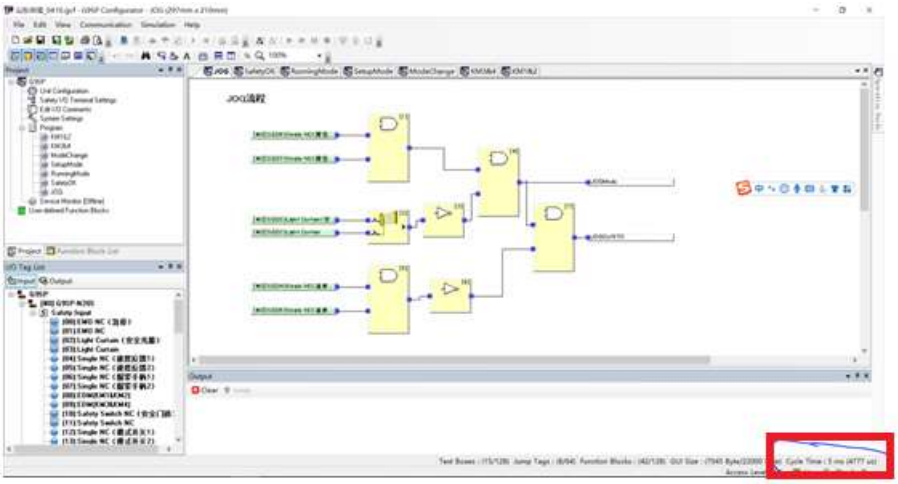
## 3.2 Response Time of Safety PLC

### 3.2.1 Cycle Time Setting Value of Safety PLC




### 3.2.2 Actual Cycle Time of Safety PLC

The actual cycle time is 4777μs as shown in the following picture. The actual cycle time is lower than cycle time setting valve.



### 3.2.3 Response Time of Safety PLC Local I/O

Calculation Equation of response time of Safety PLC Local I/O is from "Annex 2 G9SP-series Safety Controller Operation Manual".

$$Local\ Safety\ I/O\ reactioin\ time = (Cycle\ time\ \times 2) - 2\ + Input\ OFF\ delay\ time$$

Where

$Cycle\ time\ = 5mm/s$;

$Input\ OFF\ delay\ time\ is\ 2ms$, *setting value in Safety PLC Configure Software.*

*So* response time of Safety PLC Local I/O is $(5 \times 2) - 2 + 2 = 10ms$

### 3.2.4 Response Time of Safety PLC

Calculation Equation of the maximum response time of Safety PLC is

$$Response\ time\ of\ Safety\ PLC = (Cycle\ time\ \times 2) + Response\ time\ of\ Safety\ PLC\ Local\ I/O$$

So the maximum response time of Safety PLC is $(5 \times 2) + 10 = 20ms$.

## 3.3 Response Time of Contactor KM3/KM4

Response time of Contactor KM3/KM4 is from "Annex 4 Siemens SIRIUS 3RT60 Product Information".
Response time (Open) of contactor is 7~13ms.

SIRIUS 3RT6/3RT5 Contactor

技术参数

| 接触器 | 型号 | | 3RT60 15，3RT60 16 | | 3RT60 17，3RT60 18 | |
|---|---|---|---|---|---|---|
| | 规格 | | S00 | | S00 | |
| | 宽度 | mm | 45 | | 45 | |
| **一般数据** | | | | | | |
| 允许安装位置<br>该接触器的设计用于在垂直安装表面上工作。 | | |  | | | |
| 机械寿命 | 基本单元<br>基本单元加装辅助触点 | 操作次数 | $30\times10^6$<br>$10\times10^6$ | | | |
| 电气寿命 | | | 参见第 2/19 页 | | | |
| 额定接通能力 | 符合 IEC60947 标准 | | 10* $I_e$ AC-3 | | | |
| 额定分断能力 | 符合 IEC60947 标准 | | 8* $I_e$ AC-3 | | | |
| 额定绝缘电压 $U_i$（污染等级 3） | | V | 690 | | | |
| 额定冲击耐压 $U_{imp}$ | | kV | 6 | | | |
| 线圈与主触点之间的安全绝缘<br>符合 IEC 60 947-1 附录 N | | V | 400 | | | |
| 镜像触点<br>• 镜像触点是常闭触点，此触点不会与接触器常开触点同时闭合。 | | | 可拆卸的辅助触点块以及接触器集成的辅助触点都满足此要求，符合 IEC 60947-4-1 附录 F | | | |
| 允许环境温度 | 工作时<br>储藏中 | °C<br>°C | -25 ... +60<br>-55 ... +80 | | | |
| 防护等级符合 IEC 60947-1 附录 C<br>触摸防护符合 IEC 50274 | | | IP20，线圈部分IP40<br>手指安全 | | | |
| 抗振强度，矩形冲击 | • 交流操作<br>• 直流操作 | g/ms<br>g/ms | 6.7/5 和 4.2/10<br>6.7/5 和 4.2/10 | | 7.3/5 和 4.7/10<br>7.3/5 和 4.7/10 | |
| 抗振强度，正弦冲击 | • 交流操作<br>• 直流操作 | g/ms<br>g/ms | 10.5/5 和 6.6/10<br>10.5/5 和 6.6/10 | | 11.4/5 和 7.3/10<br>11.4/5 和 7.3/10 | |
| **控制回路** | | | | | | |
| 线圈工作电压范围 | | AC/DC | 0.8 ... 1.1 $U_s$ | | | |
| 线圈功率消耗（线圈处于冷态并且为 1.0×$U_s$） | | | | | | |
| • 交流操作，50/60 Hz | 吸合<br>功率因数 P.f.<br>保持<br>功率因数 P.f. | VA<br><br>VA<br> | 27/24.3<br>0.8/0.75<br>4.2/3.3<br>0.25/0.25 | | 37/33<br>0.8/0.75<br>5.7/4.4<br>0.25/0.25 | |
| • 直流操作 | 吸合 = 保持 | W | 4 | | 4 | |
| 动作时间（额定电压下） | | | | | | |
| • 交流操作 | 吸合 | ms | 9 ... 35 | 9 ... 35 | 8 ... 33 | 8 ... 33 |
| | 打开 | ms | 3.5 ... 14 | 3.5 ... 14 | 4 ... 15 | 4 ... 15 |
| • 直流操作 | 吸合 | ms | 30 ... 100 | 30 ... 100 | 30 ... 100 | 30 ... 100 |
| | 打开 Open | ms | 7 ... 13 | 7 ... 13 | 7 ... 13 | 7 ... 13 |
| 接触器 | 型号 | | 3RT60 15 | 3RT60 16 | 3RT60 17 | 3RT60 18 |
| | 规格 | | S00 | S00 | S00 | S00 |

