VEGOVA | ELEKTROTEHNIŠKO - RAČUNALNIŠKA STROKOVNA ŠOLA IN GIMNAZIJA LJUBLJANA

30. državno tekmovanje elektro šol in 12. državno tekmovanje računalniških šol

Kategorija Elektrotehnik

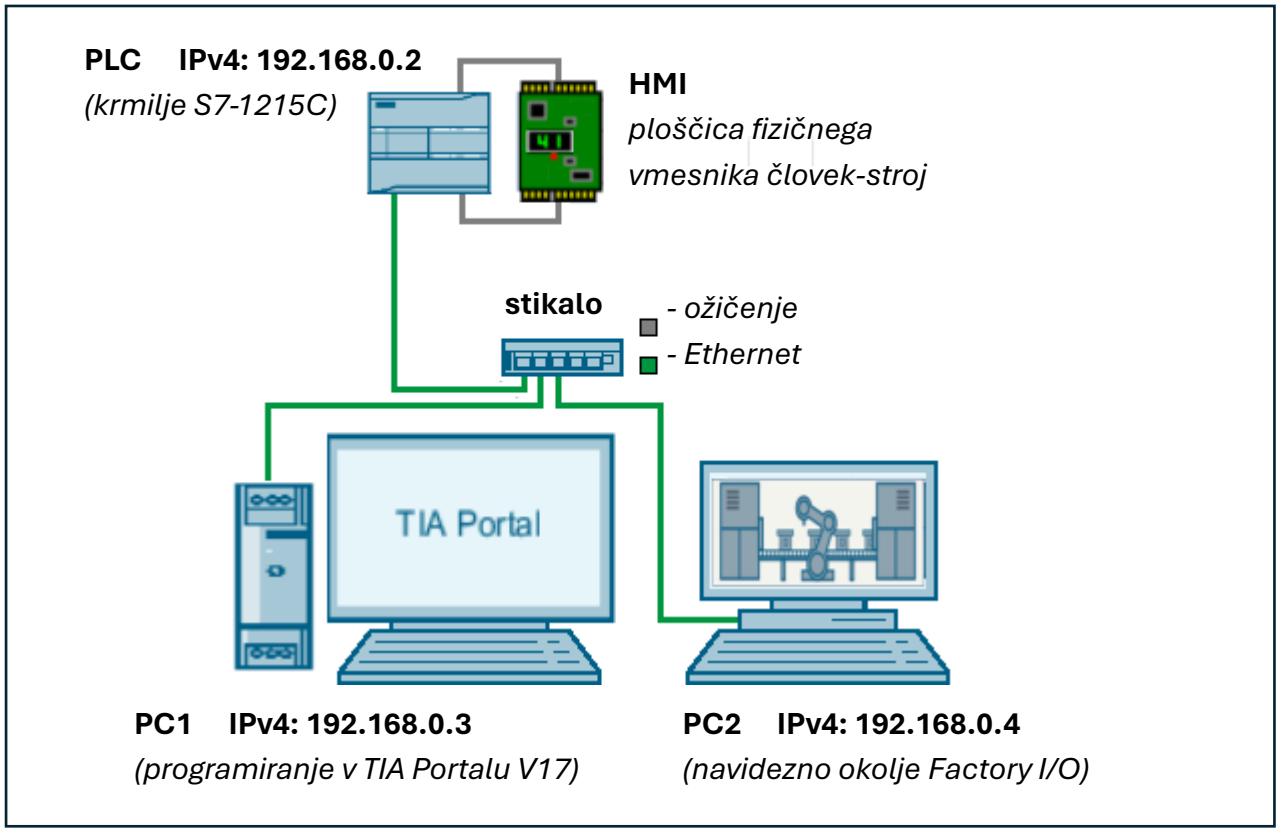
Tekmovalna naloga

Ljubljana, 28. marec 2024

STROJNA IN PROGRAMSKA OPREMA

Načrtujemo novo proizvodno linijo. Že v fazi načrtovanja se moramo izogniti napačnim rešitvam in nepotrebnim stroškom, zato bomo uporabili orodje Factory I/O, ki omogoča postavitev tovarne v navideznem okolju.

Tekmovalna naloga se osredotoča na krmiljenje dela proizvodne linije, katerega funkcija je izločanje vseh večjih paketov, ki poleg manjših paketov naključno prihajajo na prvi tekoči trak ter prestavljanje velikih paketov na drugi tekoči trak. Krmilni sistem mora ob tem tudi šteti, koliko večjih paketov je izločil ter signalizirati operaterju, da je prišlo do prekoračitve nekega dovoljenega in vnaprej določenega števila izločenih paketov.



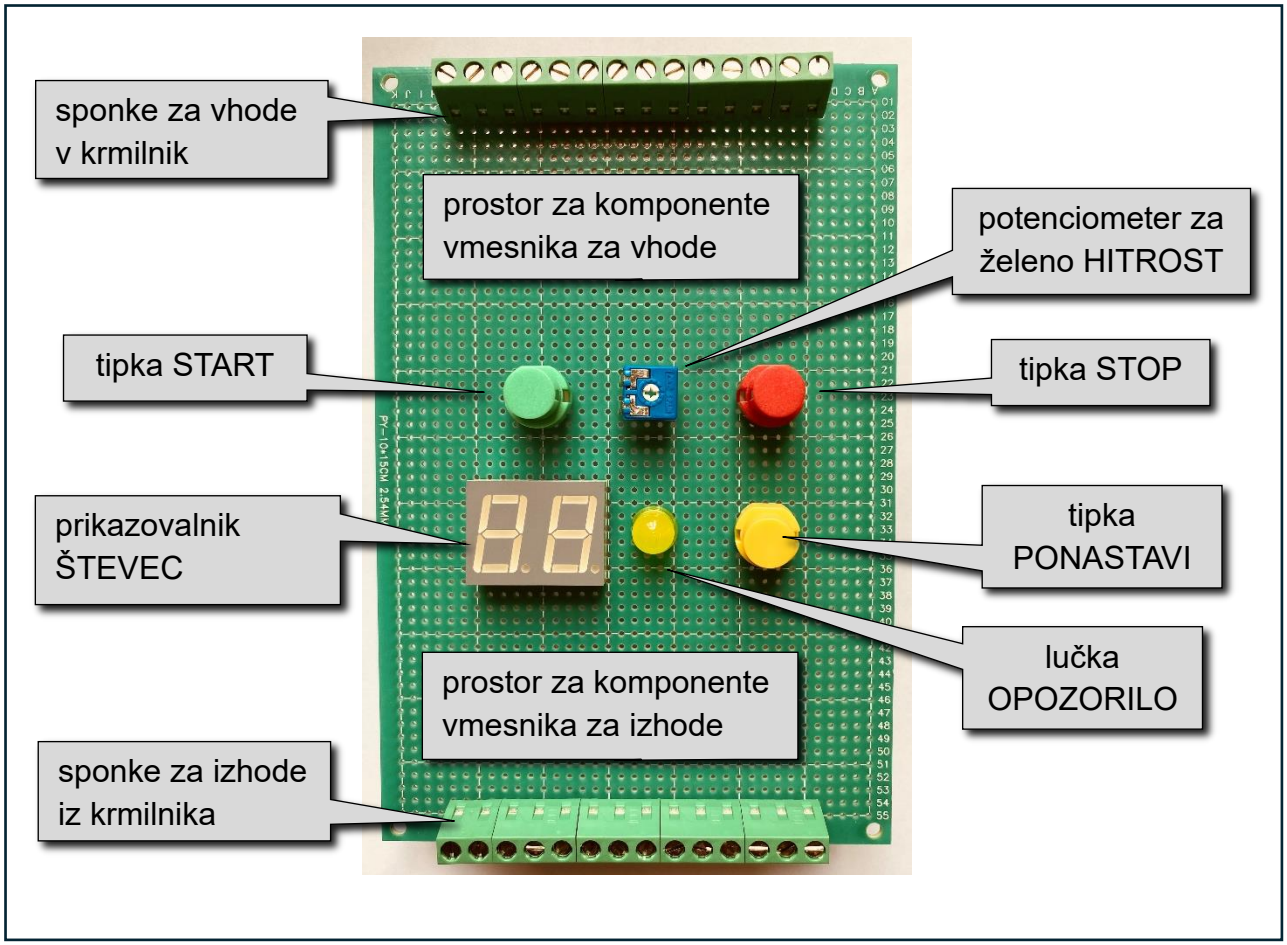
Slika 1 – Zgradba sistema (strojna oprema s pripadajočimi IPv4 naslovi)

Za realizacijo omenjenega krmilja navidezne tovarne imata tekmovalca posamezne ekipe na razpolago krmilnik Siemens S7-1215C ter dva osebna računalnika – enega z nameščeno programsko opremo Siemens TIA Portal in drugega z nameščeno programsko opremo Real Games Factory I/O. Vse tri naprave so povezane z Ethernet omrežjem preko mrežnega stikala. Statični IPv4 naslovi so vnaprej določeni in prednaloženi na posameznih napravah. Sistem obratuje »otočno« to je brez povezave z internetom. Tekmovalca posamezne ekipe ne smeta uporabljati drugih naprav za dostopanje do interneta (telefoni, tablice ipd.). Vsa potrebna dokumentacija se nahaja v prilogah tekmovalne naloge. Tekmovalca vse datoteke (arhiv TIA Portala, datoteko Factory I/O) po končanem delu

nujno shranita na priložena USB medija. Zaželeno je tudi sprotno shranjevanje na zunanja medija, ker računalniki uporabljajo sistem *DeepFreeze*, ki ob izklopu računalnika ponastavi vse podatke.

FIZIČNI KRMILNI VMESNIK

Poleg navideznega okolja s postrojem in krmilno omarico bi želeli realizirati tudi manjši vmesnik človek-stroj (HMI – Human Machine Interface) v fizični obliki. To bi izvedli s pomočjo ploščice in nekaj elektronskih komponent. Predpisano obliko in položaj posameznih komponent vmesnika prikazuje slika 2.

