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REJTANG - Industrianpassad Programmeringsenhet

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Abstract

As a result of microcomputers becoming less costly, they are often used for quite specialized tasks. In control and measurement applications a few commands are used frequently. This has created a demand from industry of designing their keyboards with big keys for GO, STOP etc. It is not possible to connect such a keyboard directly to a computer i.e. an interface is needed. Rejtang is such an interface, that can be programmed from the computer to give the various keys their functions dynamically during execution.

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Examensarbete av
Sverre Palmquist
utfört för
Rejlers Ingenjörsbyrå

Handledare: Gustaf Olsson

Abstract:

Som ett resultat av att microdatorerna har sjunkit i pris, används datorerna ofta till väldigt specialicerade uppgifter. Vid styr och mätapplicationer använder man få olika kommandon frekvent. Detta har skapat ett behov från industrin att själv kunna bygga sitt "tangentbord", med stora tangenter/ knappar för t.ex GO, NÖDSTOPP osv. Det är inte möjligt att ansluta ett sådant tangentbord direkt till en dator utan det behövs ett mellanled , ett interface. Rejtang är ett sådant interface, som kan programmeras från datorn för att de olika tangenterna skall få sin funktion. Det är möjligt att omdefiniera funktionen för sitt tangentbord mjukvarumässigt via datorn, och detta kan ske dynamiskt under programmets gång.

As a result of microcomputers becoming less costly, they are often used for quite specialized tasks. In control and measurement applications a few commands are used frequently. This has created a demand from industry of designing their keybords with big keys for GO, STOP etc. It is not possible to connect such a keybord directly to a computer i.e. an interface is needed. Rejtang is such an interface, that can be programmed from the computer to give the various keys their desired function. It is also possible to redefine their functions dynamically during execution.

Innehållsförteckning:

E. Schema hårdvara

F. Datablad ingående komponenter

G. Defaultvärden

Inledning:

I olika styr och reglerprogram har det funnits ett behov av att kunden själv utformar sin programmeringspanel. Då de lite klena standard-tangentborden inte alltid klarar den tunga miljö som kan vara aktuell. Det finns därför ett behov att kunna bygga upp en panel som är specialgjord för sin uppgift.

Vanligtvis används ett mindre PC-system för att sköta en process. När detta är datorns huvudsakliga uppgift, används få kommandon ofta. Ett flertal av Rejlers kunder har därför gjort förfrågningar om en möjlighet att själva bygga sin panel. De kontaktdon som kunderna vill använda går inte att ansluta direkt till datorn, utan kräver ett interface.

Examensarbetet har gått ut på att bygga detta interface samt göra den programmering som är nödvändig. Stommen är en standard enkortsdator (1004-10 från Dataindustrier) som kompletterats med ett framtaget in/ut-kort för anslutning av kontakter. För den seriella kommunikationen mot datorn är ett TTL till RS485 interface framtaget. (se appendix E)

Rejtang är således ett programmerbart interface mot datorn. Det finns möjlighet att fördefiniera 64 st tryck-knappspunkter.

Under utvecklingen av Rejtang byggdes en betydande flexibilitet in i systemet från start, genom att samtliga rutiner är skrivna för största möjliga generalitet. Det finns bl.a ett omfattande paket för listhantering, som ej utnyttjas till fullo för närvarande. Denna inbyggda överkapacitet möjliggör en enkel utbyggnad av programvaran med nya faciliteter.

Syfte:

Att utveckla den erfoderliga elektronik och programvara som behövs till en kontrollenhet för en i industri uppbyggd programmerings panel.
Enheten skall innehålla kompletta funktioner för att ansluta ett koordinatsystem av tangenter, (som via seriell kommunikation via datorn), kan programmeras för valfri funktion.
Anslutningen från enhet till yttre kontakter sker genom att kortsluta en punkt mellan två kopplingslister på TANG, den ena med beteckning A-H och den andra 1-8. Detta ger 64 olika kombinationer. Tex A1, A2, A3, A4 .... H8.
Dessa olika kontaktpunkter skall kunna programmeras för att ge valfri asciisträng (1 -> 128 st tecken) sänd på en seriell kanal till dator, samt med möjlighet att välja valfri individuell repetitionshastighet.
TANG skall eliminera kontaktstudsinverkan, samt undertrycka yttre störningar.
Via TANG enheten skall även en uppsättning på 8 st utgångar för anslutng av yttre lysdioder, kunna tändas respektive släckas via kommando från dator.

Kravspecifikation:

- digitala ingångar för att avkänna minst 40 st kontaktpunkter

- 8 st digitala utgångar för lysdioder

- unik ascii kod för varje kontaktpunkt

- Om flera kontaktpunkter aktiveras samtidigt skall motsvarande asciikoder sändas direkt efter varandra.

- då en tryckknapp hållits intryckt under en viss tid autorepeteras sändningen av ascii-koden.

- enheten skall kunna ta emot kommandon från datorn via seriekanal för att ändra parametrarna för:
  vilken ascii kod som genereras för vilken tangent
  vilka tryckknappar skall kunna auto repetera
  vilken frekvens för autorepetitionen
  vilka lysdioder skall vara tända

- elektriska gränssnittet skall vara RS485

Funktionsbeskrivning

Vid uppstart av Rejtang initieras de erfoderliga I/O kretsarna på CPU-kortet. Default värden till tangentlistan och timing ställs upp (se appendix G). Tangentlistan är en slags data-area som översätter tangent-koordinaten till teckenkod. Efter denna initiering ställer sig Rejtang i Huvudloopen där den scannar av tangent för tangent genom att lägga ut en rad, och läsa motsvarande kolumn i tangentkoordinat-systemet. När samtliga element i listan har testats ställer sig Huvudloopen och väntar på ett klockavbrott. Testet innehåller t.ex fråga om tangenten är nedtryckt, om den är aktiverad eller om autorepetition skall startas. Detta klockavbrott, som kan ha skett innan varvet är färdigt, tillåter en "varv räknare" att räknas upp. Varvräknarens uppgift är att se till att inga ackumulerade tidsfel uppstår. Denna varvräknare sköter timingen för kontaktstuds osv. Syftet med varvräknaren är att nedtryckning av två eller fler tangenter alltid skall ge samma följd av svar. Klockans funktion är att få timingen oberoende av antalet tangenter som är inlagda i listan.

Om tangentlistan har ändrats börjar varvet om direkt utan att avsluta resterande tangenter. Det element som påbörjats slutförs dock.

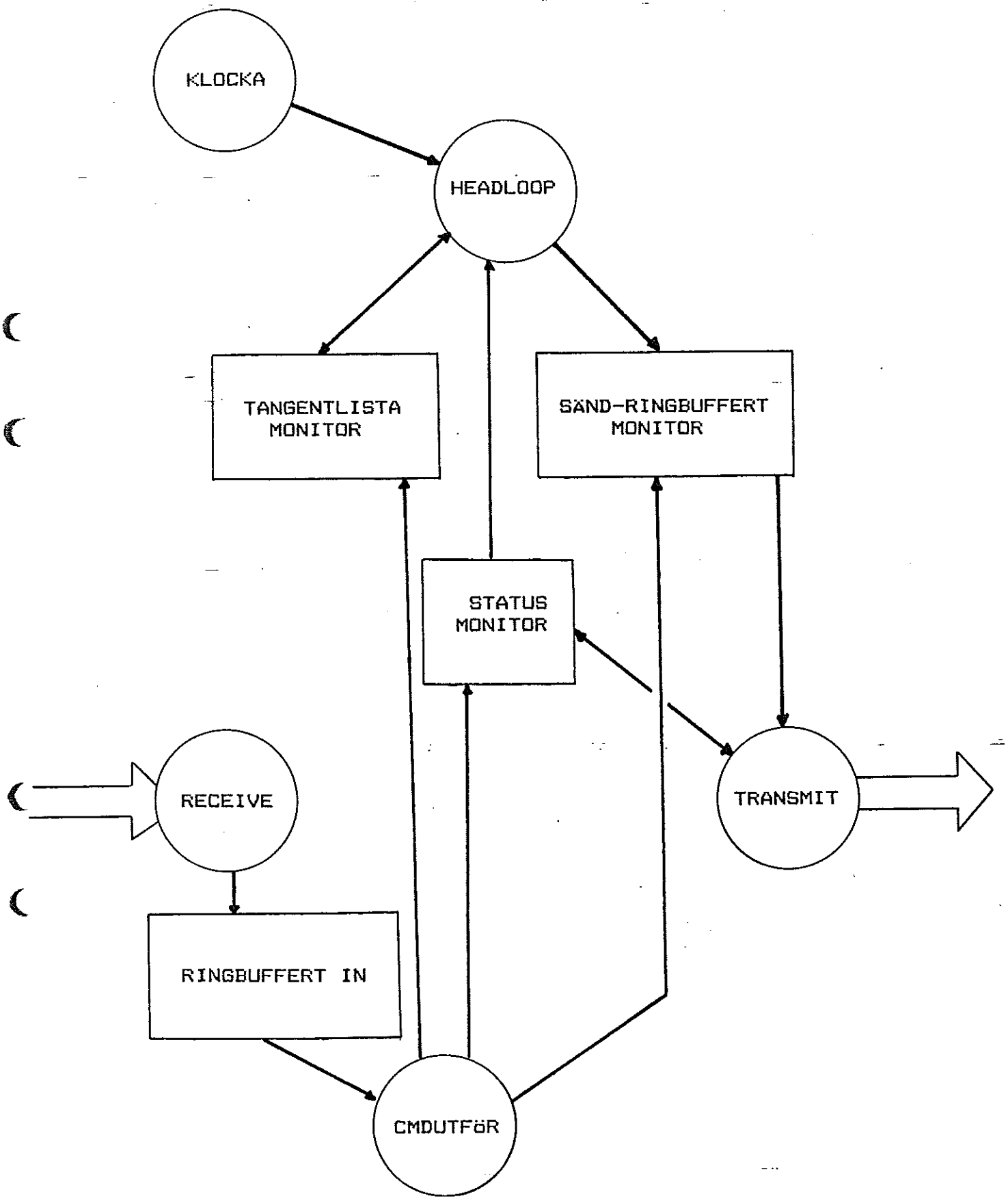
Vid tangentnedtryckning, som varat tillräckligt länge för att motsvarande teckenkod skall skrivas ut, kallar Huvudloopen på en rutin (Skrstr) som arbetar mot en monitor (Sänd-ringbuffert). Informationen i tangentlistan kopieras över till Sänd-ringbufferten. Mot denna monitor arbetar sedan en process (Transmit) som skriver tecknen ett och ett till datorn. Detta sker under ömsesidig uteslutning. De olika specialfallen: buffert full / buffert tom tas om hand i rutinerna. Skulle bufferten vara full ställs anropet att vänta på en händelse för att därefter se om plats finns.

När Rejtang programmeras, uppnås ömsesidig uteslutning genom att varje kommandosträng som sänds till Rejtang, kvitteras med en statusbit. Därefter är Rejtang redo att ta emot ett nytt kommando. Det förutsätts att ingen aktivitet sker mot tangent-koordinaterna under programmeringen från värddatorn.

Om kommandot innebär att en tangent omdefinieras kommer detta att indikeras i en programstatus flagga. Detta medför sedan att Huvudloopen ej hämtar nästa element i listan utan startar från början av listan igen.

För närmare kännedom om dessa förlopp refereras till processgrafen på nästa sida, programlistor samt appendix C.

Processgraf:



Processbeskrivning REJTANG:

Rejtang består av fem processer, vilka är:

Klocka:

En egen process som räknar upp en variabel Time, denna variabel sköter tîmingen för Huvudloopen.

Huvudloop:

Här sker den egentliga tangentbordsavkodningen, med hjälp av en länkad lista *) där all erfoderlig information ligger. Huvudloopen talar med en rutin Skrstr som är en monitor till processen Transmit som sänder de tecken som blivit inlagda i monitorn.

*) listan och dess uppbyggnad är beskriven i app. A.

Receive:

En egen process som tar emot ett tecken från den seriella ingången och lägger detta i en ringbuffert. Denna ringbuffert används endast till Receive. Om tecknet är ett avslutningstecken (här valt CHR$(0)) sker ett hopp till en process Cmdutför (se nedan) som avkodar det kommando som valts, samt utför vad som begärts. Efter varje avslutad kommando sträng svarar Rejtang alltid med en ascii byte mellan 0 -> 9 (se handhavande beskrivning). Detta ger den erfoderliga handskakningen. Buffertens storlek är vald till 140 tecken, men ändras enkelt i modulen Rejdef. (app. C)

Transmit:

Fristående process som sänder det som är inlagt i en Sänd-ringbuffert (monitor). Information fylls in till Sänd-ringbufferten via rutinen Skrstr. (se prog.lista) När Sänd-ringbufferten är tom, stängs rutinen av och väntar på en händelse via rutinen Skrstr, som återigen startar Transmit. Om ringbufferten är full vid anropet från Skrstr, inväntas en händelse. Ett nytt försök att lägga in tecken görs, ända till alla tecken är skrivna in till Sänd-ringbufferten.

Cmdutför:

Avkodar den kommando sträng som sänts till Rejtang samt utför det som begärts enligt syntax specifikationen. Rejcmd "svarar" alltid med en statusbit *) om hur begärt kommando har utförts. Denna statusbit är en asciisiffra mellan 0 och 9, 0 motsvar allt väl och talen 3 till 9 något fel. Rejcmd fyller och ändrar i den länkade lista som Huvudloopen använder.

*) statusbiten beskriven på sid 8.

Monitorer

Rejtang använder sig av fyra stycken monitorer.

Tangentlista, monitor:
Här finns all information om de individuella tangenterna, deras repetitionstid, vilka tecken dom representerar osv. Mot denna monitor arbetar processerna Cmdutför och Huvudloop, Cmdutför lägger in nya definitioner samt ändrar i gamla definitioner. När en ny definition har infogats indikeras detta i en status monitor, se nedan. För att ej få realtidsproblem med denna monitor, börjar alltid Huvudloopen om från början i Tangentlistan efter att ett element har blivit raderat från monitorn. I annat fall tillåts Huvudloopen att fortsätta med de eventuellt nya värdena.