## 3.4 Response Time of Servo Driver G1-G16

Response time of servo drive is from "Annex 3 OMRON Servo driver".

Calculation Equation of servo drive response time as follow:

$$Servo\ driver\ response\ time = BKIR\ response\ time + DB\ response\ time + Motor\ response\ time$$

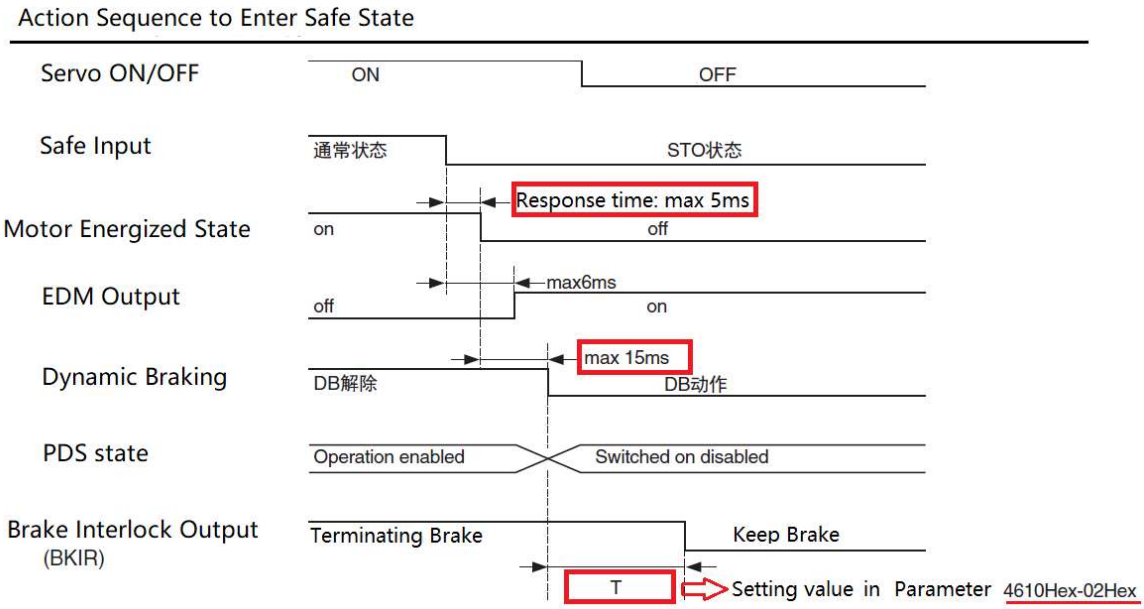
Where

BKIR response time is set in Parameter "4610Hex-02Hex", the setting value is 45ms.

DB response time is Dynamic Brake response time, the maximum value is 15ms.

The maximum value of motor response time is 5ms.

So the servo driver response time$= 45 + 15 + 5 = 65ms$.




## 3.5 Calculation Result of Overall System Stopping Time T

Calculation Equation of the maximum stopping time of overall system as follow:

$$T = 13.1 + 20 + 13 + 65 = 111ms$$

## 4 Calculation of Minimum Safety Distance

Calculation Equation with a sensor detection capability of ⩽40mm in diameter

$$S = (K \times T) + C$$

$$= (2000 \times 0.111) + 8 \times (25 - 14) = 310mm$$

## 5 Design Value and Testing Result of Safety Distance

The design value and actual value of safety distance is 330 mm.

**Result**: The actual value of safety distances of ESPDs employing Safety Light Curtain System is greater than the minimum safety distance. So, the result is **POSITIVE** to satisfy the requirements of EN ISO 13855:2010.