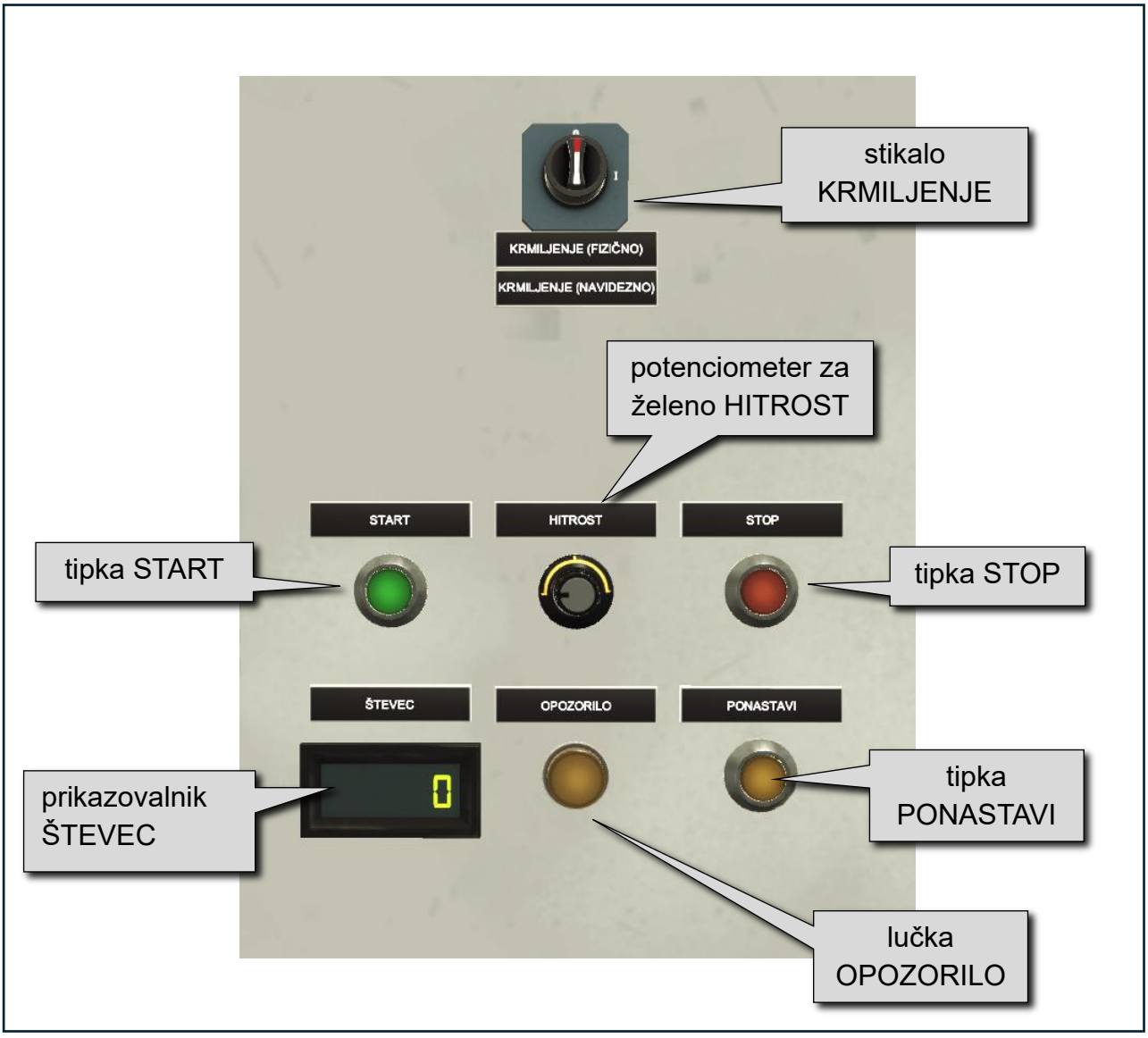


Slika 2 – Predpisana oblika vmesnika človek-stroj realiziranega s ploščico

Potrebno je pripraviti fizični vmesnik kot je prikazano na sliki 2. Ta vmesnik se s povezovalnimi vodniki poveže na vhode oz. izhode krmilnika. Povezavo vsakega posameznega signala izvedemo s 0,75 mm^2 vodniki, ki jih na obeh koncih zaključimo z votlicami.

NAVIDEZNI KRMILNI VMESNIK

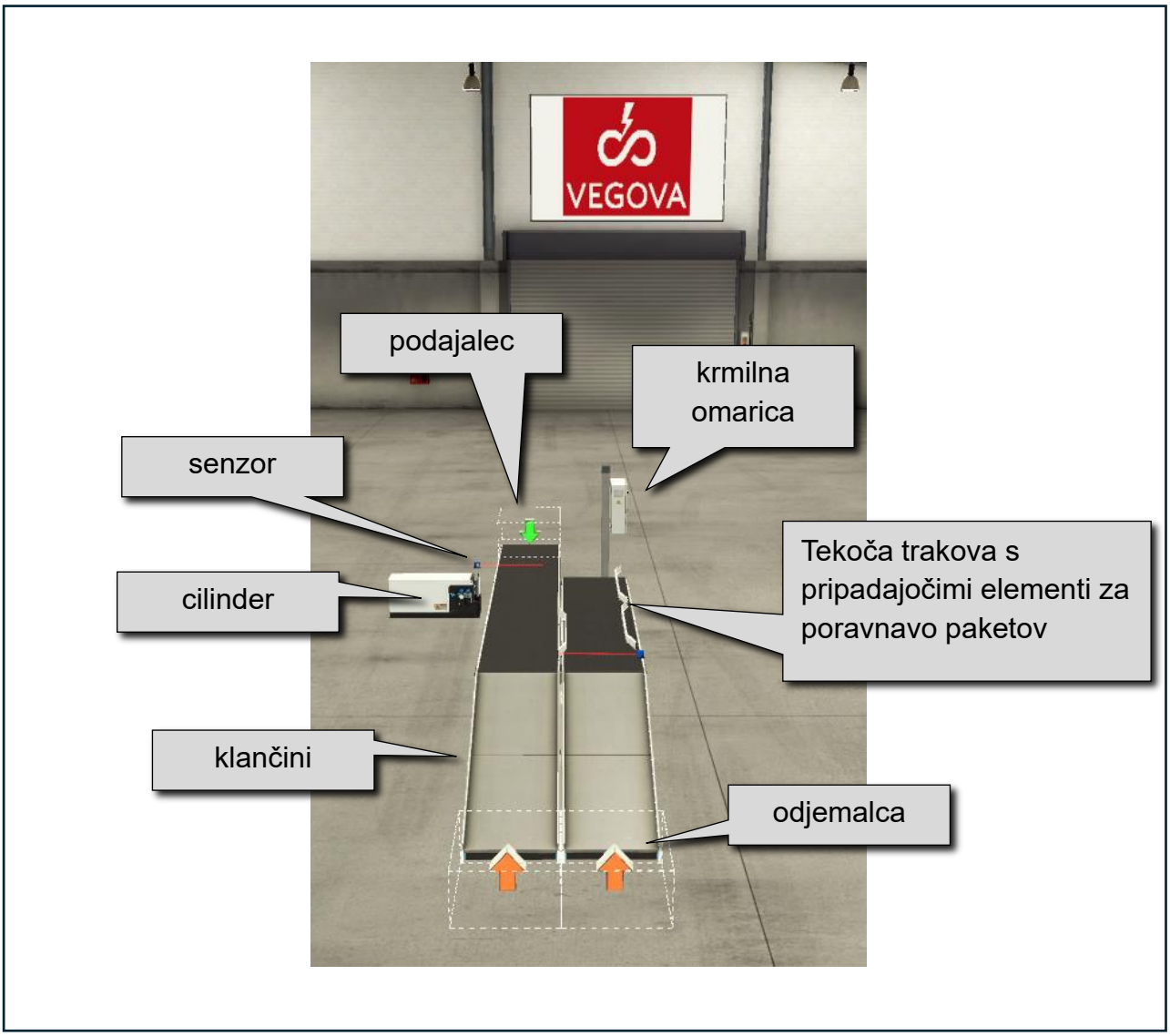
V navideznem okolju Factory I/O je potrebno pripraviti krmilno omarico, kot jo prikazuje slika 3. Razpored tipk, lučk in prikazovalnika je enak kot na fizičnem vmesniku. Razlika je le dodatno izbirno stikalo za lokacijo krmiljenja, ki ga na fizičnem vmesniku ni.



Slika 3 – Predpisana oblika vmesnika človek-stroj realiziranega v Factory I/O

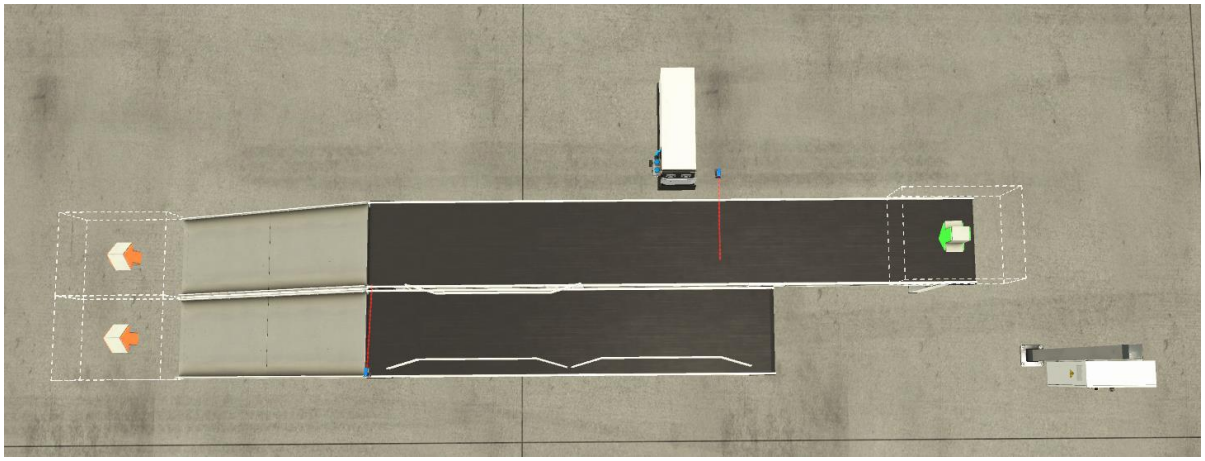
NAVIDEZNI POSTROJ

Postroj bo v celoti realiziran v navideznem svetu. Sliki 4 in 5 prikazujeta konfiguracijo elektromehanske opreme.