Status monitor:
Här finns information om lysdiodernas status, (ställs i Cmdutför och läses från Huvudloop). Det finns även information om Sänd-ringbuffert monitorn (se nedan). Monitorn består av två bytes:

1) Diodstat som direkt motsvarar tända/ släckta lysdioder.
2) Progstat där de ingående bitarna innebär:

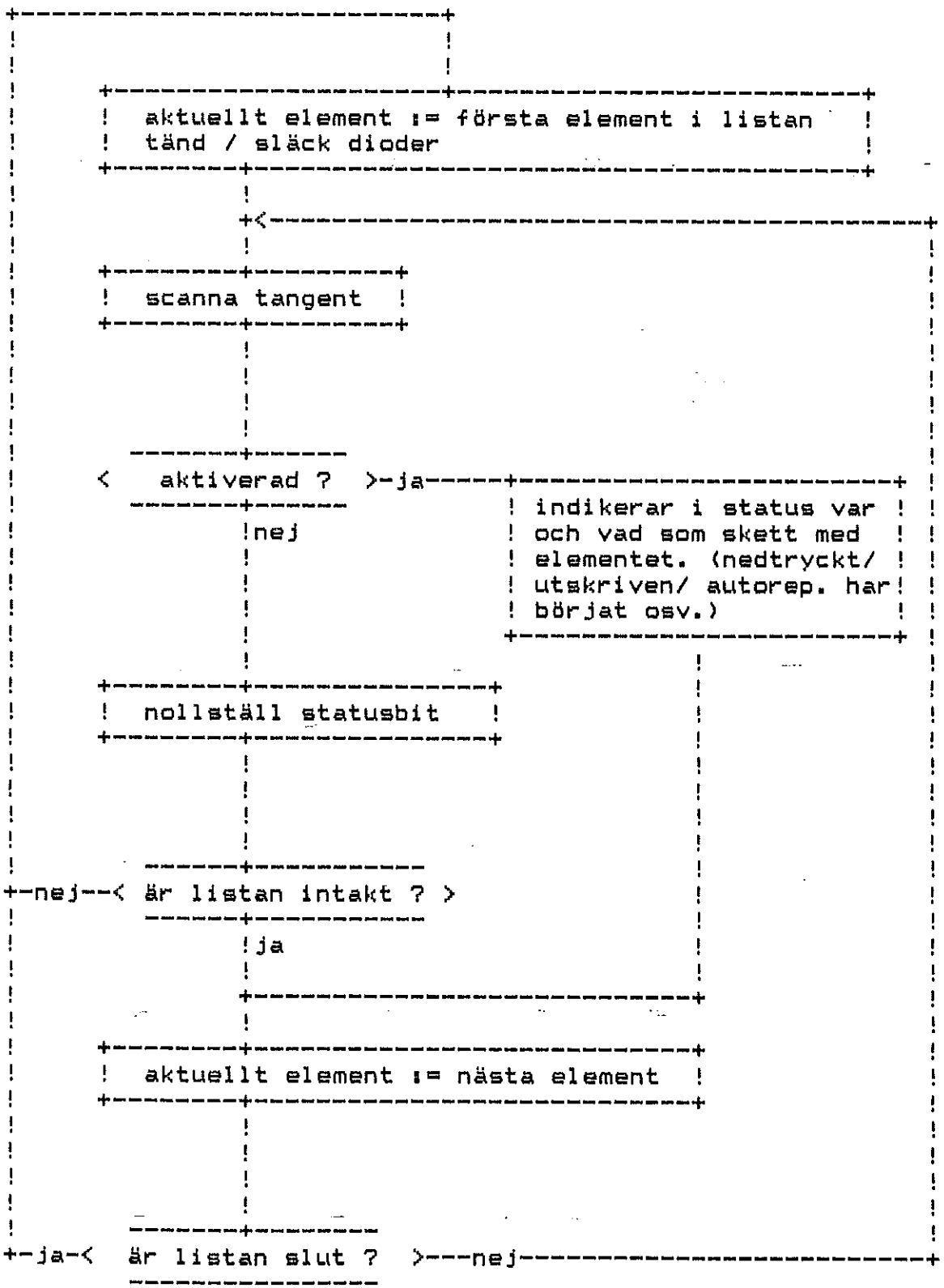
```
bit 0 = 0 -> Ny uppstart
bit 1 = 0 -> Tx interupt pending avstängd
bit 2 = 0 -> Sänd-ringbuffert är tom
bit 3        ej använd
bit 4 = 1 -> Begärd reset
bit 5        ej använd
bit 6 = 0 -> listan är ändrad
bit 7        ej använd
```

De fyra lägsta bitvikterna nollställs vid initieringen. De fyra högsta bitarna blir oförändrade vid initiering.

Sänd-ringbuffert monitor:
Monitor där utbufferten till sändrutinen (Transmit) finns. Mot denna monitor jobbar rutinen Skrstr (beskriven i appendix B) och processen Transmit. Skyddad genom ömsesidig uteslutning.

Ringbuffert-in:
Hit läggs de indata som kommer via processen Receive. Efter avslutat kommando använder Cmdutför kommandosträngen som finns här. Detta utan att kopiera den till en arbetsarea. Ringbuffert-in skyddas genom handskakning mot värddatorn.

Flödesschema huvudloop



Handhavandebeskrivning:

Programmeringsrutinerna mot Rejtang består av tre delar:

1) Kommando för lysdioder
2) Modifiering av tangenter
3) Generella kommando

Generellt avslutas alla kommandon med ett specialtecken som är det enda som inte kan ingå i tangentbordets teckenuppsättning. Här är det valt till chr$(0). Chr$(0) kan alltså ej lämnas från Rejtang. Rejtang svarar alltid med ett tal mellan 0 och 9 efter ett avslutat kommando. Denna siffra skickas över som en byte med ascii värdet för motsvarande siffra. Innebörden av de olika svaren är följande:

Kvittens svar efter avslutat kommando:

kvittens svar	
0	ALLT OK
1	- (ej definierad)
2	BEGÄRD RESET
fel meddelande:	
3	MINNES BRIST, KOMMANDO EJ UTFÖRT !
4	TANGENT SAKNAS I LISTAN
5	RANGE ERROR ASCII STRÄNG
6	RANGE ERROR TANGENT A1 -> H8
7	RANGE ERROR LYSDIOD 1 -> 8
8	FÖRVÄNTAD SIFFRA UTEBLIVEN
9	OKÄNT KOMMANDO

Svarsalternativ 2 ges endast efter begärd reset, eller eventuellt efter spänningstillslag. Vilket beror på att minnescellernas start-tillstånd är slumpmässiga.

För lysdioderna:

Tänd / Släck diod.
För att tända en diod sänder man en ascii-sträng till Rejtang bestående av "L:"+ diodnummer avslutat med en chr$(0). På motsvarande vis släcker man med "U:"+ diodnummer.

För tangentlistan:

Här finns all information om de individuella tangenternas status.

1) lägga in information om en ny definition för tangent.

2) ändra information på en redan existerande tangent.

3) aktiverad tangent

4) deaktiverad tangent

I samtliga fall refereras tangenten med sin koordinatplats, dvs A-H + 1-8. ex A1 .. H8, först anges bokstav och därefter siffra.

Initalvärde vid uppstart.
Vid uppstart av Rejtang har alla kontakt-koordinaterna ett defaultvärde. Det är autorepetition med ca 60 ms intervall samt tecken 0 till o för A1 -> H8. (Se appendix G för specifikation.)

Ny definition.
När man lägger till en ny definition raderas den existerande definitionen ur listan samt den nya läggs sist. Detta innebär att efter många omdefinieringar kommer minnet att fyllas. Om detta leder till att minnet blir fullt svarar Rejtang 3, minnesbrist. Vid försök att lägga in ytterligare tangentdefinitioner. För att undvika detta bör man tömma minnet vid nydefiniering av hela tangentbordet. Detta beskrives i avsnittet om generella kommandon.

Ändra i definition.
Kommandot för att ändra definitionen tillåter att asciisträng samt repetitionshastighet ändras. Ett absolut krav är att asciisträngen ej är längre än den tidigare definierade. I defaultlistan är samtliga tangenters definition inställda på en ascii längd av ett tecken. Skulle den nya strängen vara längre än den som tidigare definierats kommer Rejtang svara med 5, range error ascii.

Aktivera / Deaktivera tangent.
Det finns möjlighet att "stänga av" en tangent temporärt med strängen "D:"+ tangentkoordinat. Detta för att vissa alternativ inte alltid skall vara möjliga i alla lägen. För att åter "sätta på" tangenten används "A:"+ tangentkoordinat. Dessa kommandon ändrar inget av definitionerna i övrigt.

Generella kommandon:

Initiering av defaultlista.

1) "RESET", som används för att nollställa allt i Rejtang. Samt att lägga upp defaultvärdena inkl defaultlistan.

Tömma tangentlista.

2) Kommandot "R:" innebär att tangentlistan töms och används för att tömma tangentlistan och tillgodogöra sig minnesutrymmet igen. OBS ! Efter detta kommando töms även defaultvärdena, vilket innebär att inga tangenter finns definierade !

Ändra default tider.

3) Kommando för att ändra tiderna för kontaktstudselimination, och tiden för att autorepetionen skall starta. Detta används som "T:"+ kontaktstudseliminationstid + start till autorepetionstid, varje enhet motsvarar ca 0.01 sek Defaulttiderna är "T:2 60" och behöver normalt inte ändras.

Sammanfattning:
Kommando till Rejtang

För Lysdioder:

"L:1"+chr¤(0)	Tänd diod 1
"U:1"+chr¤(0)	Släck diod 1

För tangentlista:

"F:A1 50 YES"+chr¤(0)	Definiera tangent A1 med YES och en repetitionstid på ca 500 millisekunder
"C:A1 50 NO"+chr¤(0)	Omdefiniera tangent A1 till NO.
"D:A1"+chr¤(0)	Deaktivera tangent A1
"A:A1"+chr¤(0)	Aktivera tangent A1

Generella kommando:

"RESET"+chr¤(0)	Töm alla definitioner, återlämna använt minne
"R:"+chr¤(0)	Tömmer tangentlistan
"T:3 60"+chr¤(0)	Ändra kontaktsudstiden till ca 3 millisekunder, autorepetiotion startar efter 600 millisekunder,

Exempel

L(ight) : 1 -> 8
tänder lysdiod 1 -> 8

ex. "L:5" chr¤(0)

U(nlight) : 0 -> 7
släcker lysdiod 0 -> 7

ex. "U:5" chr¤(0)

F(ill) : koordinat repeat "asciisträng"
Definiera en tangent i tangentlistan

ex "F:A1 12 RUN"+chr¤(0)
=> Om tangent A1 trycks ner sänds "RUN" till datorn

C(hange) : koordinat repeat "asciisträng"
Byter innehåll i existerande lista. OBS ascii får ej vara längre än vad som tidigare definierats med F(ill)

ex. "C:A1 12 A"+chr¤(0)
=> Byter RUN mot A i existerande lista. repeat är det samma som tidigare.

D(eaktivate) : koordinat
Stänger av motsvarande tangent utan att förstöra informationsblocket, vilket innebär att ingeting händer om motsvarande tangent trycks ner.

ex "D:A5"+chr¤(0)

A(ktivate) : koordinat
Aktiverar motsvarande tangent (används efter det att den blivit avstängd via kommandot deaktivate)

ex "A:A5"+chr¤(0)

RESET:
Mjukvarumässig reset för TANG, nollställer allt som tidigare definierats. Ställer samtliga värden till default.

ex. "RESET" chr¤(0)

R:
Tömmer defaultlistan för tangenter, och återlämnar använt minne. Efter detta kommando finns ingen tangent definierad.

ex. "R:"+chr¤(0)

T(iming) kontaktstudselimination & autorepetitions-start
Definierar tidsparametrar.
ex. "T:3 60"+chr¤(0)

(se föregående sida)

Litteraturförteckning:

Z80-CPU Z80A-CPU
Technical Manual, Zilog 1977

- - - - -

Z80 CPU, PIO & CTC
Tecknical manual, SGS 1981

- - - - -

Z80 SIO
Technincal manual, SGS

- - - - -

Z80-CPU Programming Reference Card
SGS-ATES

- - - - -

Z80 Assembly language programming
Lance A. Leventhal

- - - - -

Linear Databook
National Semiconductor

- - - - -

THE TTL DATA BOOK Vol 1
Texas Instrument

- - - - -

DATABOARD 4680 1004-10
Z80A-CTC-SIO Single Board computer
Datablad.

- - - - -

Bit för Bit
Luxor Datorer 1982

- - - - -

- - - - -

DATOR ABC802
Manual BASIC II
Luxor Datorer

- - - - -

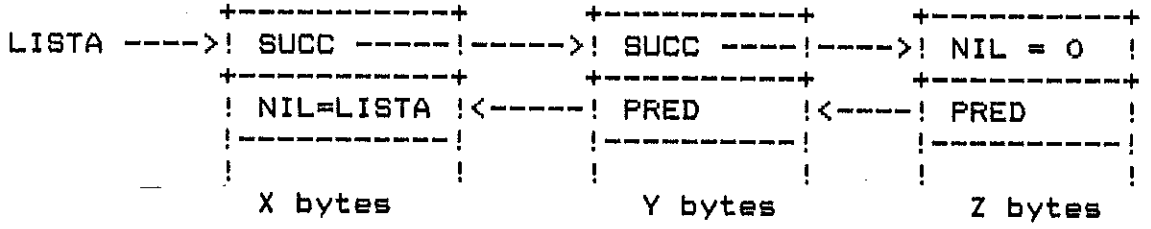
Microprocessor Applications Reference Book
volume 1, Zilog juli 1981

- - - - -

Listor och dess uppbyggnad i TANG:

Globala variabler är:

BOTRAM	Start på ledigt ram minne
TOPRAM	Slut på ledigt ram minne



Listans uppbyggnad framgår av ovanstående figur. Variabeln LISTA pekar på det första elementet i listan, och de två första byten pekar på nästa element. Listans sista element indikeras av SUCC pekaren = 0. De två efterföljande byten pekar på föregående element. Efter dessa två tvåbytespekare ligger data enligt nedan spec storlekarna X, Y och Z behöver inte vara lika stora, vilket ger dynamisk storlek på varje listelement.

Sista elementet i listan pekar på NIL, vilket är identiskt med att vidarepekaren = 0.
Första elementets PRED pekare pekar på NIL, vilket motsvarar att det pekar på sig själv.

I dokumentationen kommer representationen av ett listelement vara en 16 bitars adress, en pekaren, följt av en punkt samt variabelnamnet. Ex: ett element i en lista heter pek, nästa element i denna lista är pek.succ.

Succ och Pred är de enda fördefinierade variabelernan i liststrukturen, dessa måste ligga först och uppta två bytes var. Om en variabel följs av ett stort L eller H betyder det låg respektive låg byte i en adress. ex: pek.succL & pek.succH

Tangent-listan i TANG:

TANGLIST	ADR:
SUCC	TANGLIST
PRED	TANGLIST+2
STATUS	TANGLIST+4
TG	TANGLIST+5
REPEAT	TANGLIST+6
COUNT	TANGLIST+7
ANT. ASCII	TANGLIST+8
ASCIISTRÄNG	TANGLIST+6

För att använda listor skapas ett listhuvud vid assemblering-en genom-att reservera två 2 bytes pekare, som skall peka till NIL. (se appendix C, modul REJDEF)
För att sedan använda denna lista användes de subrutiner som beskrivs på följande sidor. Ett nytt listhuvud skall ej skapas dynamiskt, utan endast nya element i redan existerande listor.

Rutiner för listor:

NEW(storlek,pek)
Skapar ett tomt listelement i minnet

IN: BC : storlek (antal bytes, att reservera)
UT: DE : adress till reserverat element, pek
Returnerar carry=1 om minnesbrist

HEAD(pek)
Ger carry=1 om pek pekar på listhuvudet

IN: DE : pek
UT: oförändrat

INLAST(pek,lista) Lägger elementet pek sist i listan lista

IN: DE pek
HL lista
UT: oförändrat

LAST(pek)
Hämtar sista element i listan

IN: DE pek
UT: DE sista element

FIRST(pek)
Hämtar första element i listan

IN: DE pek
UT: DE första element

DEL(pek,lista)
Tar bort elementet pek ur listan lista, om pek inte finns i lista händer ingenting.

IN: DE pek
HL lista
UT: oförändrat

LSUCC(pek)

Hämtar nästa element i listan

IN: DE pek
UT: DE pek.succ carry=0, om pek.succ <> NIL
annars DE oförändrat carry=1

LPRED(pek)

Hämtar föregående element i listan

IN: DE pek
UT: DE pek.pred carry=0, om pek.pred <> NIL
annars DE oförändrat carry=1

Modulbeskrivning:

Programpaketet är uppdelat i 11 st filer, där varje fil har ett modulnamn. Modulnamnet är skrivet med svart stil, och de ingående subrutinerna med understruken stil:

INITSIO

Initierar IO-kretsarna Z80-SIO och Z80-CTC på CPU kortet.

REJINTER

Interruptrutinerna som ingår vid kommunikationen samt den egna processen klocka

RECEIVE: Tar emot enligt tidigare

TRANSMIT: Sänder enligt tidigare

TRANS: Startar processen transmit

KLOCKA: Klockprocess

EXTSTAT: Skall normalt aldrig anropas, felrutin, nollställer felflaggan

SPRXCOND: Skall normalt aldrig anropas, felrutin, nollställer felflaggan

SKRSTR

Talar med sänd-ringbufferten, genom ömsesidig uteslutning.

SKRSTR: lägger in BC (register upsättning i CPU) tecken till sänd-ringbuffert-monitorn. Från adress som register HL pekar på. Väntar på ledigt utrymme om buffert full.

REJINIT

Initieringsmodul, initierar nödvändiga minnesvariabler samt lägger upp defaultlistan för tangenter

INITMEM: Initierar minne samt lista

INDEFAULT: Lägger upp defaultlistan, se appendix B, för tangenter.

RESLISTA: Tömmer tangentlistan

REJLEX

Sköter avkodningen av kommando mot en tabell, tabellen är uppbyggd som kommando, skiljebit+rutin-nummer Returnerar rutinnummer som svar. Om man skall lägga till eller ta bort något kommando görs detta genom att ändra i tabellen enligt programlista.

REJLEX: Kommandoavkodningsrutin, returnerar reg A=rutin nummer A=0 innebär att rutinen saknas i lista.

REJCMD

Kommando avkodningsrutiner, samt vissa hjälprutiner

CMDUTFÖR: Kallar på lexscan som avkodar kommando samt utför begärt kommando

ERR0,.. ERR9: Skriver statusbyte

SKIPBLANK: Läser förbi blanka i en sträng

SIFFRA: Returnerar i reg A=tal som HL pekar på eller om det ej är en siffra carry=1

GRÄNS: Kollar om 1<A<9 om så är fallet returnera carry=0 annars carry=1.

TANGENT: Packar upp tangent från ex A1 till 1, samt gör en kontroll av riktighet, om tangent inom rätt intervall returneras A= tangentnummer och carry=0 annars carry=1

BINBIT: Binär till Bit konvertering, in reg A=bitnummer en byte i A med med binummer A satt till 1. ex. in: A=2 ut A=4 (00000100), bit 2=1

COUNTSTR: Räknar antalet tecken i sträng fram till endbyte, returnerar A = antalet tecken, ändrar ej buffert.

LISTOR

Listpaket, se separat beskrivning

REJDEF

Innehåller alla minnesvariabler som används i hela REJTANG. Här definieras ringbufferternas storlek.

REJSTRUC

Innehåller strukturen för tangentlistan

READLIST: Packar upp elementet reg. DE pekar på, till minnesvariabler. Detta används vid kommando F:(ill) och C:(hange)

WRITELIST: Packar ner minnesvariabler till element i listan.

FINDTG: Letar i tangentlistan efter tangent-nr som finns i reg A. Returnerar reg DE som pekar på element, vid lyckad sökning, samt carry=0. Fanns ej tangenten returneras carry=1 vilket motsvarar att tangent saknas i listan.

OMVANDLA

Innehåller omvandlingsmoduler

DECBIN: Decimalt till binärt, returnerar A=tal som HL pekar på HL pekar efter anrop på först byte <> från siffra. Siffran måste vara mindre än 255.

BINDEC: Binärt till decimal omvandling, omvandlar register A till decimalt och lägger in detta som tre bytes i buffert. HL pekar på buffert, A innehåller tal att omvandla. Vid retur pekar HL på första lediga byte efter omvandlat tal.

BIN2DEC: Motsvarande BINDEC, men två bytes tal som läggs i DE vid anrop.

REJHEAD

Den egentliga huvudloopen. Svarar på eventuell begärd reset och ställer sig därefter i en oändlig loop. Där den går igenom tangentlistan steg för steg, och ställer motsvarande rad låg och avläser kolumn för att se om tangent är nedtryckt. Huvudloopen syncar sig själv varje varv genom att vänta på händelse vilket motsvarar att klockan ökat med ett. Detta för att nedtryckning av två eller fler tangenter skall ge samma följd av ascii tecken beroende på ordningen de trycktes ner. Genom att ha olika repeat kan man uppnå en repetition som består av valfritt antal av det ena samt ett av det andra tecknet som autorepeteras.

HEADLOOP: Initierar headl, samt svarar vi begärd reset.

HEADL: Egentliga huvudloopen, väntar på sync samt går igenom tangentlistan en gång.

LOOP: Elementloop här gås elementen igenom ett och ett, när listan är slut går den upp till Headl

AKTIVERAD: Hopp hit om tangent är nedtryckt. Kontrollerar om tangenten är aktiverad och därefter om den var nedtryckt förra varvet. Om nedtryckt förra varvet görs hopp till nedtryck. Annars indikeras "nedtryckt förra varvet" i tangentens statusbit.

NEDTRYCK: Kollar om tangenten är utskriven, i så fall görs ett hopp till ejutskr. Annars kontrolleras om den skall skrivas ut (har det gått tillräckligt med tid för att eliminera kontaktstuds) Därefter indikeras att den är utskriven en gång, under förutsättning att den skrevs ut.

EJUTSKR: Kollar om autorepetitionen har börjat om så är fallet hopp till autorep. Annars kollas om autorep skall starta. Är repeat = 0 görs ingen autorepetition, är repeat <> 0 kollas om det är tid för att autorepetition skall börja. Då skrivs motsvarande element ut samt det indikeras att autorepetition har startat.

AUTOREP: Kollar om det är dags för att autorepetera igen.

CLEAR: Nollställer status för tangent, anropas varje gång en tangent ej är nedtryckt.

OKEJ: Skriver ut element, via skrstr.

DIFFTIME: Returnerar antalet varv "sedan sist"

Modulernas beroende

```
          MODUL INITSIO.ASM
EXTERNA RUTINER
          EXTERNAL INITMEM,HEADLOOP
          EXTERNAL RECEIVE, TRANSMIT, KLOCKA
          EXTERNAL EXTSTAT, SPRXCOND

EXTERNA DATA
          EXTERNAL STACK

GLOBALA PORTADRESSER & KONSTANTER
          GLOBAL SIOADTA, SIOACMD, ENDBYTE, RESET

          MODUL REJINTER.ASM
EXTERNA DATA
          EXTERNAL IBPEKIN, IBSTART, IBEND
          EXTERNAL UBPEKUT, UBSTART, UBEND, UBANTAL
          EXTERNAL SIOADTA, SIOACMD
          EXTERNAL TIME, PROGSTAT

EXTERNA KONSTANTER
          EXTERNAL ENDBYTE

EXTERNA RUTINER
          EXTERNAL CMDUTFÖR, HEADLOOP

GLOBALA RUTINER
          GLOBAL RECEIVE, TRANSMIT, TRANS, KLOCKA
          GLOBAL EXTSTAT, SPRXCOND

          MODUL SKRSTR.ASM
EXTERNA DATA
          EXTERNAL UBPEKIN, UBSTART, UBEND, UBANTAL
          EXTERNAL PROGSTAT

EXTERNA RUTINER
          EXTERNAL TRANS

GLOBALA RUTINER
          GLOBAL SKRSTR

          MODUL REJINIT
GLOBALA RUTINER
          GLOBAL INITMEM, RESLISTA

EXTERNA DATA
          EXTERNAL TGLISTA, TGPRED, PEK
          EXTERNAL BOTRAM, STARTRAM
          EXTERNAL UBPEKIN, UBPEKUT, UBSTART, UBANTAL
          EXTERNAL IBPEKIN, IBPEKUT, IBSTART
          EXTERNAL TIME, XSTR, PROGSTAT, DIODSTAT
          EXTERNAL STRÄNG,TG,STATUS,REPEAT,ANTAL
          EXTERNAL STUDS,AUTOR

EXTERNA RUTINER
          EXTERNAL NEW, INLAST, WRITELIST
```

```
          MODUL REJHEAD
EXTERNA RUTINER
          EXTERNAL HEAD, LSUCC, BINBIT
          EXTERNAL SKRSTR, ERR2

EXTERNA DATA
          EXTERNAL TGLISTA,PEK
          EXTERNAL VARV,TIME,PROGSTAT, DIODSTAT
          EXTERNAL STUDS, AUTOR

EXTERNA KONSTANTER
          EXTERNAL XSTATUS,XTG,XREPEAT,XCOUNT,XANTAL,XSTR

GLOBALA RUTINER
          GLOBAL HEADLOOP

          MODUL REJCMD
EXTERNA RUTINER
          EXTERNAL LEXSCAN, SKRSTR, DECBIN, BINDEC
          EXTERNAL NEW, INLAST, DEL, WRITELIST, READLIST
          EXTERNAL SKRORD, FINDTG, LSUCC, LPRED
          EXTERNAL LAST, FIRST, RESLISTA, RESET

GLOBALA RUTINER
          GLOBAL CMDUTFöR, BINBIT, ERR2

EXTERNA DATA
          EXTERNAL BUFFERT, ENDBYTE, XSTR
          EXTERNAL SUCC, PRED, STATUS, TG, REPEAT, COUNT, ANTAL
          EXTERNAL TGLISTA, PEK, STRÄNG, DIODSTAT
          EXTERNAL STUDS, AUTOR, PROGSTAT

          MODUL REJLEX
GLOBAL RUTINER
          GLOBAL LEXSCAN

          MODUL LISTOR.ASM
EXTERNA DATA
          EXTERNAL BOTRAM

GLOBALA RUTINER
          GLOBAL NEW, DEL, INLAST, LSUCC, LPRED
          GLOBAL LAST, FIRST, HEAD


          MODUL REJSTRUC.ASM
GLOBALA RUTINER
          GLOBAL WRITELIST, READLIST, FINDTG

GLOBALA KONSTANTER
          GLOBAL XSUCCL,XSUCCH,XPREDL,XPREDH,XSTATUS,XTG,XREPEAT
          GLOBAL XCOUNT,XANTAL,XSTR

EXTERNA DATA
          EXTERNAL SUCC, PRED, STATUS, TG, REPEAT, COUNT, ANTAL
          EXTERNAL TGLISTA, STRÄNG
```

MODUL OMVANDL.ASM

```
GLOBALA RUTINER
        GLOBAL DECBIN,BINDEC, BIN2DEC
```

MODUL REJDEF.ASM

```
GLOBALA DATA
        GLOBAL STACK
        GLOBAL IBPEKIN, IBPEKUT, IBSTART, IBEND
        GLOBAL UBPEKIN, UBPEKUT, UBSTART, UBEND, UBANTAL
        GLOBAL BUFFERT
        GLOBAL BOTRAM, STARTRAM
        GLOBAL SUCC,PRED,STATUS, TG, REPEAT, COUNT, ANTAL, STRÄNG
        GLOBAL TGLISTA, TGPRED
        GLOBAL PEK,TIME
        GLOBAL VARV, STUDS, AUTOR, PROGSTAT, DIODSTAT
```

```
LOCATION PLC CODE      ARG     LC  SOURCE STATEMENT ----------------------------------------------------------

0000                            1          ZPROG INITSIO.ASM
0000                            2          *PAGE 60
                                3  ;
                                4  ; EXTERNA RUTINER
                                5          EXTERNAL INITMEM,HEADLOOP
                                6          EXTERNAL RECEIVE, TRANSMIT, KLOCKA
                                7          EXTERNAL EXTSTAT, SPRXCOND
                                8  ;
                                9  ;
                               10  ; EXTERNA DATA
                               11          EXTERNAL STACK
                               12  ;
                               13  ; GLOBALA PORTADRESSER & KONSTANTER
                               14          GLOBAL SIOADTA, SIOACMD, ENDBYTE, RESET
                               15  ;
                               16  ;
                               17  ; ************************************************************
                               18  ;
                               19  ;
                               20  ;
                               21  ;        INIT, INITIERAR SIO SAMT SKÖTER AVBROTTSHANTERINGEN
                               22  ;         ALL IN OCH UTMATNING MOT V24-SNITT
                               23  ;
                               24  ;
                               25  ;
                               26  ;        VER   DATUM   SIGN      BESKRIVNING
                               27  ;        1.0   850925   SP          -
                               28  ;
                               29  ;
                               30  ; ************************************************************
                               31  ;
0000                    0000   32  ENDBYTE   EQU   0
                               33  ;
                               34  ;
                               35          *EJECT
```

```
   LOCATION PLC CODE      ARG     LC  SOURCE STATEMENT ----------------------------------------------------

                                  36  ;
                                  37  ; ************************* DEFINITIONER ***************************
                                  38  ;                           PORTAR
                                  39  ;                           ======
   0000                   0039    40  SIOACMD   EQU   57
   0000                   003B    41  SIOBCMD   EQU   59
   0000                   0038    42  SIOADTA   EQU   56
   0000                   003A    43  SIOBDTA   EQU   58
                                  44  ;
   0000                   0030    45  CTC0CMD   EQU   48
   0000                   0032    46  CTC2CMD   EQU   50
   0000                   0033    47  CTC3CMD   EQU   51
                                  48  ;              INSTÄLLNING AV CTC2 FÖR BAUDRATE
                                  49  ;              ================================
   0000                   0001    50  BAUD9600  EQU   1
   0000                   0002    51  BAUD4800  EQU   2
   0000                   0004    52  BAUD2400  EQU   4
   0000                   0008    53  BAUD1200  EQU   8
   0000                   0010    54  BAUD600   EQU   16
   0000                   0020    55  BAUD300   EQU   32
                                  56  ;                       INSTÄLLNINGAR SIO
                                  57  ;                       =================
                                  58  ;                       REG 1
                                  59  ;                       =====
   0000                   0002    60  ENTXINT   EQU   2               ; ENABLE TX INTERUPT
   0000                   0004    61  STAFVEKT  EQU   4               ; STATUS AFFECT VECTOR
   0000                   0018    62  INTALLRX  EQU   24              ; INTERUPT ON ALL RX
                                  63  ;                       REG 3
                                  64  ;                       =====
   0000                   0000    65  RX5BIT    EQU   0               ; ANTAL DATABITAR MOTTAGNING
   0000                   0040    66  RX6BIT    EQU   64
   0000                   0080    67  RX7BIT    EQU   128
   0000                   00C0    68  RX8BIT    EQU   192
   0000                   0020    69  AUTOEN    EQU   32              ; AUTO ENABLE
   0000                   0001    70  RXENABLE  EQU   1               ; ENABLE RX
                                  71  ;                       REG 4
                                  72  ;                       =====
   0000                   0004    73  STOP1     EQU   4               ; ANTAL STOPBITAR
   0000                   0008    74  STOP15    EQU   8
   0000                   000C    75  STOP2     EQU   12
   0000                   0000    76  NOPARI    EQU   0               ; INGEN PARITET
   0000                   0003    77  JÄMNPARI  EQU   3               ; JÄMN PARITET, KONTROLL
   0000                   0001    78  UDDAPARI  EQU   1               ; UDDA PARITET, KONTROLL
   0000                   0000    79  X1        EQU   0               ; SYSTEM KLOCKA DIVIDERAT MED.
   0000                   0040    80  X16       EQU   64
   0000                   0080    81  X32       EQU   128
   0000                   00C0    82  X64       EQU   192
                                  83  ;                       REG 5
                                  84  ;                       =====
   0000                   0000    85  TX5BIT    EQU   0               ; ANTAL BITAR SÄNDNING
   0000                   0040    86  TX6BIT    EQU   64
   0000                   0020    87  TX7BIT    EQU   32
   0000                   0060    88  TX8BIT    EQU   96
   0000                   0080    89  DTRUT     EQU   128             ; DTR SIGNAL UT
   0000                   0002    90  RTSUT     EQU   2               ; RTS SIGNAL UT
   0000                   0008    91  TXENABLE  EQU   8               ; ENABLE SÄNDNING
                                  92  ;
                                  93          $EJECT
```

```
   LOCATION PLC CODE      ARG     LC  SOURCE STATEMENT ----------------------------------------------------

    0000        F3                 94 RESET    DI
    0001      X 310000             95          LD    SP,STACK
                                   96 ;
    0004        ED5E               97          IM    2
    0006        AF                 98          XOR   A
    0007        ED47               99          LD    I,A
    0009        C32800            100          JP    CLR
                                  101 ;
    000C                  0010    102          ORG   010H
    0010        8000              103 INTVEKT   DEFW  EIRETII          ; CHANNEL B
    0012        8000              104          DEFW  EIRETII
    0014        8000              105          DEFW  EIRETII
    0016        8000              106          DEFW  EIRETII
                                  107 ;
    0018        7700              108          DEFW  TRANSA
    001A      X 0000              109          DEFW  EXTSTAT          ; EXTERNAL STATUS
    001C        7A00              110          DEFW  RECEIVEA
    001E      X 0000              111          DEFW  SPRXCOND         ; ERROR
                                  112 ;
    0020        8000              113 CTCINT    DEFW  EIRETII
    0022        8000              114          DEFW  EIRETII
    0024        8000              115          DEFW  EIRETII
    0026        7D00              116          DEFW  KLOCK
                                  117 ;
    0028                  0028    118 CLR      EQU   *
    0028        0606              119          LD    B,6
    002A                  002A    120 CLRDAISY EQU   *
    002A        CD8100            121          CALL  RETII
    002D        10FB              122          DJNZ  CLRDAISY
                                  123 ;
    002F        D339              124          OUT   SIOACMD,A        ; VÄLJ REGISTER 0
    0031        D33B              125          OUT   SIOBCMD,A
    0033        3E18              126          LD    A,018H           ; RESET CHANNEL
    0035        D339              127          OUT   SIOACMD,A
    0037        D33B              128          OUT   SIOBCMD,A
                                  129 ;
    0039        0605              130          LD    B,5              ; VÄNTA PÅ SIO
    003B                  003B    131 DELAY1   EQU   *
    003B        10FE              132          DJNZ  DELAY1
                                  133 ;
    003D                  003D    134 INITSIO  EQU   *
    003D        216B00            135          LD    HL,SIOVEKT
    0040        0608              136          LD    B,SIOB-SIOA
    0042                  0042    137 ISIOA    EQU   *
    0042        7E                138          LD    A,(HL)
    0043        D339              139          OUT   SIOACMD,A
    0045        23                140          INC   HL
    0046        10FA              141          DJNZ  ISIOA
    0048        0604              142          LD    B,SIOSLUT-SIOB
    004A                  004A    143 ISIOB    EQU   *
    004A        7E                144          LD    A,(HL)
    004B        D33B              145          OUT   SIOBCMD,A
    004D        23                146          INC   HL
    004E        10FA              147          DJNZ  ISIOB
                                  148 ;
                                  149          *EJECT
```

```
   LOCATION PLC CODE      ARG     LC   SOURCE STATEMENT ----------------------------------------------------

                                  150  ;
                                  151  ;
   0050        3E17               152          LD    A,23            ; INITERING AV CTC
   0052        D332               153          OUT   CTC2CMD,A       ; ================
   0054        3E01               154          LD    A,BAUD9600      ; CTC 2 FÖR BAUDRATE
   0056        D332               155          OUT   CTC2CMD,A
                                  156  ;
   0058        3E20               157          LD    A,CTCINT        ; INITERUPTVEKTOR
   005A        D330               158          OUT   CTC0CMD,A       ; TILL CTC 0
                                  159  ;                            ; CTC3 FÖR KLOCKAVBROTT
   005C        3EA5               160          LD    A,0A5H          ; ENABLE INT, PRESCALL=255
   005E        D333               161          OUT   CTC3CMD,A
   0060        3E7D               162          LD    A,07DH          ; TIMEKONSTANT = 125
   0062        D333               163          OUT   CTC3CMD,A
                                  164  ;
   0064      X CD0000             165          CALL  INITMEM
                                  166  ;
   0067        FB                 167          EI
   0068      X C30000             168          JP    HEADLOOP
                                  169  ;
                                  170  ;
   006B                 006B      171  SIOVEKT  EQU   *
   006B                 006B      172  SIOA     EQU   *
   006B        0444               173          DEFB  004H,X16+STOP1+NOPARI
   006D        011A               174          DEFB  001H,INTALLRX+ENTXINT
   006F        0568               175          DEFB  005H,TX8BIT+TXENABLE
   0071        03C1               176          DEFB  003H,RX8BIT+RXENABLE
   0073                 0073      177  SIOB     EQU   *
   0073        0104               178          DEFB  001H,STAFVEKT
   0075        0210               179          DEFB  002H,INTVEKT
   0077                 0077      180  SIOSLUT  EQU   *
                                  181  ;
                                  182  ;
                                  183  ;
   0077                 0077      184  TRANSA   EQU   *
   0077      X C30000             185          JP    TRANSMIT
                                  186  ;
                                  187  ;
   007A                 007A      188  RECEIVEA EQU   *
   007A      X C30000             189          JP    RECEIVE
                                  190  ;
                                  191  ;
   007D                 007D      192  KLOCK    EQU   *
   007D      X C30000             193          JP    KLOCKA
                                  194  ;
                                  195  ;
   0080                 0080      196  EIRETII  EQU   *
   0080        FB                 197          EI
   0081                 0081      198  RETII    EQU   *
   0081        ED4D               199          RETI
                                  200  ;
   0083    00  0000               201          END   RESET

 ERRORS :    0  WARNINGS :    0
```