Slika 4 – Prikaz predpisanega izgleda navideznega postroja v Factory I/O

Postroj sestavljajo: dva tekoča trakova – **Belt Conveyor (6m)** in **Belt Conveyor (4m)**, en podajalec – **Emitter**, dva odjemalca – **Remover**. Pakete, ki jih podajalec spušča na tekoči trak, omejimo le na malo in veliko škatlo – **Part to Emit – Box(S)** in **Box(L)**. Na koncu vsakega traka dodamo klančino – **Chute Conveyor**, da paketi ne padajo s tekočih trakov. Ugotavljanje velikosti paketov izvedemo s pomočjo difuznega optičnega senzorja – **Diffuse Sensor**, izločanje pa s pomočjo cilindra – **Pusher**. Da se paketi gladko premikajo po tekočem traku pa po potrebi uporabimo elemente za poravnavo paketov - **Aligner 1**, **2** in/ali **3**.



Slika 5 – Prikaz predpisanega navideznega postroja iz ptičje perspektive

ZAHTEVANO DELOVANJE KRMILNEGA SISTEMA (S TOČKOVNIKOM)

Točke dobi ekipa samo v primeru, da navedeni elementi delujejo (oz. da so funkcionalnosti izpolnjene). Vsaka spodaj našteta funkcionalnost je vredna dve točki, delno izpolnjena funkcionalnost eno točko, neizpolnjena pa nič točk.

Če dve ali več ekip doseže enako število točk, boljše mesto zasede ekipa z najkrajšim časom reševanja tekmovalne naloge.

FACTORY I/O

POZICIJA	OPIS DELOVANJE POSAMEZNEGA SKLOPA	PREDVIDENE TOČKE
1	Tipka START na omarici vklopi oba trakova, če je izbrana lokacija krmiljenja NAVIDEZNO.	2
2	Tipka STOP na omarici izklopi oba trakova, če je izbrana lokacija krmiljenja NAVIDEZNO.	2
3	Podajalnik podaja zaboje na trak (pravilne nastavitve - časi, izdelki).	2
4	Dva odjemalnika za velike in male škatle jemljeta škatle s trakov (pravilne nastavitve - časi, izdelki).	2
5	Senzor škatel pravilno zaznava velike ali male škatle.	2
6	Kretnica oz. cilinder pravilno deluje. To pomeni, da pravilno izloča večje škatle na drug trak neodvisno od hitrosti premikanja trakov.	2
7	Številčni zaslon ŠTEVEC na omarici prikazuje pravilno število izločenih velikih škatel.	2
8	Rumena lučka OPOZORILO na krmilni omarici začne utripati, ko vrednost števca preseže vrednost 5. To pomeni, ko je n>5. Frekvenca utripanja naj bo približno 2 Hz.	2
9	Po prvem pritisku na rumeno tipko PONASTAVI mora rumena lučka nehati utripati in ostati prižgana. Rumena tipka PONASTAVI deluje le, če je izbrana lokacija krmiljenja NAVIDEZNO. Števec mora še vedno prikazovati aktualno trenutno vrednost.	2
10	Po drugem pritisku na rumeno tipko PONASTAVI le ob pogoju, ko je izbrana lokacija krmiljenja NAVIDEZNO, se dejansko zbriše stanje števca (postavi se na vrednost nič n=0). Rumena lučka OPOZORILO tedaj ugasne.	2
11	Potenciometer HITROST na čelni plošči omarice krmili hitrost delovanja trakov le, ko je izbrana lokacija krmiljenja NAVIDEZNO.	2
12	Preklopno stikalo KRMILJENJE za izbiro lokacije krmiljenja preklaplja med krmiljenjem preko fizičnega ali navideznega vmesnika.	0, ker je funkcionalnost zajeta pri drugih pozicijah

PLOŠČICA

POZICIJA	OPIS DELOVANJE POSAMEZNEGA SKLOPA	PREDVIDENE TOČKE
13	Fizična tipka za start (zelena) vklopi oba trakova, če je na omarici v Factory I/O izbrana lokacija krmiljenja FIZIČNO.	2
14	Fizična tipka za stop (rdeča) izklopi oba trakova, če je na omarici v Factory I/O izbrana lokacija krmiljenja FIZIČNO.	2
15	Prikaz enic na dvojnem 7-segmentnem LED prikazovalniku je pravilen glede na število izločenih velikih škatel.	2
16	Prikaz desetic na dvojnem 7-segmentnem LED prikazovalniku je pravilen glede na število izločenih velikih škatel.	2
17	Rumena LED začne utripati, ko vrednost števca preseže vrednost 5. To pomeni, ko je n>5. Frekvenca utripanja naj bo približno 2 Hz.	2
18	Po prvem pritisku na tipko za ponastavitev (rumena) mora rumena LED nehati utripati in ostati prižgana. Tipka za ponastavitev deluje le, če je izbrana lokacija krmiljenja FIZIČNO. Števec mora še vedno prikazovati aktualno trenutno vrednost.	2
19	Po drugem pritisku tipko za ponastavitev (rumena) le ob pogoju, ko je izbrana lokacija krmiljenja FIZIČNO, se dejansko zbriše stanje števca (postavi se na vrednost nič n=0). Rumena lučka OPOZORILO tedaj ugasne.	2
20	Potenciometer za hitrost krmili hitrost delovanja trakov le, ko je izbrana lokacija krmiljenja FIZIČNO.	2

VSEBINA VREČKE Z MATERIALOM

- 1 kos Tipka (zelena), normally-open kontakt, za spajkanje na PCB: https://www.tme.eu/si/sl/details/d6r-g/stikala-s-tipkovnico/c-k/d6r50-f1-lfs/

- 1 kos Tipka (rdeča), normally-open kontakt, za spajkanje na PCB: https://www.tme.eu/si/sl/details/d6r-r/stikala-s-tipkovnico/c-k/d6r40-f1-lfs/

- 1 kos Tipka (rumena), normally-open kontakt, za spajkanje na PCB: https://www.tme.eu/si/sl/details/d6r-y/stikala-s-tipkovnico/c-k/d6r30-f1-lfs/

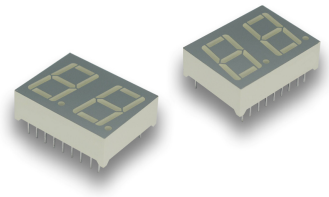
- 100 kos Votlice enojne za 0,75 mm^2, sive https://www.tme.eu/si/sl/details/216-242/nastavki-in-stiskalne-puse/wago/

- 20 kos Votlice dvojne za 0,75 mm^2, modre https://www.tme.eu/si/sl/details/bm00753/nastavki-in-stiskalne-puse/bm-group/

- 1 kos Dvojni (2 x 7-seg. LED) , skupna katoda, zelene barve https://si.farnell.com/multicomp/ld0565gwk/display-seven-segment-0-56-inch/dp/2627648

- 2 kosa Sauro sponke po 14 priključkov (kombinacija 2 x 2 in 8 x 3 in se jih potem sestavi da se dobi dve vrsti po 14 sponk)
- 1 kos Eksperimentalna ploščica za tiskano vezje, 15 x 10 cm, enostranska PY-10 · 15CM 2.54MM
- 10 m Žica (finožična) 0,75 mm^2 - črne barve
- 0,8 m Žica (trda) 4 x parica iz UTP kabla
- 2 kosa Tranzistor 2N2222A
- 1 kos Zaščitna dioda 1N4148
- 1 kos LED rumena Φ8mm
- 1 kos Upor 10 kOhm, 0,25 W, toleranca +-1 %
- 1 kos Upor 3,9 kOhm, 0,25 W, tolerance +-1 %
- 1 kos Trimer potenciometer 10 kOhm linearen
- 2 kosa Upor 1 kOhm, 0,25 W
- 8 kos Upor 1,5 kOhm, 1W
- 8 kos Upor 470 Ohm, 0,25 W

Kingbright



DC56-11GWA

14.22 mm (0.56 inch) Dual Digit Numeric Display

DESCRIPTION

- The Green source color devices are made with Gallium Phosphide Green Light Emitting Diode

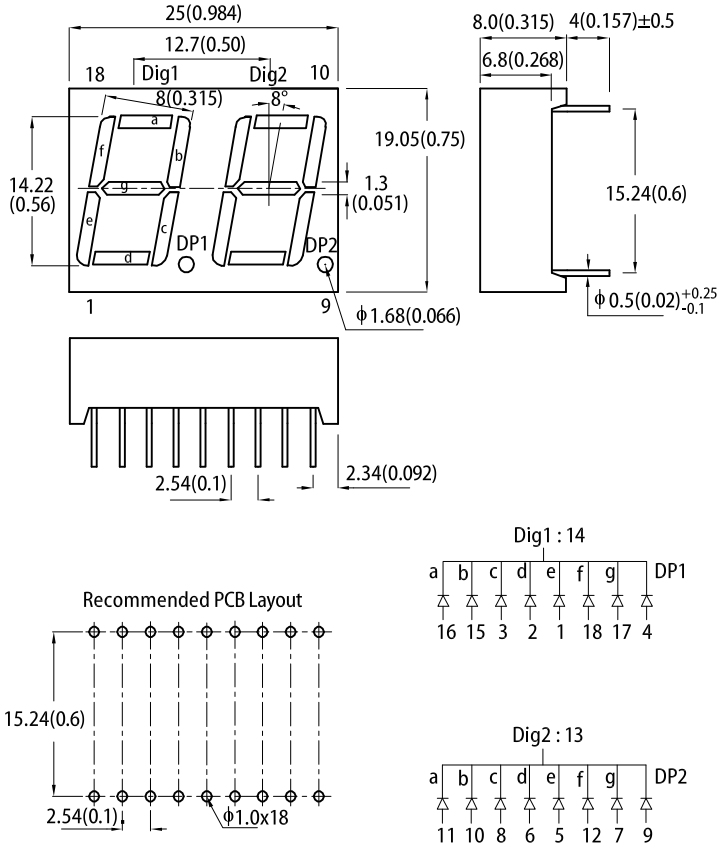
FEATURES

- 0.56 inch digit height
- Low current operation
- Excellent character appearance
- Easy mounting on P.C. boards or sockets
- Two digit package simplifies alignments & assembly
- Mechanically rugged
- Standard: gray face, white segment
- RoHS compliant

APPLICATIONS

- Home and smart appliances
- Display time and digital combination
- Industrial and instrumental applications
- Numeric status

PACKAGE DIMENSIONS



Notes:
1. All dimensions are in millimeters (inches), Tolerance is ±0.25(0.01")unless otherwise noted.
2. The specifications, characteristics and technical data described in the datasheet are subject to change without prior notice.