CROSS REFERENCE LISTING

SYMBOL	LOCATION	DECL	REFERENCES
?AUTOEN	0020	69	
?BAUD1200	0008	53	
?BAUD2400	0004	52	
?BAUD300	0020	55	
?BAUD4800	0002	51	
?BAUD600	0010	54	
BAUD9600	0001	50	154
CLR	0028	118	100
CLRDAISY	002A	120	122
CTC0CMD	0030	45	158
CTC2CMD	0032	46	153 155
CTC3CMD	0033	47	161 163
CTCINT	0020	113	157
DELAY1	003B	131	132
?DTRUT	0080	89	
EIRETII	0080	196	103 104 105 106 113 114 115
>ENDBYTE	0000	32	14
ENTXINT	0002	60	174
<EXTSTAT	0000	7	109
<HEADLOOP	0000	5	168
<INITMEM	0000	5	165
?INITSIO	003D	134	
INTALLRX	0018	62	174
INTVEKT	0010	103	179
ISIOA	0042	137	141
ISIOB	004A	143	147
?JAMNPARI	0003	77	
KLOCK	007D	192	116
<KLOCKA	0000	6	193
NOPARI	0000	76	173
<RECEIVE	0000	6	189
RECEIVEA	007A	188	110
>RESET	0000	94	14 201
RETII	0081	198	121
?RTSUT	0002	90	
?RX5BIT	0000	65	
?RX6BIT	0040	66	
?RX7BIT	0080	67	
RX8BIT	00C0	68	176
RXENABLE	0001	70	176
SIOA	006B	172	136
>SIOACMD	0039	40	14 124 127 139
>SIOADTA	003B	42	14
SIOB	0073	177	136 142
SIOBCMD	003B	41	125 128 145
?SIOBDTA	003A	43	
SIOSLUT	0077	180	142
SIOVEKT	006B	171	135
<SPRXCOND	0000	7	111
<STACK	0000	11	95
STAFVEKT	0004	61	178
STOP1	0004	73	173
?STOP15	0008	74	
?STOP2	000C	75	
TRANSA	0077	184	108
<TRANSMIT	0000	6	185
?TX5BIT	0000	85	
?TX6BIT	0040	86	
?TX7BIT	0020	87	
TX8BIT	0060	88	175

CROSS REFERENCE LISTING

SYMBOL	LOCATION	DECL	REFERENCES
TXENABLE	0008	91	175
?UDDAPARI	0001	78	
?X1	0000	79	
X16	0040	80	173
?X32	0080	81	
?X64	00C0	82	

```
ASMZ-4.46 REJINTER.ASM                          ERRORS:    0    12:00:00    86-02-24    PAGE  1

   LOCATION PLC CODE      ARG     LC   SOURCE STATEMENT ----------------------------------------------------

    0000    00                      1           ZPROG REJINTER.ASM
    0000                            2           *PAGE 60
                                    3 ;
                                    4 ;
                                    5 ; EXTERNA DATA
                                    6           EXTERNAL IBPEKIN, IBSTART, IBEND
                                    7           EXTERNAL UBPEKUT, UBSTART, UBEND, UBANTAL
                                    8           EXTERNAL SIOADTA, SIOACMD
                                    9           EXTERNAL TIME, PROGSTAT
                                   10 ;
                                   11 ;
                                   12 ; EXTERNA KONSTANTER
                                   13           EXTERNAL ENDBYTE
                                   14 ;
                                   15 ;
                                   16 ; EXTERNA RUTINER
                                   17           EXTERNAL CMDUTFOR, HEADLOOP
                                   18 ;
                                   19 ;
                                   20 ; GLOBALA RUTINER
                                   21           GLOBAL RECEIVE, TRANSMIT, TRANS, KLOCKA, PUT
                                   22           GLOBAL EXTSTAT, SPRXCOND
                                   23 ;
                                   24 ;
                                   25 ;
                                   26 ; ********************************************************
                                   27 ;
                                   28 ; REJINTER, INTERUPTRUTINER
                                   29 ;
                                   30 ;        RECEIVE - TERMINAL IN
                                   31 ;        TRANSMIT- TERMINAL UT
                                   32 ;        KLOCKA  -  KLOCKA  (CTC3)
                                   33 ;
                                   34 ;
                                   35 ;        VER   DATUM   SIGN      BESKRIVNING
                                   36 ;        1.0   851117   SP            -
                                   37 ;        1.1   860101   SP       EXTSTAT, SPRXCOND
                                   38 ;        1.2   860113   SP       UBANTAL, ANTAL TECKEN I UTBUFF
                                   39 ;        1.3   860115   SP       SKRSTR, FLYTTAD TILL EGEN MOD.
                                   40 ;
                                   41 ; ********************************************************
                                   42 ;
    0000              0028     43 RTIP      EQU   028H             ; RESET TX INT PENDING
    0000              0001     44 R1        EQU   001H             ; REGISTER 1
    0000              0030     45 ER        EQU   030H             ; ERROR RESET
    0000              0010     46 RESI      EQU   010H             ; RESET EXT/STAT INT
                               47 ;
                               48           *EJECT
```

```
LOCATION PLC CODE      ARG    LC  SOURCE STATEMENT ----------------------------------------------------------

0000    00             0000   49 RECEIVE  EQU  *
0000       F5                 50          PUSH AF              ; RÄDDA REGISTER
0001       E5                 51          PUSH HL
0002       D5                 52          PUSH DE
                              53 ;
0003     X DB00               54          IN   A,(SIOADTA)     ; LÄS TECKEN
                              55 ;
0005     X ED5B0000           56          LD   DE,(IBPEKIN)    ; LÄGG TKN I BUFFERT
0009       12                 57          LD   (DE),A
                              58 ;
000A       13                 59          INC  DE              ; UPPGRADERA BUFFPTR
000B     X 210000             60          LD   HL,IBEND
000E       A7                 61          AND  A
000F       ED52               62          SBC  HL,DE
0011    00 2003               63          JR   NZ,BB1
0013     X 110000             64          LD   DE,IBSTART
0016     X ED530000           65 BB1      LD   (IBPEKIN),DE
                              66 ;
001A     X FE00               67          CP   ENDBYTE         ; COMMANDO STRÄNG FÄRDIG ?
001C    00 CA2500             68          JP   Z,STRREADY
001F       D1                 69          POP  DE
0020       E1                 70          POP  HL
0021       F1                 71          POP  AF
0022       FB                 72          EI
0023       ED4D               73          RETI
                              74 ;
0025    00             0025   75 STRREADY EQU  *
                              76 ;
0025    00 CDC400             77          CALL EIRETI
0028       C5                 78          PUSH BC              ; RÄDDA RESTEN AV REGISTER
0029       DDE5               79          PUSH IX
                              80 ;
002B     X 210000             81          LD   HL,IBSTART
002E     X CD0000             82          CALL CMDUTFÖR
                              83 ;
0031     X 210000             84          LD   HL,IBSTART
0034     X 220000             85          LD   (IBPEKIN),HL
                              86 ;
0037       DDE1               87          POP  IX
0039       C1                 88          POP  BC
003A       D1                 89          POP  DE
003B       E1                 90          POP  HL
003C       F1                 91          POP  AF
003D       FB                 92          EI
003E       ED4D               93          RETI
                              94 ;
                              95          *EJECT
```

```
LOCATION PLC CODE      ARG     LC   SOURCE STATEMENT ----------------------------------------------------

 0040    00             0040    96  PUT       EQU   *               ; SKRIVER TECKEN I A TILL SIO
 0040      X D300               97              OUT   SIOADTA,A
 0042      X 3A0000             98              LD    A,(PROGSTAT)
 0045        CBCF               99              SET   1,A             ; TX.PEND AKTIV
 0047      X 320000            100              LD    (PROGSTAT),A
 004A        CB57              101              BIT   2,A             ; TRANSMIT BUFFERT EMPTY !
 004C    00  CA8600            102              JP    Z,RESTXPEN
 004F        C9                103              RET
                               104 ;
                               105 ;
 0050    00             0050   106  TRANSMIT  EQU   *
 0050    00  CD8B00            107              CALL  TRSAVE
                               108 ;
 0053    00             0053   109  TRANS     EQU   *
                               110 ;
 0053      X 3A0000            111              LD    A,(PROGSTAT)
 0056        CBCF              112              SET   1,A             ; TX.PEND AKTIV
 0058      X 320000            113              LD    (PROGSTAT),A
                               114 ;
 005B      X 3A0000            115              LD    A,(UBANTAL)     ; FINNS FLER TKN ATT SKRIVA
 005E        3D                116              DEC   A
 005F      X 320000            117              LD    (UBANTAL),A
 0062    00  CA7E00            118              JP    Z,BUFFEMPT
                               119 ;
 0065      X ED5B0000          120              LD    DE,(UBPEKUT)    ; SKRIV TKN TILL SERIESNGRE
 0069        1A                121              LD    A,(DE)
 006A      X D300              122              OUT   SIOADTA,A
                               123 ;
 006C        13                124              INC   DE              ; UPPGRADERA BUFF PTR
 006D      X 210000            125              LD    HL,UBEND
 0070        A7                126              AND   A
 0071        ED52              127              SBC   HL,DE
 0073    00  C27900            128              JP    NZ,BB2
 0076      X 110000            129              LD    DE,UBSTART
 0079      X ED530000          130  BB2       LD    (UBPEKUT),DE
 007D        C9                131              RET
                               132 ;
 007E    00             007E   133  BUFFEMPT  EQU   *
 007E      X 3A0000            134              LD    A,(PROGSTAT)    ; BUFFERT TOM
 0081        CB97              135              RES   2,A
 0083      X 320000            136              LD    (PROGSTAT),A
                               137 ;
 0086    00             0086   138  RESTXPEN  EQU   *
 0086      X 3A0000            139              LD    A,(PROGSTAT)    ; TRANSMIT AVSTANGT
 0089        CB8F              140              RES   1,A
 008B      X 320000            141              LD    (PROGSTAT),A
                               142 ;
 008E        3E28              143              LD    A,RTIP          ; RESET TX INT PENDING
 0090      X D300              144              OUT   SIOACMD,A
 0092        C9                145              RET
                               146 ;
                               147              #EJECT
```

```
   LOCATION PLC CODE      ARG    LC   SOURCE STATEMENT ----------------------------------------------------

                                  148  ;
   0093    00             0093   149  KLOCKA   EQU   *
   0093        F5                 150           PUSH  AF
   0094      X 3A0000             151           LD    A,(TIME)
   0097        3C                 152           INC   A
   0098      X 320000             153           LD    (TIME),A
   009B        F1                 154           POP   AF
   009C        FB                 155           EI
   009D        ED4D               156           RETI
                                  157  ;
                                  158  ;
   009F    00             009F   159  SPRXCOND EQU   *
   009F        F5                 160           PUSH  AF
   00A0        3E01               161           LD    A,R1
   00A2      X D300               162           OUT   SIOACMD,A
   00A4      X DB00               163           IN    A,SIOACMD
                                  164  ;
   00A6        3E30               165           LD    A,ER
   00A8      X D300               166           OUT   SIOACMD,A
   00AA      X DB00               167           IN    A,SIOADTA
   00AC        F1                 168           POP   AF
   00AD        FB                 169           EI
   00AE        ED4D               170           RETI
                                  171  ;
                                  172  ;
   00B0    00             00B0   173  EXTSTAT  EQU   *
   00B0        F5                 174           PUSH  AF
   00B1      X DB00               175           IN    A,SIOACMD
                                  176  ;
   00B3        3E10               177           LD    A,RESI
   00B5      X D300               178           OUT   SIOACMD,A
   00B7        F1                 179           POP   AF
   00B8        FB                 180           EI
   00B9        ED4D               181           RETI
                                  182  ;
                                  183  ;
   00BB        E3                 184  TRSAVE   EX    (SP),HL
   00BC        D5                 185           PUSH  DE
   00BD        F5                 186           PUSH  AF
   00BE    00  CDC700             187           CALL  GO
   00C1        F1                 188           POP   AF
   00C2        D1                 189           POP   DE
   00C3        E1                 190           POP   HL
   00C4        FB                 191  EIRETII  EI
   00C5        ED4D               192           RETI
   00C7        E9                 193  GO       JP    (HL)
                                  194  ;
   00C8                           195   END

   ERRORS :    0   WARNINGS :    0
```