SELECTION GUIDE

Part Number	Emitting Color (Material)	Lens Type	Iv (ucd) @ 10mA [1]		Description
			Min.	Typ.	
DC56-11GWA	Green (GaP)	White Diffused	3600	11000	Common Cathode, Rt. Hand Decimal
			*2200	*4500	

Notes:
1. Luminous intensity / luminous Flux: +/-15%.
** Luminous intensity value is traceable to CIE127-2007 standards.*

ELECTRICAL / OPTICAL CHARACTERISTICS at T_A=25°C

Parameter	Symbol	Emitting Color	Value		Unit
			Typ.	Max.	
Wavelength at Peak Emission I_F = 10mA	λ_{peak}	Green	565	-	nm
Dominant Wavelength I_F = 10mA	λ_{dom} [1]	Green	568	-	nm
Spectral Bandwidth at 50% Φ REL MAX I_F = 10mA	Δλ	Green	30	-	nm
Capacitance	C	Green	15	-	pF
Forward Voltage I_F = 10mA	V_F [2]	Green	2	2.4	V
Reverse Current (V_R = 5V)	I_R	Green	-	10	uA

Notes:
1. The dominant wavelength (λd) above is the setup value of the sorting machine. (Tolerance λd : ±1nm.)
2. Forward voltage: ±0.1V.
3. Wavelength value is traceable to CIE127-2007 standards.
4. Excess driving current and / or operating temperature higher than recommended conditions may result in severe light degradation or premature failure.

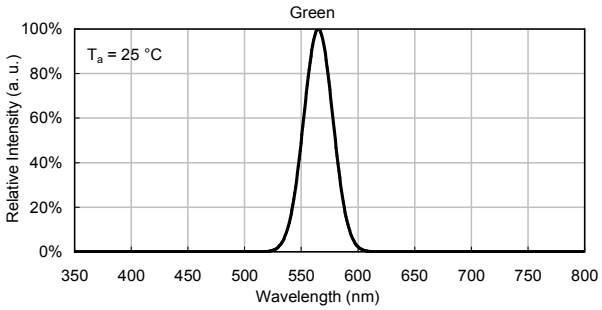
ABSOLUTE MAXIMUM RATINGS at T_A=25°C

Parameter	Symbol	Value	Unit
Power Dissipation	P_D	62.5	mW
Reverse Voltage	V_R	5	V
Junction Temperature	T_j	110	°C
Operating Temperature	T_{op}	-40 to +85	°C
Storage Temperature	T_{stg}	-40 to +85	°C
DC Forward Current	I_F	25	mA
Peak Forward Current	I_{FM} [1]	140	mA
Electrostatic Discharge Threshold (HBM)	-	8000	V
Lead Solder Temperature [2]		260°C For 3-5 Seconds	

Notes:
1. 1/10 Duty Cycle, 0.1ms Pulse Width.
2. 2mm below package base.
3. Relative humidity levels maintained between 40% and 60% in production area are recommended to avoid the build-up of static electricity – Ref JEDEC/JESD625-A and JEDEC/J-STD-033.

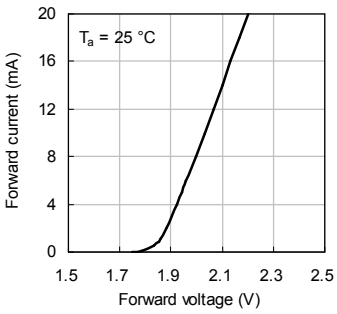
TECHNICAL DATA

RELATIVE INTENSITY vs. WAVELENGTH

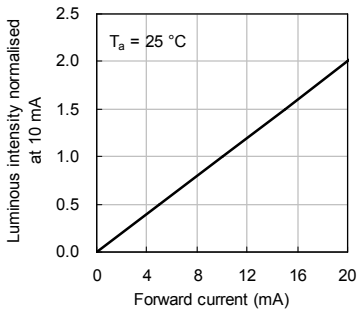


GREEN

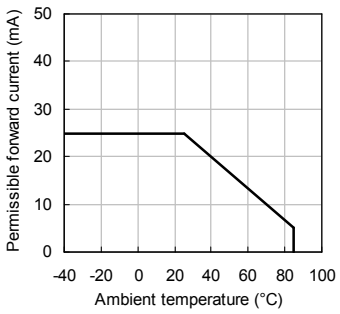
Forward Current vs. Forward Voltage



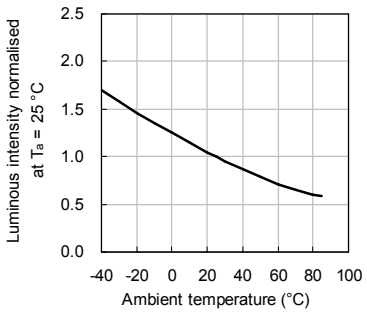
Luminous Intensity vs. Forward Current



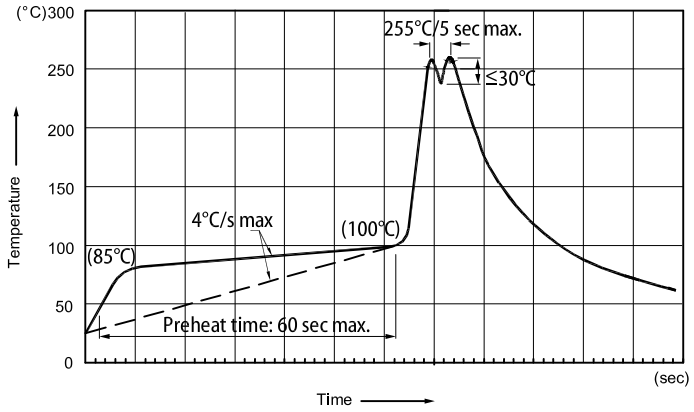
Forward Current Derating Curve



Luminous Intensity vs. Ambient Temperature



RECOMMENDED WAVE SOLDERING PROFILE



Notes:
1. *Recommend pre-heat temperature of 105°C or less (as measured with a thermocouple attached to the LED pins) prior to immersion in the solder wave with a maximum solder bath temperature of 260°C*
2. *Peak wave soldering temperature between 245°C ~ 255°Cfor 3 sec (5 sec max).*
3. *Do not apply stress to the epoxy resin while the temperature is above 85°C.*
4. *Fixtures should not incur stress on the component when mounting and during soldering process.*
5. *SAC 305 solder alloy is recommended.*
6. *No more than one wave soldering pass.*
7. *During wave soldering, the PCB top-surface temperature should be kept below 105°C.*

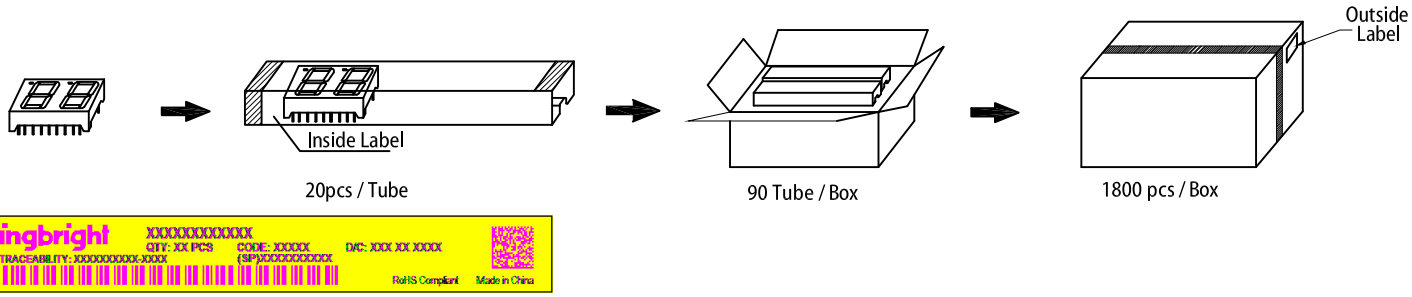
Soldering General Notes

1. Through-hole displays are incompatible with reflow soldering.
2. If components will undergo multiple soldering processes, or other processes where the components may be subjected to intense heat, please check with Kingbright for compatibility.

CLEANING

1. Mild "no-clean" fluxes are recommended for use in soldering.
2. If cleaning is required, Kingbright recommends to wash components with water only. Do not use harsh organic solvents for cleaning because they may damage the plastic parts .
3. The cleaning process should take place at room temperature and the devices should not be washed for more than one minute.
4. When water is used in the cleaning process, Immediately remove excess moisture from the component with forced-air drying afterwards.

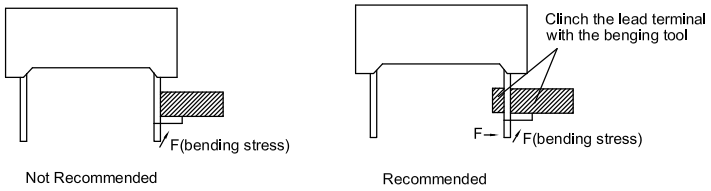
PACKING & LABEL SPECIFICATIONS



THROUGH HOLE DISPLAY MOUNTING METHOD

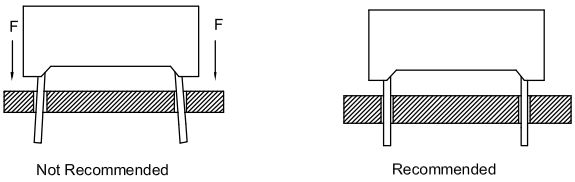
Lead Forming

Do not bend the component leads by hand without proper tools. The leads should be bent by clinching the upper part of the lead firmly such that the bending force is not exerted on the plastic body.

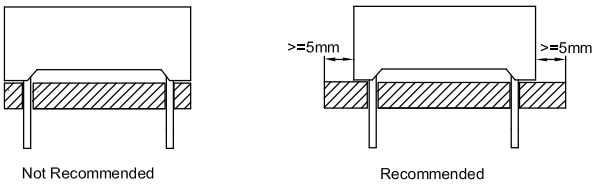


Installation

1. The installation process should not apply stress to the lead terminals.
2. When inserting for assembly, ensure the terminal pitch matches the substrate board's hole pitch to prevent spreading or pinching the lead terminals. *(Fig.1)*
3. The component shall be placed at least 5mm from edge of PCB to avoid damage caused excessive heat during wave soldering.*(Fig.2)*



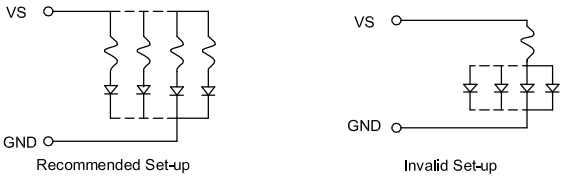
(Fig.1)



(Fig.2)

CIRCUIT DESIGN NOTES

1. Protective current-limiting resistors may be necessary to operate the LEDs within the specified range.
2. LEDs mounted in parallel should each be placed in series with its own current-limiting resistor.*(Fig.3)*
3. The driving circuit should be designed to protect the LED against reverse voltages and transient voltage spikes when the circuit is powered up or shut down.
4. The safe operating current should be chosen after considering the maximum ambient temperature of the operating environment.
5. Prolonged reverse bias should be avoided, as it could cause metal migration, leading to an increase in leakage current or causing a short circuit.



(Fig.3)

PRECAUTIONARY NOTES

1. The information included in this document reflects representative usage scenarios and is intended for technical reference only.
2. The part number, type, and specifications mentioned in this document are subject to future change and improvement without notice. Before production usage customer should refer to the latest datasheet for the updated specifications.
3. When using the products referenced in this document, please make sure the product is being operated within the environmental and electrical limits specified in the datasheet. If customer usage exceeds the specified limits, Kingbright will not be responsible for any subsequent issues.
4. The information in this document applies to typical usage in consumer electronics applications. If customer's application has special reliability requirements or have life-threatening liabilities, such as automotive or medical usage, please consult with Kingbright representative for further assistance.
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6. When any special process such as potting is required for LED assembly, please consult with Kingbright representative before proceeding.
7. All design applications should refer to Kingbright application notes available at https://www.KingbrightUSA.com/ApplicationNotes

P2N2222A

Amplifier Transistors

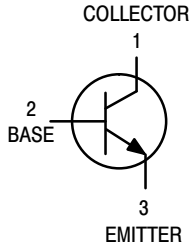
NPN Silicon

ON Semiconductor®

http://onsemi.com

Features

- These are Pb−Free Devices*



MAXIMUM RATINGS (T_A = 25°C unless otherwise noted)

Characteristic	Symbol	Value	Unit
Collector − Emitter Voltage	V_{CEO}	40	Vdc
Collector − Base Voltage	V_{CBO}	75	Vdc
Emitter − Base Voltage	V_{EBO}	6.0	Vdc
Collector Current − Continuous	I_C	600	mAdc
Total Device Dissipation @ T_A = 25°C Derate above 25°C	P_D	625 5.0	mW mW/°C
Total Device Dissipation @ T_C = 25°C Derate above 25°C	P_D	1.5 12	W mW/°C
Operating and Storage Junction Temperature Range	T_J, T_{stg}	−55 to +150	°C

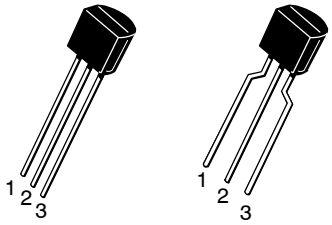
THERMAL CHARACTERISTICS

Characteristic	Symbol	Max	Unit
Thermal Resistance, Junction to Ambient	$R_{\theta JA}$	200	°C/W
Thermal Resistance, Junction to Case	$R_{\theta JC}$	83.3	°C/W

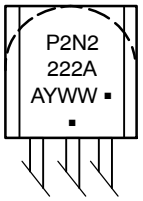
Stresses exceeding Maximum Ratings may damage the device. Maximum Ratings are stress ratings only. Functional operation above the Recommended Operating Conditions is not implied. Extended exposure to stresses above the Recommended Operating Conditions may affect device reliability.

*For additional information on our Pb−Free strategy and soldering details, please download the ON Semiconductor Soldering and Mounting Techniques Reference Manual, SOLDERRM/D.

TO−92
CASE 29
STYLE 17



MARKING DIAGRAM



A = Assembly Location
Y = Year
WW = Work Week
▪ = Pb−Free Package
(Note: Microdot may be in either location)

ORDERING INFORMATION

Device	Package	Shipping†
P2N2222AG	TO−92 (Pb−Free)	5000 Units/Bulk
P2N2222ARL1G	TO−92 (Pb−Free)	2000/Tape & Ammo

†For information on tape and reel specifications, including part orientation and tape sizes, please refer to our Tape and Reel Packaging Specification Brochure, BRD8011/D.

ELECTRICAL CHARACTERISTICS (T_A = 25°C unless otherwise noted)

Characteristic	Symbol	Min	Max	Unit
OFF CHARACTERISTICS				
Collector – Emitter Breakdown Voltage (I_C = 10 mAdc, I_B = 0)	$V_{(BR)CEO}$	40	–	Vdc
Collector – Base Breakdown Voltage (I_C = 10 μAdc, I_E = 0)	$V_{(BR)CBO}$	75	–	Vdc
Emitter – Base Breakdown Voltage (I_E = 10 μAdc, I_C = 0)	$V_{(BR)EBO}$	6.0	–	Vdc
Collector Cutoff Current (V_{CE} = 60 Vdc, $V_{EB(off)}$ = 3.0 Vdc)	I_{CEX}	–	10	nAdc
Collector Cutoff Current (V_{CB} = 60 Vdc, I_E = 0) (V_{CB} = 60 Vdc, I_E = 0, T_A = 150°C)	I_{CBO}	– –	0.01 10	μAdc
Emitter Cutoff Current (V_{EB} = 3.0 Vdc, I_C = 0)	I_{EBO}	–	10	nAdc
Collector Cutoff Current (V_{CE} = 10 V)	I_{CEO}	–	10	nAdc
Base Cutoff Current (V_{CE} = 60 Vdc, $V_{EB(off)}$ = 3.0 Vdc)	I_{BEX}	–	20	nAdc
ON CHARACTERISTICS				
DC Current Gain (I_C = 0.1 mAdc, V_{CE} = 10 Vdc) (I_C = 1.0 mAdc, V_{CE} = 10 Vdc) (I_C = 10 mAdc, V_{CE} = 10 Vdc) (I_C = 10 mAdc, V_{CE} = 10 Vdc, T_A = −55°C) (I_C = 150 mAdc, V_{CE} = 10 Vdc) (Note 1) (I_C = 150 mAdc, V_{CE} = 1.0 Vdc) (Note 1) (I_C = 500 mAdc, V_{CE} = 10 Vdc) (Note 1)	h_{FE}	 35 50 75 35 100 50 40	 – – – – 300 – –	–
Collector – Emitter Saturation Voltage (Note 1) (I_C = 150 mAdc, I_B = 15 mAdc) (I_C = 500 mAdc, I_B = 50 mAdc)	$V_{CE(sat)}$	 – –	 0.3 1.0	Vdc
Base – Emitter Saturation Voltage (Note 1) (I_C = 150 mAdc, I_B = 15 mAdc) (I_C = 500 mAdc, I_B = 50 mAdc)	$V_{BE(sat)}$	 0.6 –	 1.2 2.0	Vdc
SMALL–SIGNAL CHARACTERISTICS				
Current – Gain – Bandwidth Product (Note 2) (I_C = 20 mAdc, V_{CE} = 20 Vdc, f = 100 MHz)C	f_T	300	–	MHz
Output Capacitance (V_{CB} = 10 Vdc, I_E = 0, f = 1.0 MHz)	C_{obo}	–	8.0	pF
Input Capacitance (V_{EB} = 0.5 Vdc, I_C = 0, f = 1.0 MHz)	C_{ibo}	–	25	pF
Input Impedance (I_C = 1.0 mAdc, V_{CE} = 10 Vdc, f = 1.0 kHz) (I_C = 10 mAdc, V_{CE} = 10 Vdc, f = 1.0 kHz)	h_{ie}	 2.0 0.25	 8.0 1.25	kΩ
Voltage Feedback Ratio (I_C = 1.0 mAdc, V_{CE} = 10 Vdc, f = 1.0 kHz) (I_C = 10 mAdc, V_{CE} = 10 Vdc, f = 1.0 kHz)	h_{re}	 – –	 8.0 4.0	X 10^{-4}
Small–Signal Current Gain (I_C = 1.0 mAdc, V_{CE} = 10 Vdc, f = 1.0 kHz) (I_C = 10 mAdc, V_{CE} = 10 Vdc, f = 1.0 kHz)	h_{fe}	 50 75	 300 375	–
Output Admittance (I_C = 1.0 mAdc, V_{CE} = 10 Vdc, f = 1.0 kHz) (I_C = 10 mAdc, V_{CE} = 10 Vdc, f = 1.0 kHz)	h_{oe}	 5.0 25	 35 200	μMhos
Collector Base Time Constant (I_E = 20 mAdc, V_{CB} = 20 Vdc, f = 31.8 MHz)	$rb'C_c$	–	150	ps
Noise Figure (I_C = 100 μAdc, V_{CE} = 10 Vdc, R_S = 1.0 kΩ, f = 1.0 kHz)	N_F	–	4.0	dB

1. Pulse Test: Pulse Width ≤ 300 μs, Duty Cycle ≤ 2.0%.
2. f_T is defined as the frequency at which $|h_{fe}|$ extrapolates to unity.