CROSS REFERENCE LISTING

SYMBOL	LOCATION	DECL	REFERENCES
BB1	0016	65	63
BB2	0079	130	128
BUFFEMPT	007E	133	118
<CMDUTFöR	0000	17	82
EIRETII	00C4	191	77
<ENDBYTE	0000	13	67
ER	0030	45	165
>EXTSTAT	00B0	173	22
GO	00C7	193	187
?HEADLOOP	0000	17	
<IBEND	0000	6	60
<IBPEKIN	0000	6	56 65 85
<IBSTART	0000	6	64 81 84
>KLOCKA	0093	149	21
<PROGSTAT	0000	9	98 100 111 113 134 136 139 141
>PUT	0040	96	21
R1	0001	44	161
>RECEIVE	0000	49	21
RESI	0010	46	177
RESTXPEN	0086	138	102
RTIP	0028	43	143
<SIOACMD	0000	8	144 162 163 166 175 178
<SIOADTA	0000	8	54 97 122 167
>SPRXCOND	009F	159	22
STRREADY	0025	75	68
<TIME	0000	9	151 153
>TRANS	0053	109	21
>TRANSMIT	0050	106	21
TRSAVE	00BB	184	107
<UBANTAL	0000	7	115 117
<UBEND	0000	7	125
<UBPEKUT	0000	7	120 130
<UBSTART	0000	7	129

```
ASMI-4.46 SKRSTR.ASM                              ERRORS:    0    12:00:00    86-02-24    PAGE  1

    LOCATION PLC CODE      ARG     LC   SOURCE STATEMENT ----------------------------------------------------

     0000    00                      1          ZPROG SKRSTR.ASM
     0000                            2          *PAGE 60
                                     3 ;
                                     4 ;
                                     5 ; EXTERNA DATA
                                     6          EXTERNAL UBPEKIN, UBSTART, UBEND, UBANTAL
                                     7          EXTERNAL PROGSTAT
                                     8 ;
                                     9 ; EXTERNA RUTINER
                                    10          EXTERNAL TRANS
                                    11 ;
                                    12 ;
                                    13 ; GLOBALA RUTINER
                                    14          GLOBAL SKRSTR
                                    15 ;
                                    16 ;
                                    17 ; ********************************************************
                                    18 ;
                                    19 ; SKRSTR, MONITOR FÖR TRANSMIT RUTINEN FYLLER BC TECKEN IN I
                                    20 ;        BUFFERT FRAN HL
                                    21 ;
                                    22 ;
                                    23 ;        VER   DATUM   SIGN      BESKRIVNING
                                    24 ;        1.0   860115   SP       EGEN MODUL
                                    25 ;
                                    26 ; ********************************************************
                                    27 ;
                                    28 ;
                                    29          *EJECT
```

```
LOCATION PLC CODE      ARG    LC  SOURCE STATEMENT ----------------------------------------------------

                              30  ;
0000    00             0000   31  SKRSTR   EQU   *
0000       FB                 32           EI                    ; TILLAT AVBROTT
0001       A7                 33           AND   A               ; DUMMY
0002       F3                 34           DI
                              35  ;
0003     X 3A0000             36           LD    A,(UBANTAL)     ; BUFFERT FULL ?
0006       3C                 37           INC   A
0007     X FE00               38           CP    UBEND-UBSTART
0009    00 CA0000            39           JP    Z,SKRSTR        ; JA
000C     X 320000             40           LD    (UBANTAL),A
                              41  ;
000F     X ED5B0000           42           LD    DE,(UBPEKIN)    ; LAGG IN I BUFFERT
0013       EDA0               43           LDI
                              44  ;
0015       E5                 45           PUSH  HL              ; UPPGRADERA BUFFPTR
0016     X 210000             46           LD    HL,UBEND
0019       A7                 47           AND   A
001A       ED52               48           SBC   HL,DE
001C       E1                 49           POP   HL
001D    00 C22300            50           JP    NZ,BBB3
0020     X 110000             51           LD    DE,UBSTART
0023     X ED530000           52  BBB3     LD    (UBPEKIN),DE
                              53  ;
0027     X 3A0000             54           LD    A,(PROGSTAT)
002A       CB57               55           BIT   2,A
002C    00 CC3600            56           CALL  Z,SKRFIRST
                              57  ;
002F       78                 58           LD    A,B
0030       B1                 59           OR    C
0031    00 C20000            60           JP    NZ,SKRSTR       ; JA, SATT IGANG AVBROTT
                              61  ;
0034       FB                 62           EI
0035       C9                 63           RET
                              64  ;
                              65  ;
0036    00             0036   66  SKRFIRST  EQU   *
0036       CBD7               67           SET   2,A             ; TRANSBUFF NOT EMPTY
0038     X 320000             68           LD    (PROGSTAT),A
003B       3E02               69           LD    A,2             ; 1 TECKEN + RESET INT.PEND
003D     X 320000             70           LD    (UBANTAL),A
0040       E5                 71           PUSH  HL
0041     X CD0000             72           CALL  TRANS
0044       E1                 73           POP   HL
0045       C9                 74           RET
                              75  ;
                              76  ;
0046       -                  77  END

ERRORS :    0   WARNINGS :    0
```

ASMZ-4.46 SKRSTR.ASM ERRORS: 0 12:00:00 86-02-24 PAGE 3

CROSS REFERENCE LISTING

SYMBOL	LOCATION	DECL	REFERENCES			
BBB3	0023	52	50			
<PROGSTAT	0000	7	54	68		
SKRFIRST	0036	66	56			
>SKRSTR	0000	31	14	39	60	
<TRANS	0000	10	72			
<UBANTAL	0000	6	36	40	70	
<UBEND	0000	6	38	46		
<UBPEKIN	0000	6	42	52		
<UBSTART	0000	6	38	51		

```
ASM1-4.46 REJINIT                              ERRORS:    0    12:00:00    86-02-24    PAGE  1

    LOCATION PLC CODE      ARG     LC   SOURCE STATEMENT ----------------------------------------------------

                                    1           ZPROG REJINIT
                                    2           *PAGE 60
                                    3 ;
                                    4 ; GLOBALA RUTINER
                                    5           GLOBAL INITMEM, RESLISTA
                                    6 ;
                                    7 ; EXTERNA DATA
                                    8           EXTERNAL TGLISTA, TGPRED, PEK
                                    9           EXTERNAL BOTRAM, STARTRAM
                                   10           EXTERNAL UBPEKIN, UBPEKUT, UBSTART, UBANTAL
                                   11           EXTERNAL IBPEKIN, IBPEKUT, IBSTART
                                   12           EXTERNAL TIME, XSTR, PROGSTAT, DIODSTAT
                                   13           EXTERNAL STRANG,TG,STATUS,REPEAT,ANTAL
                                   14           EXTERNAL STUDS,AUTOR
                                   15 ;
                                   16 ; EXTERNA RUTINER
                                   17           EXTERNAL NEW, INLAST, WRITELIST
                                   18 ;
                                   19 ; ************************************************************
                                   20 ;
                                   21 ;        INITMEM, INITIERAR NÖDVÄNDIGA MINNESVARIABLER
                                   22 ;
                                   23 ; ************************************************************
                                   24 ;
                                   25 ;
    0000                0002       26 DEFSTUDS  EQU   2              ; 0.02 SEKUNDER
    0000                003C       27 DEFAUTOR  EQU   60             ; 0.6 SEKUNDER
                                   28 ;
                                   29           *EJECT
```

```
LOCATION PLC CODE      ARG    LC  SOURCE STATEMENT ----------------------------------------------------------

0000    00             0000   30  RESLISTA  EQU   *
0000       210000             31            LD    HL,0
0003     X 220000             32            LD    (TGLISTA),HL
                              33  ;
0006     X 210000             34            LD    HL,TGLISTA
0009     X 220000             35            LD    (TGPRED),HL
                              36  ;
000C     X 210000             37            LD    HL,STARTRAM
000F     X 220000             38            LD    (BQTRAM),HL
                              39  ;
0012       C9                 40            RET
                              41  ;
0013    00             0013   42  INITMEM   EQU   *
0013    00 CD0000            43            CALL  RESLISTA
                              44  ;
0016     X 210000             45            LD    HL,IBSTART
0019     X 220000             46            LD    (IBPEKIN),HL
001C     X 220000             47            LD    (IBPEKUT),HL
                              48  ;
001F     X 210000             49            LD    HL,UBSTART
0022     X 220000             50            LD    (UBPEKIN),HL
0025     X 220000             51            LD    (UBPEKUT),HL
                              52  ;
0028    00 CD4800            53            CALL  INDEFAUL
                              54  ;
0028       AF                 55            XOR   A
002C     X 320000             56            LD    (TIME),A          ; NOLLSTÄLL KLOCKAN
002F     X 320000             57            LD    (UBANTAL),A       ; 0 TKN I UTBUFFERT
0032     X 320000             58            LD    (DIODSTAT),A      ; ALLA DIODER SLÄCKTA
                              59  ;
0035     X 3A0000             60            LD    A,(PROGSTAT)
0038       E6F0               61            AND   11110000B         ; NOLLSTÄLL BIT 0-3
003A     X 320000             62            LD    (PROGSTAT),A
                              63  ;
003D       3E02               64            LD    A,DEFSTUDS
003F     X 320000             65            LD    (STUDS),A
0042       3E3C               66            LD    A,DEFAUTOR
0044     X 320000             67            LD    (AUTOR),A
                              68  ;
0047       C9                 69            RET
                              70            *EJECT
```

```
   LOCATION PLC CODE      ARG     LC   SOURCE STATEMENT ----------------------------------------------------

                                  71  ;
    0048    00            0048    72  INDEFAUL  EQU   *
    0048       3E01               73            LD    A,1             ; AKTIV, 1 TKN.
    004A     X 320000             74            LD    (STATUS),A
    004D     X 320000             75            LD    (ANTAL),A
                                  76  ;
    0050       3E0A               77            LD    A,10            ; REPEAT = 10
    0052     X 320000             78            LD    (REPEAT),A
                                  79  ;
    0055     X 210000             80            LD    HL,PEK
    0058       362F               81            LD    (HL),47         ; 0,1,....P
                                  82  ;
    005A       0640               83            LD    B,64            ; 64 TANGENTER.
    005C    00            005C    84  LOOP      EQU   *
    005C       C5                 85            PUSH  BC
                                  86  ;
    005D       3E40               87            LD    A,64
    005F       90                 88            SUB   B
    0060     X 320000             89            LD    (TG),A
                                  90  ;
    0063     X 3E00               91            LD    A,XSTR
    0065       3C                 92            INC   A
    0066       4F                 93            LD    C,A             ; ANTAL BYTE'S PER POST
    0067       0600               94            LD    B,0
    0069     X CD0000             95            CALL  NEW
                                  96  ;
    006C     X 210000             97            LD    HL,PEK
    006F       34                 98            INC   (HL)
    0070     X 220000             99            LD    (STRÄNG),HL
                                 100  ;
    0073     X CD0000            101            CALL  WRITELIST       ; PACKA IN POST
    0076     X 210000            102            LD    HL,TGLISTA
    0079     X CD0000            103            CALL  INLAST          ; LÄGG IN I LISTA
                                 104  ;
    007C       C1                105            POP   BC
    007D    00 10DD              106            DJNZ  LOOP
                                 107  ;
    007F       C9                108            RET
    0080                         109   END

    ERRORS :    0   WARNINGS :    0
```

```
ASMZ-4.46 REJINIT                                    ERRORS:    0    12:00:00    86-02-24    PAGE  4
    CROSS REFERENCE LISTING
    SYMBOL      LOCATION   DECL   REFERENCES  ----------------------------------------------------------------

    <ANTAL          0000     13    75
    <AUTOR          0000     14    67
    <BOTRAM         0000      9    38
     DEFAUTOR       003C     27    66
     DEFSTUDS       0002     26    64
    <DIODSTAT       0000     12    58
    <IBPEKIN        0000     11    46
    <IBPEKUT        0000     11    47
    <IBSTART        0000     11    45
     INDEFAUL       0048     72    53
    >INITMEM        0013     42     5
    <INLAST         0000     17   103
     LOOP           005C     84   106
    <NEW            0000     17    95
    <PEK            0000      8    80    97
    <PROGSTAT       0000     12    60    62
    <REPEAT         0000     13    78
    >RESLISTA       0000     30     5    43
    <STARTRAM       0000      9    37
    <STATUS         0000     13    74
    <STRÄNG         0000     13    99
    <STUDS          0000     14    65
    <TB             0000     13    89
    <TBLISTA        0000      8    32    34   102
    <TBPRED         0000      8    35
    <TIME           0000     12    56
    <UBANTAL        0000     10    57
    <UBPEKIN        0000     10    50
    <UBPEKUT        0000     10    51
    <UBSTART        0000     10    49
    <WRITELIS       0000     17   101
    <XSTR           0000     12    91
```

```
ASMZ-4.46 REJHEAD                                ERRORS:    0    12:00:00    86-02-24    PAGE  1

   LOCATION PLC CODE      ARG     LC   SOURCE STATEMENT ----------------------------------------------------

    0000    00                      1           ZPROG REJHEAD
    0000                            2           *PAGE 60
                                    3 ;
                                    4 ; EXTERNA RUTINER
                                    5           EXTERNAL HEAD, LSUCC, BINBIT
                                    6           EXTERNAL SKRSTR, ERR2
                                    7 ;
                                    8 ; EXTERNA DATA
                                    9           EXTERNAL TGLISTA,PEK
                                   10           EXTERNAL VARV,TIME,PROGSTAT, DIODSTAT
                                   11           EXTERNAL STUDS, AUTOR
                                   12 ;
                                   13 ; EXTERNA KONSTANTER
                                   14           EXTERNAL XSTATUS,XTG,XREPEAT,XCOUNT,XANTAL,XSTR
                                   15 ;
                                   16 ; GLOBALA RUTINER
                                   17           GLOBAL HEADLOOP
                                   18 ;
                                   19 ;
                                   20 ; ************************************************************
                                   21 ;
                                   22 ;
                                   23 ;
                                   24 ;
                                   25 ;
                                   26 ;        VER   DATUM  SIGN      BESKRIVNING
                                   27 ;        1.0   850926  SP           -
                                   28 ;        1.1   860113   SP      LOPEN GENOMGAS "PER VARV"
                                   29 ;
                                   30 ;
                                   31 ;
                                   32 ; ************************************************************
                                   33 ;
                                   34 ;
                                   35 ;
                                   36 ;
                                   37           *EJECT
```

```
LOCATION PLC CODE      ARG    LC  SOURCE STATEMENT ----------------------------------------------------

                              38 ;
0000    00             0000   39 HEADLOOP EQU   *
0000      X 3A0000            40          LD    A,(PROGSTAT)     ; BEGÄRD RESET ?
0003        CB67              41          BIT   4,A
0005      X C40000            42          CALL  NZ,ERR2
0008        CBA7              43          RES   4,A
000A      X 320000            44          LD    (PROGSTAT),A
                              45 ;
000D    00             000D   46 HEADL    EQU   *
000D      X 3A0000            47          LD    A,(DIODSTAT)
0010        D300              48          OUT   0,A
                              49 ;
0012    00             0012   50 SYNC     EQU   *
0012      X 3A0000            51          LD    A,(TIME)
0015        A7                52          AND   A
0016    00  28FA              53          JR    Z,SYNC
0018        AF                54          XOR   A
0019      X 320000            55          LD    (TIME),A
001C      X 3A0000            56          LD    A,(VARV)
001F        3C                57          INC   A
0020      X 320000            58          LD    (VARV),A
                              59 ;
                              60 ;
0023      X ED5B0000          61          LD    DE,(TGLISTA)     ; STARTA MED FÖRSTA ELEMENT
                              62 ;
0027    00             0027   63 LOOP     EQU   *
                              64 ;
0027      X CD0000            65          CALL  HEAD             ; ÄR LISTAN TOM ?
002A    00  DA0D00            66          JP    C,HEADL
                              67 ;
002D      X ED530000          68          LD    (PEK),DE         ; 1->8
0031      X DD2A0000          69          LD    IX,(PEK)
0035      X DD7E00            70          LD    A,(IX+XTG)
0038        E607              71          AND   7
003A        3C                72          INC   A
003B      X CD0000            73          CALL  BINBIT
003E        5F                74          LD    E,A
                              75 ;
003F      X DD7E00            76          LD    A,(IX+XTG)       ; A->H
0042        E638              77          AND   00111000B
0044        0F                78          RRCA
0045        0F                79          RRCA
0046        0F                80          RRCA
0047        3C                81          INC   A
0048      X CD0000            82          CALL  BINBIT
                              83 ;
004B        47                84          LD    B,A
004C        0E02              85          LD    C,2
                              86 ;
004E        ED41              87          OUT   (C),B            ; AKTIVERA RÄTT RAD
                              88 ;
0050        0E00              89          LD    C,0
0052        ED78              90          IN    A,(C)
0054        2F                91          CPL
0055        A3                92          AND   E                ; MASKA AV RÄTT KOLUMN
                              93 ;
0056    00  CCDE00            94          CALL  Z,CLEAR
0059    00  C47A00            95          CALL  NZ,AKTIVERAD
                              96 ;
005C      X ED5B0000          97          LD    DE,(PEK)
```

```
   LOCATION PLC CODE      ARG     LC  SOURCE STATEMENT ----------------------------------------------------

                                  98 ;
    0060        F3                99          DI
    0061      X 3A0000           100          LD    A,(PROGSTAT)
    0064        CB77             101          BIT   6,A
    0066        CBF7             102          SET   6,A
    0068      X 320000           103          LD    (PROGSTAT),A
    006B        FB               104          EI
    006C    00  CA0D00           105          JP    Z,HEADL          ; LISTAN HAR BLIVIT ANDRAD
                                 106 ;
    006F        F3               107          DI
    0070      X CD0000           108          CALL  LSUCC
    0073        FB               109          EI
    0074    00  D22700           110          JP    NC,LOOP
    0077    00  C30D00           111          JP    HEADL
                                 112 ;
                                 113          *EJECT
```

```
LOCATION PLC CODE      ARG    LC   SOURCE STATEMENT ----------------------------------------------------

                              114  ;
007A    00             007A   115  AKTIVERAD EQU   *
007A      X DDCB0046          116            BIT   0,(IX+XSTATUS)       ; AKTIVERAD ?
007E        C8                117            RET   Z
                              118  ;
007F      X DDCB004E          119            BIT   1,(IX+XSTATUS)   ; NEDTRYCKT FÖRRA GÅNGEN ?
0083    00  C29100            120            JP    NZ,NEDTRYCK
                              121  ;
0086      X 3A0000            122            LD    A,(VARV)
0089      X DD7700            123            LD    (IX+XCOUNT),A
008C      X DDCB00CE          124            SET   1,(IX+XSTATUS)   ; INDIKERA NEDTRYCKT FÖRRA VARVET
0090        C9                125            RET
                              126  ;
0091    00             0091   127  NEDTRYCK  EQU   *
0091      X DDCB0056          128            BIT   2,(IX+XSTATUS)   ; ÄR DEN UTSKRIVEN EN GÅNG ?
0095    00  C2AD00            129            JP    NZ,EJUTSKR
                              130  ;
0098    00  CDF900            131            CALL  DIFFTIME
                              132  ;
009B      X 210000            133            LD    HL,STUDS
009E        BE                134            CP    (HL)
009F        D8                135            RET   C
                              136  ;
00A0      X DDCB00D6          137            SET   2,(IX+XSTATUS)   ; IDIKERA UTSKRIVEN EN GÅNG
                              138  ;
00A4      X 3A0000            139            LD    A,(VARV)
00A7      X DD7700            140            LD    (IX+XCOUNT),A
00AA    00  C3E800            141            JP    OKEJ
                              142  ;
                              143  ;
00AD    00             00AD   144  EJUTSKR   EQU   *
00AD      X DDCB005E          145            BIT   3,(IX+XSTATUS)   ; HAR AUTO-REP BÖRJAT ?
00B1    00  C2CE00            146            JP    NZ,AUTOREP
                              147  ;
00B4        AF                148            XOR   A
00B5      X DDB600            149            OR    (IX+XREPEAT)
00B8        C8                150            RET   Z
                              151  ;
00B9    00  CDF900            152            CALL  DIFFTIME
00BC      X 210000            153            LD    HL,AUTOR
00BF        BE                154            CP    (HL)
00C0        D8                155            RET   C
                              156  ;
00C1      X 3A0000            157            LD    A,(VARV)
00C4      X DD7700            158            LD    (IX+XCOUNT),A
00C7      X DDCB00DE          159            SET   3,(IX+XSTATUS)   ; INDIKERA AUTOREPITION HAR BÖRJAT
                              160  ;
00CB    00  C3E800            161            JP    OKEJ
                              162  ;
00CE    00             00CE   163  AUTOREP   EQU   *
00CE    00  CDF900            164            CALL  DIFFTIME
00D1      X DDBE00            165            CP    (IX+XREPEAT)
00D4        D8                166            RET   C
                              167  ;
00D5      X 3A0000            168            LD    A,(VARV)
00D8      X DD7700            169            LD    (IX+XCOUNT),A
00DB    00  C3E800            170            JP    OKEJ
                              171  ;
                              172            *EJECT
```

```
ASMZ-4.46 REJHEAD                                   ERRORS:   0   12:00:00   86-02-24   PAGE  5

   LOCATION PLC CODE      ARG     LC  SOURCE STATEMENT ----------------------------------------------------

                                  173 ;
   00DE    00             00DE   174 CLEAR     EQU   *               ; TÖM STATUS
   00DE      X DD7E00            175           LD    A,(IX+XSTATUS)
   00E1        E601              176           AND   1
   00E3      X DD7700            177           LD    (IX+XSTATUS),A
   00E6        AF                178           XOR   A
   00E7        C9                179           RET
                                  180 ;
   00E8    00             00E8   181 OKEJ      EQU   *               ; SKRIV UT
   00E8      X 2A0000            182           LD    HL,(PEK)
   00EB      X 010000            183           LD    BC,XSTR
   00EE        09                184           ADD   HL,BC
   00EF      X DD7E00            185           LD    A,(IX+XANTAL)
   00F2        4F                186           LD    C,A
   00F3        0600              187           LD    B,0
   00F5      X CD0000            188           CALL  SKRSTR
   00F8        C9                189           RET
                                  190 ;
   00F9    00             00F9   191 DIFFTIME  EQU   *
   00F9      X 3A0000            192           LD    A,(VARV)
   00FC      X DD9600            193           SUB   (IX+XCOUNT)
   00FF        D0                194           RET   NC
   0100        C6FF              195           ADD   255
   0102        C9                196           RET
                                  197 ;
   0103                          198           END

   ERRORS :    0   WARNINGS :    0
```

```
ASMZ-4.46 REJHEAD                                    ERRORS:   0    12:00:00    86-02-24    PAGE  6
    CROSS REFERENCE LISTING
    SYMBOL      LOCATION   DECL   REFERENCES  ----------------------------------------------------------------

     AKTIVERA    007A       115    95
    <AUTOR       0000        11    153
     AUTOREP     00CE       163    146
    <BINBIT      0000         5    73    82
     CLEAR       00DE       174    94
     DIFFTIME    00F9       191    131   152   164
    <DIODSTAT    0000        10    47
     EJUTSKR     00AD       144    129
    <ERR2        0000         6    42
    <HEAD        0000         5    65
     HEADL       000D        46    66    105   111
    >HEADLOOP    0000        39    17
     LOOP        0027        63    110
    <LSUCC       0000         5    108
     NEDTRYCK    0091       127    120
     OKEJ        00E8       181    141   161   170
    <PEK         0000         9    68    69    97    182
    <PROBSTAT    0000        10    40    44    100   103
    <SKRSTR      0000         6    188
    <STUDS       0000        11    133
     SYNC        0012        50    53
    <TGLISTA     0000         9    61
    <TIME        0000        10    51    55
    <VARV        0000        10    56    58    122   139   157   168   192
    <XANTAL      0000        14    185
    <XCOUNT      0000        14    123   140   158   169   193
    <XREPEAT     0000        14    149   165
    <XSTATUS     0000        14    116   119   124   128   137   145   159   175   177
    <XSTR        0000        14    183
    <XTG         0000        14    70    76
```

```
ASM1-4.46 REJCMD                                ERRORS:   0    12:00:00    86-02-24    PAGE  1

   LOCATION PLC CODE      ARG     LC   SOURCE STATEMENT ----------------------------------------------------

    0000    00                      1          ZPROG REJCMD
    0000                            2          *PAGE 60
                                    3 ;         *LIST OFF
                                    4 ;
                                    5 ;
                                    6 ;
                                    7 ;
                                    8 ; EXTERNA RUTINER
                                    9          EXTERNAL LEXSCAN, SKRSTR, DECBIN, BINDEC
                                   10          EXTERNAL NEW, INLAST, DEL, WRITELIST, READLIST
                                   11          EXTERNAL SKRORD, FINDTG, LSUCC, LPRED