ELECTRICAL CHARACTERISTICS (T_A = 25°C unless otherwise noted) (Continued)

Characteristic		Symbol	Min	Max	Unit
SWITCHING CHARACTERISTICS					
Delay Time	(V_{CC} = 30 Vdc, $V_{BE(off)}$ = −2.0 Vdc, I_C = 150 mAdc, I_{B1} = 15 mAdc) (Figure 1)	t_d	–	10	ns
Rise Time		t_r	–	25	ns
Storage Time	(V_{CC} = 30 Vdc, I_C = 150 mAdc, I_{B1} = I_{B2} = 15 mAdc) (Figure 2)	t_s	–	225	ns
Fall Time		t_f	–	60	ns

SWITCHING TIME EQUIVALENT TEST CIRCUITS

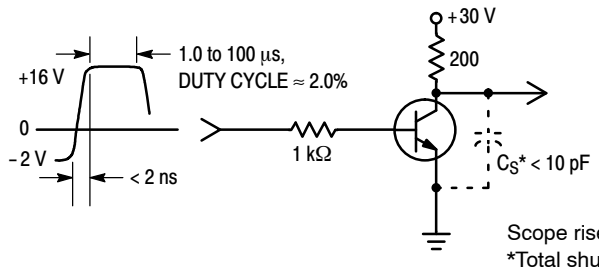
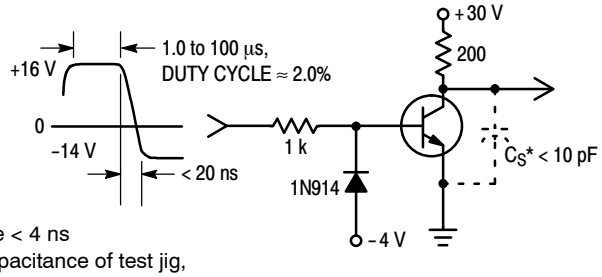


Figure 1. Turn−On Time



Scope rise time < 4 ns
*Total shunt capacitance of test jig, connectors, and oscilloscope.