                                   12          EXTERNAL LAST, FIRST, RESLISTA, RESET
                                   13 ;
                                   14 ; GLOBALA RUTINER
                                   15          GLOBAL CMDUTFöR, BINBIT, ERR2
                                   16 ;
                                   17 ;
                                   18 ; EXTERNA DATA
                                   19          EXTERNAL BUFFERT, ENDBYTE, XSTR
                                   20          EXTERNAL SUCC, PRED, STATUS, TG, REPEAT, COUNT, ANTAL
                                   21          EXTERNAL TGLISTA, PEK, STRÄNG, DIODSTAT
                                   22          EXTERNAL STUDS, AUTOR, PROGSTAT
                                   23 ;
                                   24 ;
                                   25 ; ************************************************************
                                   26 ;
                                   27 ;
                                   28 ;
                                   29 ;         VER   DATUM   SIGN      BESKRIVNING
                                   30 ;         1.0   850808   SP          -
                                   31 ;         2.0   851012   SP          -
                                   32 ;         2.1   860115   SP       LIGHT, UNLIGHT IMPLEMENTERAT
                                   33 ;
                                   34 ;
                                   35 ;
                                   36 ; ************************************************************
                                   37 ;
                                   38 ;
                                   39 ;         ERROCODER:
                                   40 ;              0                ALLT OK
                                   41 ;              1
                                   42 ;              2                BEGÄRD RESET
                                   43 ;              3                MINNES BRIST, KOMMANDO EJ UTFÖRT !
                                   44 ;              4                TANGENT SAKNAS I LISTAN
                                   45 ;              5                RANGE ERROR ASCII STRÄNG
                                   46 ;              6                RANGE ERROR TANGENT A1 -> H8
                                   47 ;              7                RANGE ERROR LYSDIOD 1 -> 8
                                   48 ;              8                FÖRVÄNTAD SIFFRA UTEBLIVEN
                                   49 ;              9                OKÄNT KOMMANDO
                                   50 ;
                                   51          *EJECT
```

```
  LOCATION PLC CODE      ARG     LC  SOURCE STATEMENT ----------------------------------------------------

                                 52  ;
  0000     00            0000    53  CMDUTFöR  EQU   *
                                 54  ;
                                 55  ;
  0000     00            0000    56  CMD       EQU   *
  0000        7E                 57            LD    A,(HL)
  0001      X CD0000             58            CALL  LEXSCAN          ; AVKODA KOMMANDO
  0004     00 CD8D01             59            CALL  SKIPBLANK        ; HOPPA öVER BLANKA
  0007     00 CA5301             60            JP    Z,FELCMD
                                 61  ;
  000A     00            000A    62  CMD1      EQU   *                ; LIGHT DIOD
  000A        FE01               63            CP    1                ; === L: ===
  000C     00 2017               64            JR    NZ,CMD2
                                 65  ;
  000E     00 CD9701             66            CALL  SIFFRA
  0011     00 DA6001             67            JP    C,ERR8
  0014     00 CDDC01             68            CALL  BINBIT           ; 0 < A < 9
  0017     00 DA6501             69            JP    C,ERR7
  001A        4F                 70            LD    C,A
  001B      X 3A0000             71            LD    A,(DIODSTAT)
  001E        B1                 72            OR    C
  001F      X 320000             73            LD    (DIODSTAT),A
  0022     00 C38801             74            JP    ERR0
                                 75  ;
                                 76  ;
  0025     00            0025    77  CMD2      EQU   *                ; UNLIGHT DIOD
  0025        FE02               78            CP    2                ; ==== U: ====
  0027     00 2018               79            JR    NZ,CMD3
                                 80  ;
  0029     00 CD9701             81            CALL  SIFFRA
  002C     00 DA6001             82            JP    C,ERR8
  002F     00 CDDC01             83            CALL  BINBIT
  0032     00 DA6501             84            JP    C,ERR7
  0035        2F                 85            CPL
  0036        4F                 86            LD    C,A
  0037      X 3A0000             87            LD    A,(DIODSTAT)
  003A        A1                 88            AND   C
  003B      X 320000             89            LD    (DIODSTAT),A
  003E     00 C38801             90            JP    ERR0
                                 91  ;
                                 92            *EJECT
```

```
   LOCATION PLC CODE      ARG     LC   SOURCE STATEMENT ----------------------------------------------------

                                  93 ;
    0041    00              0041  94 CMD3     EQU   *              ; FILL LISTA
    0041        FE03              95          CP    3              ; === F: ===
    0043    00  205B              96          JR    NZ,CMD4
                                  97 ;
    0045    00  CDBD01            98          CALL  TANGENT        ; HÄMTA TANGENT, PACKA UPP
    0048    00  DA6A01            99          JP    C,ERR6
    004B      X 320000           100          LD    (TG),A
                                 101 ;
    004E      X CD0000           102          CALL  FINDTG         ; FINNS DET REDAN ?
    0051        E5               103          PUSH  HL
    0052      X 210000           104          LD    HL,TGLISTA
    0055    00  DA5E00           105          JP    C,FANNSEJ
    0058      X CD0000           106          CALL  DEL            ; TA BORT DET !
    005B    00  CDA801           107          CALL  INDANDLI       ; INDIKERA ÄNDRAT I LISTAN
    005E    00              005E 108 FANNSEJ  EQU   *
    005E        E1               109          POP   HL
                                 110 ;
    005F    00  CD8D01           111          CALL  SKIPBLANK      ; REPEAT
    0062    00  CD9701           112          CALL  SIFFRA
    0065    00  DA6001           113          JP    C,ERR8
    0068      X 320000           114          LD    (REPEAT),A
                                 115 ;
    006B        23               116          INC   HL
    006C      X 220000           117          LD    (STRÄNG),HL
    006F    00  CDE901           118          CALL  COUNTSTR       ; RÄKNA ANTAL TECKEN
    0072      X 320000           119          LD    (ANTAL),A
                                 120 ;
                                 121 ;
    0075      X C600             122          ADD   A,XSTR         ; FÖREGÅENDE VARIABLER
    0077        4F               123          LD    C,A
    0078        0600             124          LD    B,0
    007A      X FE00             125          CP    XSTR           ; LEN(ASCII)<>0 ?
    007C    00  CA6F01           126          JP    Z,ERR5
                                 127 ;
    007F      X 3A0000           128          LD    A,(PROGSTAT)   ; FÖRSTA GÅNGEN ?, SKALL DEFULT TÖMMA
    0082        CB47             129          BIT   0,A
                                 130 ;         CALL  Z,RESLISTA
    0084        CBC7             131          SET   0,A
    0086      X 320000           132          LD    (PROGSTAT),A
                                 133 ;
    0089      X CD0000           134          CALL  NEW
    008C    00  DA7901           135          JP    C,ERR3
                                 136 ;
    008F        3E01             137          LD    A,1            ; AKTIVERA TANGENT
    0091      X 320000           138          LD    (STATUS),A
                                 139 ;
    0094      X CD0000           140          CALL  WRITELIST      ; PACKA IN I POST
    0097      X 210000           141          LD    HL,TGLISTA
    009A      X CD0000           142          CALL  INLAST         ; LÄGG POST SIST I LISTA
                                 143 ;
    009D    00  C38B01           144          JP    ERR0
                                 145 ;
                                 146          *EJECT
```

```
LOCATION PLC CODE      ARG     LC   SOURCE STATEMENT ----------------------------------------------------

                                147  ;
00A0    00              00A0    148  CMD4      EQU   *               ; CHANGE LISTA
00A0        FE04                149            CP    4               ; ==== C: ====
00A2    00  203A                150            JR    NZ,CMD5
                                151  ;
00A4    00  CDBD01              152            CALL  TANGENT         ; HÄMTA TANGENT
00A7    00  DA6A01              153            JP    C,ERR6
00AA      X CD0000              154            CALL  FINDTG          ; FINNS DEN
00AD    00  DA7401              155            JP    C,ERR4          ; NEJ
                                156  ;
00B0    00  CD8D01              157            CALL  SKIPBLANK
00B3      X CD0000              158            CALL  READLIST        ; PACKA UPP POST
00B6    00  CD9701              159            CALL  SIFFRA
00B9    00  DABF00              160            JP    C,NONUMB        ; ÄNDRA EJ REPEAT
00BC      X 320000              161            LD    (REPEAT),A
00BF    00              00BF    162  NONUMB    EQU   *
00BF        7E                  163            LD    A,(HL)
00C0      X FE00                164            CP    ENDBYTE
00C2    00  CAD800              165            JP    Z,READY
                                166  ;
00C5        23                  167            INC   HL
00C6      X 220000              168            LD    (STRÄNG),HL
00C9    00  CDE901              169            CALL  COUNTSTR
                                170  ;
00CC        47                  171            LD    B,A             ; NYSTRÄNG KORTARE ÄN GLDSTRÄNG ?
00CD      X 3A0000              172            LD    A,(ANTAL)
00D0        B8                  173            CP    B
00D1    00  DA6F01              174            JP    C,ERR5
00D4        78                  175            LD    A,B
                                176  ;
00D5      X 320000              177            LD    (ANTAL),A
00D8      X CD0000              178  READY     CALL  WRITELIST
00DB    00  C38B01              179            JP    ERR0
                                180  ;
                                181  ;
                                182          *EJECT
```

```
LOCATION PLC CODE      ARG     LC  SOURCE STATEMENT ----------------------------------------------------------

 00DE    00              00DE   183 CMD5    EQU   *             ; DEAKTIVERA TANGENT
 00DE        FE05               184         CP    5             ; ======= D; =======
 00E0    00  201D               185         JR    NZ,CMD6
                                186 ;
 00E2    00  CDBD01             187         CALL  TANGENT
 00E5    00  DA6A01             188         JP    C,ERR6
 00EB      X CD0000             189         CALL  FINDTG
 00EB    00  DA7401             190         JP    C,ERR4
 00EE      X CD0000             191         CALL  READLIST
 00F1      X 3A0000             192         LD    A,(STATUS)
 00F4        CBB7               193         RES   0,A
 00F6      X 320000             194         LD    (STATUS),A
 00F9      X CD0000             195         CALL  WRITELIST
                                196 ;
 00FC    00  C38801             197         JP    ERRO
                                198 ;
                                199 ;
 00FF    00              00FF   200 CMD6    EQU   *             ; AKTIVERA TANGENT
 00FF        FE06               201         CP    6             ; ====== A; ======
 0101    00  201D               202         JR    NZ,CMD7
                                203 ;
 0103    00  CDBD01             204         CALL  TANGENT
 0106    00  DA6A01             205         JP    C,ERR6
 0109      X CD0000             206         CALL  FINDTG
 010C    00  DA7401             207         JP    C,ERR4
 010F      X CD0000             208         CALL  READLIST
 0112      X 3A0000             209         LD    A,(STATUS)
 0115        CBC7               210         SET   0,A
 0117      X 320000             211         LD    (STATUS),A
 011A      X CD0000             212         CALL  WRITELIST
                                213 ;
 011D    00  C38801             214         JP    ERRO
                                215 ;
                                216 ;
 0120    00              0120   217 CMD7    EQU   *             ; MJUKVARU RESET
 0120        FE07               218         CP    7             ; ==== RESET ====
 0122    00  200B               219         JR    NZ,CMD8
                                220 ;
 0124      X 3A0000             221         LD    A,(PROGSTAT)
 0127        CBE7               222         SET   4,A
 0129      X 320000             223         LD    (PROGSTAT),A
                                224 ;
 012C      X C30000             225         JP    RESET         ; RESET
                                226 ;
 012F    00              012F   227 CMD8    EQU   *             ; TIDER
 012F        FE08               228         CP    8             ; = T =
 0131    00  2015               229         JR    NZ,CMD9
                                230 ;
 0133    00  CD9701             231         CALL  SIFFRA
 0136    00  DA6001             232         JP    C,ERR8        ; INGEN SIFFRA
 0139      X 320000             233         LD    (STUDS),A
                                234 ;
 013C    00  CD9701             235         CALL  SIFFRA
 013F    00  DA6001             236         JP    C,ERR8        ; INGEN SIFFRA
 0142      X 320000             237         LD    (AUTOR),A
 0145    00  C38801             238         JP    ERRO
                                239 ;
                                240 ;
 0148    00              0148   241 CMD9    EQU   *             ; TÖM DEFAULTLISTAN
 0148        FE09               242         CP    9
```

```
    LOCATION PLC CODE      ARG     LC   SOURCE STATEMENT ----------------------------------------------------

     014A    00  C25301            243          JP    NZ,FELCMD
                                   244 ;
     014D      X CD0000            245          CALL  RESLISTA
     0150    00  C38801            246          JP    ERRO
                                   247 ;
                                   248          *EJECT
```

```
   LOCATION PLC CODE      ARG    LC   SOURCE STATEMENT ----------------------------------------------------

                                  249 ;
   0153    00              0153   250 FELCMD    EQU   *
   0153        3E39               251           LD    A,"9"            ; OKÄNT KOMMANDO
   0155    00              0155   252 ERROUT    EQU   *                ; SKRIV UT ERROR A
   0155      X 210000             253           LD    HL,BUFFERT
   0158        77                 254           LD    (HL),A
   0159        010100             255           LD    BC,1
   015C      X CD0000             256           CALL  SKRSTR
   015F        C9                 257           RET
                                  258 ;
   0160        3E38               259 ERR8      LD    A,"8"
   0162    00  C35501             260           JP    ERROUT
   0165        3E37               261 ERR7      LD    A,"7"
   0167    00  C35501             262           JP    ERROUT
   016A        3E36               263 ERR6      LD    A,"6"
   016C    00  C35501             264           JP    ERROUT
   016F        3E35               265 ERR5      LD    A,"5"
   0171    00  C35501             266           JP    ERROUT
   0174        3E34               267 ERR4      LD    A,"4"
   0176    00  C35501             268           JP    ERROUT
   0179        3E33               269 ERR3      LD    A,"3"
   017B    00  C35501             270           JP    ERROUT
   017E        3E32               271 ERR2      LD    A,"2"
   0180    00  C35501             272           JP    ERROUT
   0183        3E31               273 ERR1      LD    A,"1"
   0185    00  C35501             274           JP    ERROUT
   0188        3E30               275 ERR0      LD    A,"0"
   018A    00  C35501             276           JP    ERROUT
                                  277 ;
                                  278           *EJECT
```

```
   LOCATION PLC CODE      ARG     LC   SOURCE STATEMENT ----------------------------------------------------

                                  279  ;
    018D        2B            0   280  SKIPBLANK DEC   HL
    018E        F5            0   281            PUSH  AF
    018F        23            0   282  SKIPB     INC   HL
    0190        7E            0   283            LD    A,(HL)
    0191        FE20          0   284            CP    32
    0193   00   28FA          0   285            JR    Z,SKIPB
    0195        F1            0   286            POP   AF
    0196        C9            0   287            RET
                                  288  ;
                                  289  ;
    0197   00   -       0197   290  SIFFRA    EQU   *               ; SIFFER KONTROLL, LÄSER FÖRBI
    0197        7E            0   291            LD    A,(HL)        ; BLANKA I HL RETURNERAR NC OM OK
    0198        FE30          0   292            CP    48
    019A        D8            0   293            RET   C
    019B        FE3A          0   294            CP    58
    019D   00   DAA201        0   295            JP    C,OKSIFFRA
    01A0        37            0   296            SCF                  ; FEL
    01A1        C9            0   297            RET
    01A2   00   -       01A2   298  OKSIFFRA   EQU   *
    01A2     X  CD0000        0   299            CALL  DECBIN
    01A5        37            0   300            SCF                  ; SÄKERSTÄLL NC
    01A6        3F            0   301            CCF
    01A7        C9            0   302            RET                  ; OK SIFFRA
                                  303  ;
                                  304  ;
    01A8   00           01A8   305  INDÄNDLI   EQU   *
    01A8     X  3A0000        0   306            LD    A,(PROGSTAT)
    01AB     -  CBB7          0   307            RES   6,A
    01AD     X  320000        0   308            LD    (PROGSTAT),A
    01B0        C9            0   309            RET
                                  310  ;
    01B1   00           01B1   311  GRÄNS      EQU   *
    01B1        FE09          0   312            CP    9
    01B3   00   3006          0   313            JR    NC,FELGRÄNS
    01B5        FE00          0   314            CP    0
    01B7   00   2802          0   315            JR    Z,FELGRÄNS
    01B9        A7            0   316            AND   A
    01BA        C9            0   317            RET
    01BB        37            0   318  FELGRÄNS  SCF
    01BC        C9            0   319            RET
                                  320  ;
                                  321            *EJECT
```

```
   LOCATION PLC CODE      ARG     LC   SOURCE STATEMENT ----------------------------------------------------------

                                  322  ;
   01BD    00              01BD   323  TANGENT  EQU   *
   01BD        7E                 324           LD    A,(HL)
   01BE        D640               325           SUB   64
   01C0    00  CDB101             326           CALL  GRÄNS
   01C3    00  DADB01             327           JP    C,FELTG
   01C6        3D                 328           DEC   A                 ; A == (0:7)
   01C7        07                 329           RLCA
   01C8        07                 330           RLCA
   01C9        07                 331           RLCA
   01CA        77                 332           LD    (HL),A
   01CB        23                 333           INC   HL
   01CC        7E                 334           LD    A,(HL)
   01CD        D630               335           SUB   "0"               ; A == (1:8)
   01CF    00  CDB101             336           CALL  GRÄNS
   01D2    00  DADB01             337           JP    C,FELTG
   01D5        3D                 338           DEC   A                 ; A == (0:7)
   01D6        2B                 339           DEC   HL
   01D7        B6                 340           OR    (HL)
   01D8        23                 341           INC   HL
   01D9        23                 342           INC   HL
   01DA        A7                 343           AND   A
   01DB    00              01DB   344  FELTG    EQU   *
   01DB        C9                 345           RET
                                  346  ;
                                  347  ;
   01DC    00              01DC   348  BINBIT   EQU   *                 ; BINÄRT ==> BIT KONVERTERING
   01DC    00  CDB101             349           CALL  GRÄNS
   01DF        D8                 350           RET   C
   01E0        C5                 351           PUSH  BC
   01E1        47                 352           LD    B,A
   01E2        AF                 353           XOR   A
   01E3        37                 354           SCF
   01E4        17                 355  BBL      RLA
   01E5    00  10FD               356           DJNZ  BBL
   01E7        C1                 357           POP   BC
   01E8        C9                 358           RET
                                  359  ;
                                  360  ;
   01E9    00              01E9   361  COUNTSTR  EQU   *                 ; RÄKNAR ANTAL TKN I STRÄNG
   01E9        E5                 362           PUSH  HL
   01EA        C5                 363           PUSH  BC
   01EB        0E00               364           LD    C,0
   01ED        7E                 365  CC       LD    A,(HL)
   01EE        23                 366           INC   HL
   01EF      X FE00               367           CP    ENDBYTE
   01F1    00  2803               368           JR    Z,CCUT
   01F3        0C                 369           INC   C
   01F4    00  18F7               370           JR    CC
   01F6        79                 371  CCUT     LD    A,C
   01F7        C1                 372           POP   BC
   01F8        E1                 373           POP   HL
   01F9        C9                 374           RET
                                  375  ;
   01FA                           376           END

   ERRORS :    0   WARNINGS :    0
```