Figure 2. Turn−Off Time

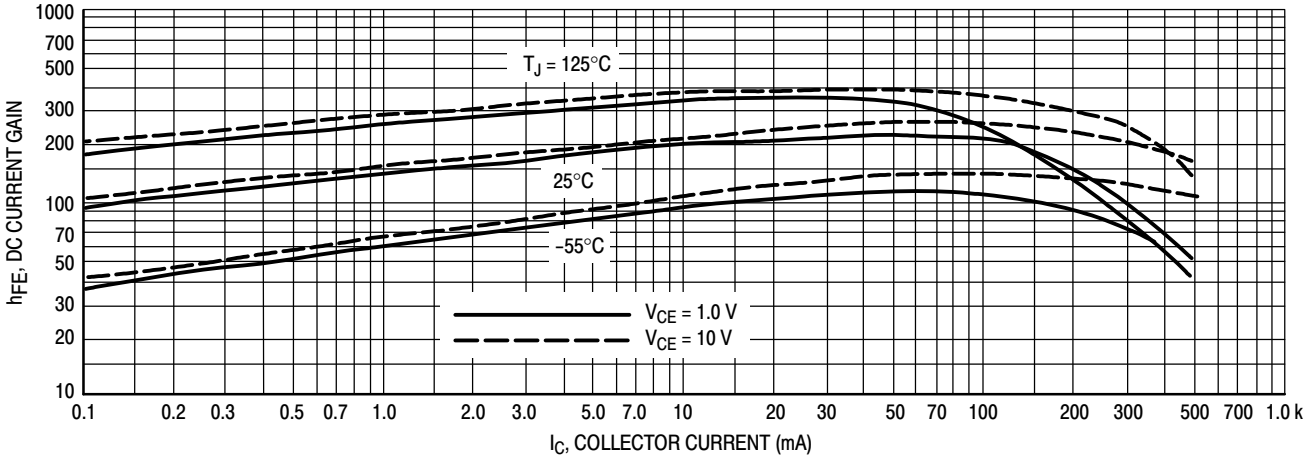


Figure 3. DC Current Gain

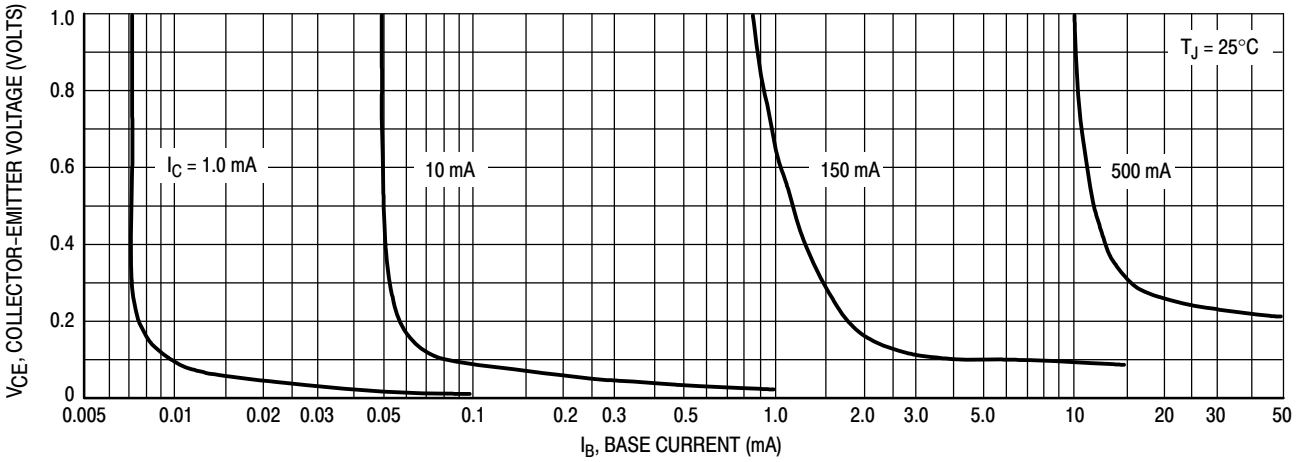


Figure 4. Collector Saturation Region

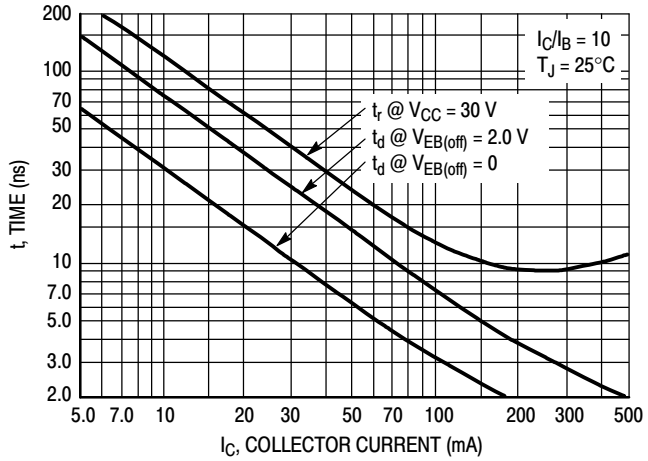


Figure 5. Turn – On Time

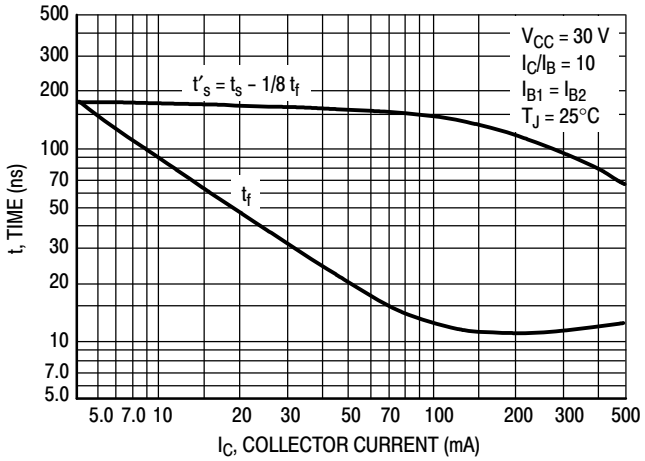


Figure 6. Turn – Off Time

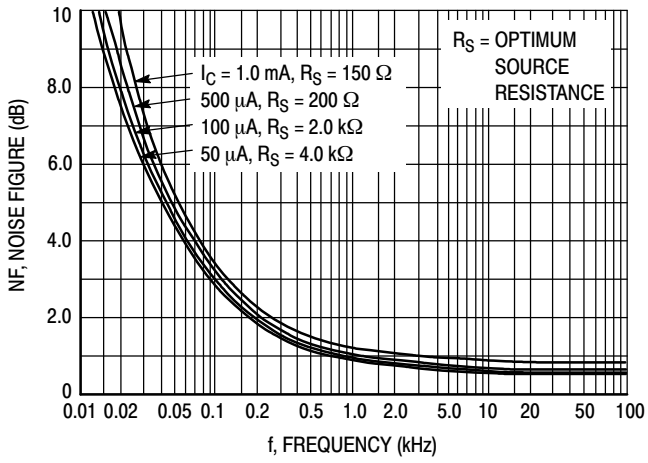


Figure 7. Frequency Effects

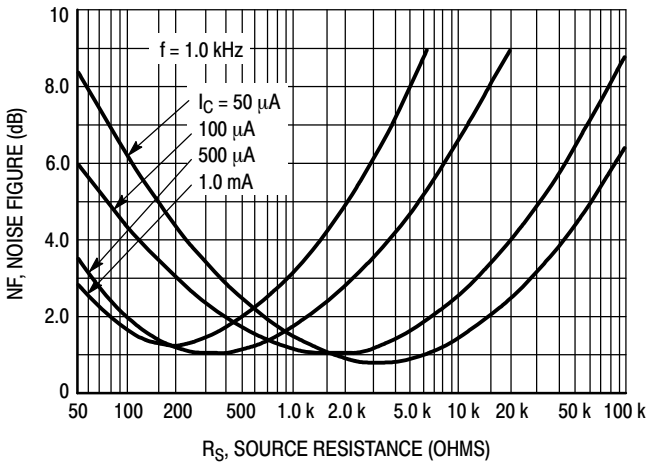


Figure 8. Source Resistance Effects

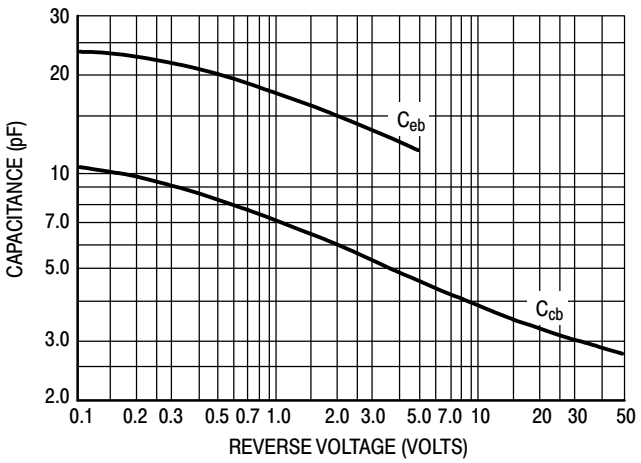


Figure 9. Capacitances

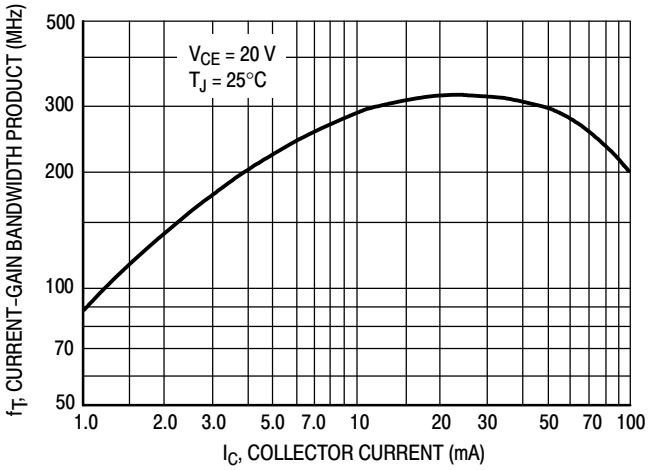


Figure 10. Current−Gain Bandwidth Product

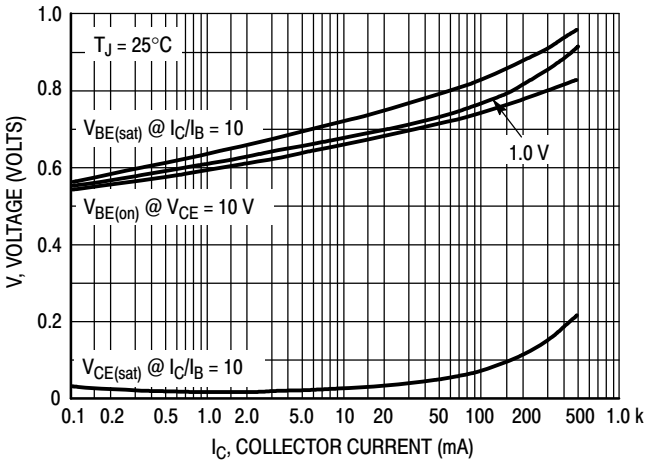


Figure 11. “On” Voltages

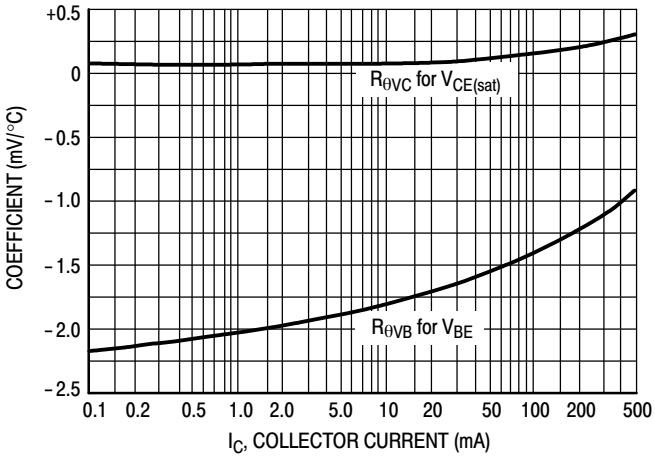


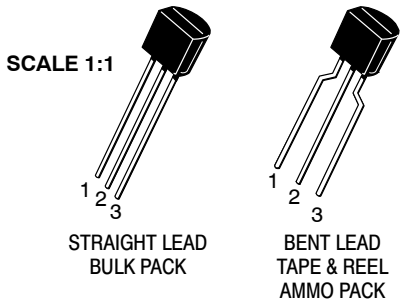
Figure 12. Temperature Coefficients

MECHANICAL CASE OUTLINE
PACKAGE DIMENSIONS

ON Semiconductor®

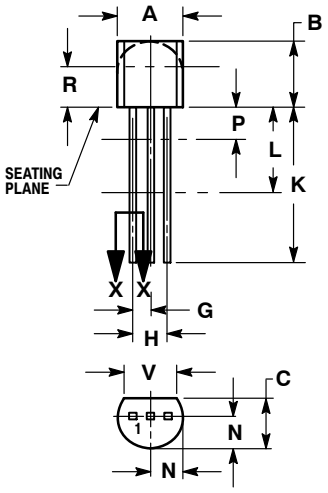
TO–92 (TO–226)
CASE 29–11
ISSUE AM

DATE 09 MAR 2007

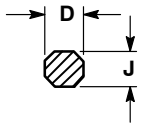


STRAIGHT LEAD
BULK PACK

BENT LEAD
TAPE & REEL
AMMO PACK



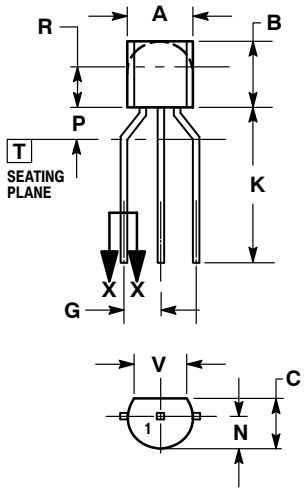
STRAIGHT LEAD
BULK PACK



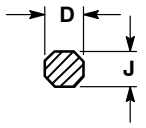
SECTION X–X

NOTES:
1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
2. CONTROLLING DIMENSION: INCH.
3. CONTOUR OF PACKAGE BEYOND DIMENSION R IS UNCONTROLLED.
4. LEAD DIMENSION IS UNCONTROLLED IN P AND BEYOND DIMENSION K MINIMUM.

	INCHES		MILLIMETERS	
DIM	MIN	MAX	MIN	MAX
A	0.175	0.205	4.45	5.20
B	0.170	0.210	4.32	5.33
C	0.125	0.165	3.18	4.19
D	0.016	0.021	0.407	0.533
G	0.045	0.055	1.15	1.39
H	0.095	0.105	2.42	2.66
J	0.015	0.020	0.39	0.50
K	0.500	---	12.70	---
L	0.250	---	6.35	---
N	0.080	0.105	2.04	2.66
P	---	0.100	---	2.54
R	0.115	---	2.93	---
V	0.135	---	3.43	---



BENT LEAD
TAPE & REEL
AMMO PACK



SECTION X–X

NOTES:
1. DIMENSIONING AND TOLERANCING PER ASME Y14.5M, 1994.
2. CONTROLLING DIMENSION: MILLIMETERS.
3. CONTOUR OF PACKAGE BEYOND DIMENSION R IS UNCONTROLLED.
4. LEAD DIMENSION IS UNCONTROLLED IN P AND BEYOND DIMENSION K MINIMUM.

	MILLIMETERS	
DIM	MIN	MAX
A	4.45	5.20
B	4.32	5.33
C	3.18	4.19
D	0.40	0.54
G	2.40	2.80
J	0.39	0.50
K	12.70	---
N	2.04	2.66
P	1.50	4.00
R	2.93	---
V	3.43	---

STYLES ON PAGE 2

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STATUS:	**ON SEMICONDUCTOR STANDARD**	
NEW STANDARD:		
DESCRIPTION:	**TO–92 (TO–226)**	**PAGE 1 OF 3**

TO−92 (TO−226)
CASE 29−11
ISSUE AM

DATE 09 MAR 2007

STYLE 1:
PIN 1. EMITTER
2. BASE
3. COLLECTOR

STYLE 2:
PIN 1. BASE
2. EMITTER
3. COLLECTOR

STYLE 3:
PIN 1. ANODE
2. ANODE
3. CATHODE

STYLE 4:
PIN 1. CATHODE
2. CATHODE
3. ANODE

STYLE 5:
PIN 1. DRAIN
2. SOURCE
3. GATE

STYLE 6:
PIN 1. GATE
2. SOURCE & SUBSTRATE
3. DRAIN

STYLE 7:
PIN 1. SOURCE
2. DRAIN
3. GATE

STYLE 8:
PIN 1. DRAIN
2. GATE
3. SOURCE & SUBSTRATE

STYLE 9:
PIN 1. BASE 1
2. EMITTER
3. BASE 2

STYLE 10:
PIN 1. CATHODE
2. GATE
3. ANODE

STYLE 11:
PIN 1. ANODE
2. CATHODE & ANODE
3. CATHODE

STYLE 12:
PIN 1. MAIN TERMINAL 1
2. GATE
3. MAIN TERMINAL 2

STYLE 13:
PIN 1. ANODE 1
2. GATE
3. CATHODE 2

STYLE 14:
PIN 1. EMITTER
2. COLLECTOR
3. BASE

STYLE 15:
PIN 1. ANODE 1
2. CATHODE
3. ANODE 2

STYLE 16:
PIN 1. ANODE
2. GATE
3. CATHODE

STYLE 17:
PIN 1. COLLECTOR
2. BASE
3. EMITTER

STYLE 18:
PIN 1. ANODE
2. CATHODE
3. NOT CONNECTED

STYLE 19:
PIN 1. GATE
2. ANODE
3. CATHODE

STYLE 20:
PIN 1. NOT CONNECTED
2. CATHODE
3. ANODE

STYLE 21:
PIN 1. COLLECTOR
2. EMITTER
3. BASE

STYLE 22:
PIN 1. SOURCE
2. GATE
3. DRAIN

STYLE 23:
PIN 1. GATE
2. SOURCE
3. DRAIN

STYLE 24:
PIN 1. EMITTER
2. COLLECTOR/ANODE
3. CATHODE

STYLE 25:
PIN 1. MT 1
2. GATE
3. MT 2

STYLE 26:
PIN 1. V_{CC}
2. GROUND 2
3. OUTPUT

STYLE 27:
PIN 1. MT
2. SUBSTRATE
3. MT

STYLE 28:
PIN 1. CATHODE
2. ANODE
3. GATE

STYLE 29:
PIN 1. NOT CONNECTED
2. ANODE
3. CATHODE

STYLE 30:
PIN 1. DRAIN
2. GATE
3. SOURCE

STYLE 31:
PIN 1. GATE
2. DRAIN
3. SOURCE

STYLE 32:
PIN 1. BASE
2. COLLECTOR
3. EMITTER

STYLE 33:
PIN 1. RETURN
2. INPUT
3. OUTPUT

STYLE 34:
PIN 1. INPUT
2. GROUND
3. LOGIC

STYLE 35:
PIN 1. GATE
2. COLLECTOR
3. EMITTER

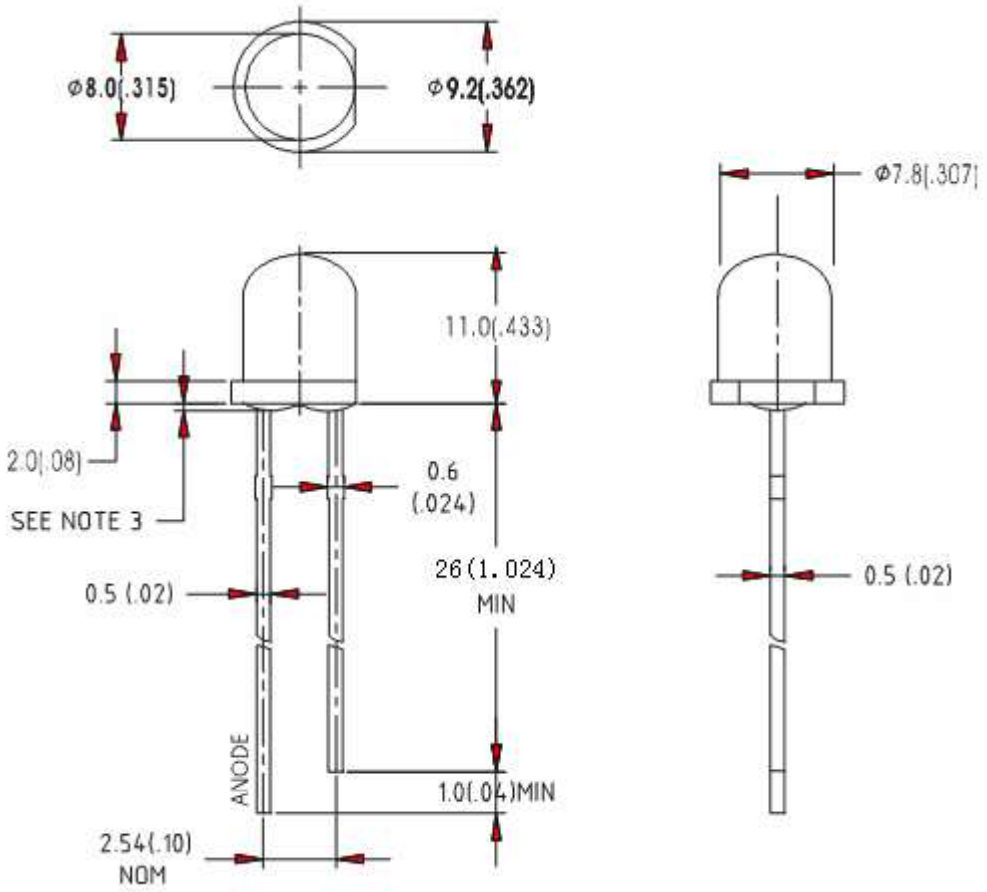
ISSUE	REVISION	DATE
AM	ADDED BENT−LEAD TAPE & REEL VERSION. REQ. BY J. SUPINA.	09 MAR 2007

ADDITIONAL INFORMATION

TECHNICAL PUBLICATIONS:
Technical Library: www.onsemi.com/design/resources/technical−documentation
onsemi Website: www.onsemi.com

ONLINE SUPPORT: www.onsemi.com/support
For additional information, please contact your local Sales Representative at www.onsemi.com/support/sales

Package Dimension:



Part No.	Chip Material	Lens Color	Source Color
LL-803YD2C-2Y	GaP	Yellow Diffused	Yellow

Notes:

1. All dimensions are in millimeters (inches).
2. Tolerance is ± 0.25 mm (.010") unless otherwise noted.
3. Protruded resin under flange is 1.00 mm (.04") max.
4. Specifications are subject to change without notice.

Absolute Maximum Ratings at Ta=25℃

Parameters	Symbol	Max.	Unit
Power Dissipation	PD	78	mW
Peak Forward Current (1/10 Duty Cycle, 0.1ms Pulse Width)	IFP	100	mA
Forward Current	IF	30	mA
Reverse Voltage	VR	5	V
Operating Temperature Range	Topr	-40℃ to +80℃	
Storage Temperature Range	Tstg	-40℃ to +85℃	
Lead Soldering Temperature [4mm (.157") From Body]	Tsld	260℃ for 5 Seconds	

Electrical Optical Characteristics at Ta=25℃

Parameters	Symbol	Min.	Typ.	Max.	Unit	Test Condition
Luminous Intensity *	IV	3	13	---	mcd	IF=10mA (Note 1)
Viewing Angle *	$2\theta_{1/2}$	---	40	---	Deg	IF=20mA (Note 2)
Peak Emission Wavelength	λp	---	592	---	nm	IF=20mA
Dominant Wavelength	λd	---	589	---	nm	IF=20mA (Note 3)
Spectral Line Half-Width	△λ	---	35	---	nm	I_F=20mA
Forward Voltage	VF	1.80	2.20	2.60	V	IF=20mA
Reverse Current	IR	---	---	10	μA	V_R=5V

Notes:

1. Luminous Intensity Measurement allowance is ± 10%.
2. $\theta_{1/2}$ is the off-axis angle at which the luminous intensity is half the axial luminous intensity.
3. The dominant wavelength (λd) is derived from the CIE chromaticity diagram and represents the single wavelength which defines the color of the device.

VEGOVA | ELEKTROTEHNIŠKO - RAČUNALNIŠKA STROKOVNA ŠOLA IN GIMNAZIJA LJUBLJANA

30. državno tekmovanje elektro šol in 12. državno tekmovanje računalniških šol

Kategorija Elektrotehnik

Ocenjevalni obrazec

Ljubljana, 28. marec 2024

OCENJEVALNI OBRAZEC

Točke dobi ekipa samo v primeru, da navedeni elementi delujejo (oz. da so funkcionalnosti izpolnjene). Vsaka spodaj našteta funkcionalnost je vredna dve točki, delno izpolnjena funkcionalnost pa eno točko. Neizpolnjena pa nič točk.

Če dve ali več ekip doseže enako število točk, boljše mesto zasede ekipa z najkrajšim časom reševanja tekmovalne naloge.

FACTORY I/O

POZICIJA	OPIS DELOVANJE POSAMEZNEGA SKLOPA	DOSEŽENE TOČKE
1	Tipka START na omarici vklopi oba trakova, če je izbrana lokacija krmiljenja NAVIDEZNO.	/2
2	Tipka STOP na omarici izklopi oba trakova, če je izbrana lokacija krmiljenja NAVIDEZNO.	/2
3	Podajalnik podaja zaboje na trak (pravilne nastavitve - časi, izdelki).	/2
4	Dva odjemalnika za velike in male škatle jemljeta škatle s trakov (pravilne nastavitve - časi, izdelki).	/2
5	Senzor škatel pravilno zaznava velike ali male škatle.	/2
6	Kretnica oz. cilinder pravilno deluje. To pomeni, da pravilno izloča večje škatle na drug trak neodvisno od hitrosti premikanja trakov.	/2
7	Številčni zaslon ŠTEVEC na omarici prikazuje pravilno število izločenih velikih škatel.	/2
8	Rumena lučka OPOZORILO na krmilni omarici začne utripati, ko vrednost števca preseže vrednost 5. To pomeni, ko je n>5. Frekvenca utripanja naj bo približno 2 Hz.	/2
9	Po prvem pritisku na rumeno tipko PONASTAVI mora rumena lučka nehati utripati in ostati prižgana. Rumena tipka PONASTAVI deluje le, če je izbrana lokacija krmiljenja NAVIDEZNO. Števec mora še vedno prikazovati aktualno trenutno vrednost.	/2
10	Po drugem pritisku na rumeno tipko PONASTAVI le ob pogoju, ko je izbrana lokacija krmiljenja NAVIDEZNO, se dejansko zbriše stanje števca (postavi se na vrednost nič n=0). Rumena lučka OPOZORILO tedaj ugasne.	/2
11	Potenciometer HITROST na čelni plošči omarice krmili hitrost delovanja trakov le, ko je izbrana lokacija krmiljenja NAVIDEZNO.	/2
12	Preklopno stikalo KRMILJENJE za izbiro lokacije krmiljenja preklaplja med krmiljenjem preko fizičnega ali navideznega vmesnika.	0, ker je funkcionalnost zajeta pri drugih pozicijah

PLOŠČICA

POZICIJA	OPIS DELOVANJE POSAMEZNEGA SKLOPA	DOSEŽENE TOČKE
13	Fizična tipka za start (zelena) vklopi oba trakova, če je na omarici v Factory I/O izbrana lokacija krmiljenja FIZIČNO.	/2
14	Fizična tipka za stop (rdeča) izklopi oba trakova, če je na omarici v Factory I/O izbrana lokacija krmiljenja FIZIČNO.	/2
15	Prikaz enic na dvojnem 7-segmentnem LED prikazovalniku je pravilen glede na število izločenih velikih škatel.	/2
16	Prikaz desetic na dvojnem 7-segmentnem LED prikazovalniku je pravilen glede na število izločenih velikih škatel.	/2
17	Rumena LED začne utripati, ko vrednost števca preseže vrednost 5. To pomeni, ko je n>5. Frekvenca utripanja naj bo približno 2 Hz.	/2
18	Po prvem pritisku na tipko za ponastavitev (rumena) mora rumena LED nehati utripati in ostati prižgana. Tipka za ponastavitev deluje le, če je izbrana lokacija krmiljenja FIZIČNO. Števec mora še vedno prikazovati aktualno trenutno vrednost.	/2
19	Po drugem pritisku tipko za ponastavitev (rumena) le ob pogoju, ko je izbrana lokacija krmiljenja FIZIČNO, se dejansko zbriše stanje števca (postavi se na vrednost nič n=0). Rumena lučka OPOZORILO tedaj ugasne.	/2
20	Potenciometer za hitrost krmili hitrost delovanja trakov le, ko je izbrana lokacija krmiljenja FIZIČNO.	/2

DOSEŽENE TOČKE	/38

OCENJEVALNA KOMISIJA

1.

2.

3.