CROSS REFERENCE LISTING

SYMBOL	LOCATION	DECL	REFERENCES
<ANTAL	0000	20	119 172 177
<AUTOR	0000	22	237
BBL	01E4	355	356
>BINBIT	01DC	348	15 68 83
?BINDEC	0000	9	
<BUFFERT	0000	19	253
CC	01ED	365	370
CCUT	01F6	371	368
?CMD	0000	56	
?CMD1	000A	62	
CMD2	0025	77	64
CMD3	0041	94	79
CMD4	00A0	148	96
CMD5	00DE	183	150
CMD6	00FF	200	185
CMD7	0120	217	202
CMD8	012F	227	219
CMD9	0148	241	229
>CMDUTFöR	0000	53	15
?COUNT	0000	20	
COUNTSTR	01E9	361	118 169
<DECBIN	0000	9	299
<DEL	0000	10	106
<DIODSTAT	0000	21	71 73 87 89
<ENDBYTE	0000	19	164 367
ERR0	0188	275	74 90 144 179 197 214 238 246
?ERR1	0183	273	
>ERR2	017E	271	15
ERR3	0179	269	135
ERR4	0174	267	155 190 207
ERR5	016F	265	126 174
ERR6	016A	263	99 153 188 205
ERR7	0165	261	69 84
ERR8	0160	259	67 82 113 232 236
ERROUT	0155	252	260 262 264 266 268 270 272 274 276
FANNSEJ	005E	108	105
FELCMD	0153	250	60 243
FELGRÄNS	01BB	318	313 315
FELTG	01DB	344	327 337
<FINDTG	0000	11	102 154 189 206
?FIRST	0000	12	
GRÄNS	01B1	311	326 336 349
INDÄNDLI	01A8	305	107
<INLAST	0000	10	142
?LAST	0000	12	
<LEXSCAN	0000	9	58
?LPRED	0000	11	
?LSUCC	0000	11	
<NEW	0000	10	134
NONUMB	00BF	162	160
OKSIFFRA	01A2	298	295
?PEK	0000	21	
?PRED	0000	20	
<PROGSTAT	0000	22	128 132 221 223 306 308
<READLIST	0000	10	158 191 208
READY	00D8	178	165
<REPEAT	0000	20	114 161
<RESET	0000	12	225
<RESLISTA	0000	12	245
SIFFRA	0197	290	66 81 112 159 231 235

```
ASMZ-4.46 REJCMD                                ERRORS:    0    12:00:00    86-02-24    PAGE 11
    CROSS REFERENCE LISTING
    SYMBOL      LOCATION   DECL   REFERENCES  ----------------------------------------------------------

     SKIPB        018F      282   285
     SKIPBLAN     018D      280    59   111   157
    ?SKRORD       0000       11
    <SKRSTR       0000        9   256
    <STATUS       0000       20   138   192   194   209   211
    <STRANG       0000       21   117   168
    <STUDS        0000       22   233
    ?SUCC         0000       20
     TANGENT      01BD      323    98   152   187   204
    <TG           0000       20   100
    <TGLISTA      0000       21   104   141
    <WRITELIS     0000       10   140   178   195   212
    <XSTR         0000       19   122   125
```

```
ASMZ-4.46 REJLEX                                ERRORS:    0    12:00:00    86-02-24    PAGE  1

   LOCATION PLC CODE      ARG     LC   SOURCE STATEMENT ----------------------------------------------------------

    0000                           1           ZPROG REJLEX
                                   2           GLOBAL LEXSCAN
                                   3 ;
    0000                           4           *PAGE 60
                                   5 ;
                                   6 ;
                                   7 ; ********************************************************************
                                   8 ;
                                   9 ;         REILEX, LETAR EFTER STRÄNG SOM HL PEKAR PÅ
                                  10 ;         I TABELL.
                                  11 ;
                                  12 ;         A INNEHÅLLER SKILJEBITEN OM OK
                                  13 ;         A = 0 OM INTE OK.
                                  14 ;
                                  15 ;
                                  16 ;         VER   DATUM   SIGN      BESKRIVNING
                                  17 ;         1.0   850615   SP
                                  18 ;
                                  19 ;
                                  20 ; ********************************************************************
                                  21 ;
                                  22 ;
    0000    00          0000      23 LEXSCAN   EQU   *
    0000        D5                24           PUSH  DE
    0001        E5                25           PUSH  HL
    0002    00  212800            26           LD    HL,TABELL
    0005        D1                27 LEX1      POP   DE              ; HÄMTA STÄNGSTART
    0006        D5                28           PUSH  DE
    0007        1A                29 LEX2      LD    A,(DE)
    0008        BE                30           CP    (HL)
    0009    00  2009              31           JR    NZ,NÄSTA
    000B        13                32           INC   DE
    000C        23                33           INC   HL
    000D        7E                34           LD    A,(HL)
    000E        FE80              35           CP    128
    0010    00  3010              36           JR    NC,HITTAT
    0012    00  18F3              37           JR    LEX2
                                  38 ;
    0014        23                39 NÄSTA     INC   HL
    0015        7E                40           LD    A,(HL)
    0016        FE80              41           CP    128
    0018    00  38FA              42           JR    C,NÄSTA
    001A        FEFF              43           CP    255
    001C    00  2803              44           JR    Z,FANNSEJ
    001E        23                45           INC   HL
    001F    00  18E4              46           JR    LEX1
                                  47 ;
    0021        AF                48 FANNSEJ   XOR   A
    0022        E67F              49 HITTAT    AND   127
    0024        E1                50           POP   HL
    0025        EB                51           EX    DE,HL
    0026        D1                52           POP   DE
    0027        C9                53           RET
                                  54 ;
                                  55           *EJECT
```

```
   LOCATION PLC CODE      ARG     LC   SOURCE STATEMENT ----------------------------------------------------

                                  56  ;
    0028        4C3A              57  TABELL    DEFM  "L:"            ; L(IGHT)
    002A        81                58            DEFB  128+1
    002B        553A              59            DEFM  "U:"            ; U(NLIGHT) SLÄCK DIOD
    002D        82                60            DEFB  128+2
                                  61  ;
    002E        463A              62            DEFM  "F:"            ; DEFINIERA I LISTA
    0030        83                63            DEFB  128+3
                                  64  ;
    0031        433A              65            DEFM  "C:"            ; CHANGE I LISTA
    0033        84                66            DEFB  128+4
                                  67  ;
    0034        443A              68            DEFM  "D:"            ; DEAKTIVERA TANGENT
    0036        85                69            DEFB  128+5
                                  70  ;
    0037        413A              71            DEFM  "A:"            ; AKTIVERA TANGENT
    0039        86                72            DEFB  128+6
                                  73  ;
    003A        52455345          74            DEFM  "RESET"         ; MJUKVARUMÄSSIG RESET
    003F        87                75            DEFB  128+7
                                  76  ;
    0040        543A              77            DEFM  "T:"            ; TIMING KONSTANTER
    0042        88                78            DEFB  128+8
                                  79  ;
    0043        523A              80            DEFM "R:"             ; TÖM DEFAULTLISTAN
    0045        89                81            DEFB  128+9
                                  82  ;
                                  83  ;
    0046        FF                84            DEFB  255               ; AVSLUTNING
                                  85  ;
    0047                          86   END

   ERRORS :   0   WARNINGS :   0
```

```
ASM2-4.46 REJLEX                                    ERRORS:   0    12:00:00    86-02-24    PAGE  3
    CROSS REFERENCE LISTING
    SYMBOL      LOCATION   DECL   REFERENCES
     FANNSEJ      0021       48    44
     HITTAT       0022       49    36
     LEX1         0005       27    46
     LEX2         0007       29    37
    >LEXSCAN      0000       23     2
     NXSTA        0014       39    31    42
     TABELL       0028       57    26
```

```
ASMZ-4.46 LISTOR.ASM                              ERRORS:    0    12:00:00    86-02-24    PAGE  1

   LOCATION PLC CODE      ARG     LC   SOURCE STATEMENT ----------------------------------------------------

    0000    00                      1           ZPROG LISTOR.ASM
    0000                            2           *PAGE 60
                                    3 ;
                                    4 ;
                                    5 ; EXTERNA DATA
                                    6           EXTERNAL BOTRAM
                                    7 ;
                                    8 ; GLOBALA RUTINER
                                    9           GLOBAL NEW, DEL, INLAST, LSUCC, LPRED
                                   10           GLOBAL LAST, FIRST, HEAD
                                   11 ;
                                   12 ;
                                   13 ;
                                   14 ; ********************************************************
                                   15 ;
                                   16 ;        LISTOR, PAKET MED RUTINER FÖR TVÅVÄGSLISTOR
                                   17 ;        FAST I STUKTUREN ÄR ATT ELEMENTET STARTAR MED EN SUCC
                                   18 ;        PEKARE SOM FÖLJS AV EN PRED PEKARE, GENERELLT ÄR HL
                                   19 ;        LISTHUVUD OCH DE ELEMENT.
                                   20 ;
                                   21 ;
                                   22 ;        VER   DATUM   SIGN      BESKRIVNING
                                   23 ;        1.0   851103   SP           -
                                   24 ;        1.1   851104   SP       LSUCC
                                   25 ;        1.2   860113   SP       NEW GER C=1 VID MINNESBRIST
                                   26 ;
                                   27 ;
                                   28 ;
                                   29 ; ********************************************************
                                   30 ;
                                   31           *EJECT
```

```
   LOCATION PLC CODE      ARG    LC  SOURCE STATEMENT ----------------------------------------------------

                                  32  ; NEW(STORLEK,PEK), SKAPAR ETT TOMT LISTELEMENT I MINNET
                                  33  ; IN: BC   STORLEK PA ELEMENT
                                  34  ; UT: DE   ADRESS TILL RESERVERAT ELEMENT, PEK
                                  35  ;
    0000    00           0000     36  NEW       EQU   *
    0000        EB               37            EX    DE,HL
    0001      X 2A0000           38            LD    HL,(BOTRAM)       ; FÖRSTA LEDIGA BYTE I RAM
                                  39  ;
    0004        3600             40            LD    (HL),0            ; PEK.SUCC := NIL, PEK.PRED := NIL
    0006        23               41            INC   HL
    0007        3600             42            LD    (HL),0
    0009        23               43            INC   HL
    000A        3600             44            LD    (HL),0
    000C        23               45            INC   HL
    000D        3600             46            LD    (HL),0
    000F        2B               47            DEC   HL
    0010        2B               48            DEC   HL
    0011        2B               49            DEC   HL
                                  50  ;
    0012        E5               51            PUSH  HL
    0013        09               52            ADD   HL,BC
    0014    00  3803             53            JR    C,NEWEXIT
    0016      X 220000           54            LD    (BOTRAM),HL
    0019    00           0019     55  NEWEXIT   EQU   *
    0019        E1               56            POP   HL
    001A        EB               57            EX    DE,HL
    001B        C9               58            RET
                                  59  ;
                                  60  ;
                                  61  ; HEAD(PEK), GER C=1 OM DE PEKAR PA LISTHUVUDET
                                  62  ; IN DE : LISTA
                                  63  ; UT: OFÖRÄNDRAT
                                  64  ;
    001C    00           001C     65  HEAD      EQU   *
    001C        D5               66            PUSH  DE
    001D        EB               67            EX    DE,HL
    001E        23               68            INC   HL
    001F        23               69            INC   HL
    0020        7E               70            LD    A,(HL)
    0021        E3               71            EX    (SP),HL
    0022        BD               72            CP    L                 ; LISTA.SUCCL = LISTAL ?
    0023        E3               73            EX    (SP),HL
    0024    00  200B             74            JR    NZ,NOTEMP
    0026        23               75            INC   HL
    0027        7E               76            LD    A,(HL)
    0028        E3               77            EX    (SP),HL
    0029        BC               78            CP    H                 ; LISTA.SUCCH = LISTAH ?
    002A        E3               79            EX    (SP),HL
    002B    00  2004             80            JR    NZ,NOTEMP
    002D        EB               81            EX    DE,HL
    002E        D1               82            POP   DE
    002F        37               83            SCF
    0030        C9               84            RET
                                  85  ;
    0031    00           0031     86  NOTEMP   EQU   *
    0031        EB               87            EX    DE,HL
    0032        D1               88            POP   DE
    0033        A7               89            AND   A
    0034        C9               90            RET
                                  91            *EJECT
```

```
   LOCATION PLC CODE      ARG     LC  SOURCE STATEMENT ----------------------------------------------------

                                  92 ;
                                  93 ;
                                  94 ; INLAST(PEK,LISTA), LÄGGER ELEMENTET PEK SIST I LISTAN LISTA
                                  95 ; IN: DE PEK, HL LISTA
                                  96 ; UT: OFÖRÄNDRAT
                                  97 ;
    0035    00          0035      98 INLAST   EQU  *
    0035        F5                99         PUSH AF
    0036        D5               100         PUSH DE
    0037        E5               101         PUSH HL
                                 102 ;
    0038        23               103         INC  HL
    0039        7E               104         LD   A,(HL)          ; LISTA.NEXT = NIL ?
    003A        2B               105         DEC  HL
    003B        B6               106         OR   (HL)
    003C    00  2805             107         JR   Z,FÖRSTA
                                 108 ;
    003E        EB               109         EX   DE,HL
    003F    00  CD5100           110         CALL LAST            ; HÄMTA SISTA ELEMENT I LISTAN
    0042        EB               111         EX   DE,HL
                                 112 ;
    0043        73               113 FÖRSTA  LD   (HL),E          ; SE.NEXT:L := PEK:L
    0044        23               114         INC  HL
    0045        72               115         LD   (HL),D          ; SE.NEXT:H := PEK:H
    0046        2B               116         DEC  HL
    0047        EB               117         EX   DE,HL
    0048        23               118         INC  HL              ; PEK.PRED := "SISTA ELEMENT"
    0049        23               119         INC  HL
    004A        73               120         LD   (HL),E          ; PEK.PRED:L := SE:L
    004B        23               121         INC  HL
    004C        72               122         LD   (HL),D          ; PEK.PRED:H := SE:H
                                 123 ;
    004D        E1               124         POP  HL
    004E        D1               125         POP  DE
    004F        F1               126         POP  AF
    0050        C9               127         RET
                                 128 ;
                                 129 ;
                                 130         #EJECT
```

```
LOCATION PLC CODE      ARG    LC  SOURCE STATEMENT ----------------------------------------------------

                              131 ;LAST(PEK), HÄMTAR SISTA ELEMENTET I LISTAN
                              132 ; IN: DE PEKARE
                              133 ; UT: DE PEKARE TILL SISTA ELEMENT
                              134 ;
 0051   00             0051  135 LAST    EQU  *
 0051      E5                 136         PUSH HL
 0052   00             0052  137 LALOP   EQU  *
 0052      D5                 138         PUSH DE             ; PEK
 0053   00 CD9B00            139         CALL LSUCC          ; PEK := PEK.SUCC
 0056   00 3803              140         JR   C,LAOK
 0058      E1                 141         POP  HL             ; DUMMY, TÖMMER STACK
 0059   00 18F7              142         JR   LALOP
 005B   00             005B  143 LAOK    EQU  *
 005B   00 CD1C00            144         CALL HEAD           ; C=1 -> TOM LISTA
 005E      D1                 145         POP  DE             ; PEK
 005F      E1                 146         POP  HL
 0060      C9                 147         RET
                              148 ;
                              149 ;
                              150 ;FIRST(PEK), HÄMTAR FÖRSTA ELEMENTET I LISTAN
                              151 ; IN: PEK
                              152 ; UT: PEKARE TILL FÖRSTA ELEMENT
                              153 ;
 0061   00             0061  154 FIRST   EQU  *
 0061      E5                 155         PUSH HL
 0062   00 CD9B00            156         CALL LSUCC          ; UNDVIKA LISTHUVUDET
 0065   00             0065  157 FILOP   EQU  *
 0065      D5                 158         PUSH DE
 0066   00 CDB500            159         CALL LPRED
 0069   00 3808              160         JR   C,FIOK
 006B   00 CD1C00            161         CALL HEAD
 006E   00 3803              162         JR   C,FIOK
 0070      E1                 163         POP  HL
 0071   00 18F2              164         JR   FILOP
 0073   00             0073  165 FIOK    EQU  *
 0073   00 CD1C00            166         CALL HEAD           ; C=1 -> TOM LISTA
 0076      D1                 167         POP  DE
 0077      E1                 168         POP  HL
 0078      C9                 169         RET
                              170 ;
                              171         *EJECT
```

```
   LOCATION PLC CODE      ARG    LC   SOURCE STATEMENT ----------------------------------------------------

                                  172 ;
                                  173 ;
                                  174 ; DEL(PEK), TAR BORT ELEMENTET PEK UR LISTAN
                                  175 ; IN: DE PEK
                                  176 ; UT: OFÖRÄNDRAT
                                  177 ;
    0079   00          0079       178 DEL     EQU  *
                                  179 ;
    0079       E5                 180         PUSH HL
    007A       D5                 181         PUSH DE
                                  182 ;
    007B   00  CDB500             183         CALL LPRED
    007E       EB                 184         EX   DE,HL          ; HL := PEK.PRED
    007F       D1                 185         POP  DE             ; DE := PEK
                                  186 ;
    0080       1A                 187         LD   A,(DE)         ; PEK.PRED.SUCC := PEK.SUCC
    0081       77                 188         LD   (HL),A
    0082       13                 189         INC  DE
    0083       23                 190         INC  HL
    0084       1A                 191         LD   A,(DE)
    0085       77                 192         LD   (HL),A
    0086       1B                 193         DEC  DE
                                  194 ;
    0087       D5                 195         PUSH DE
    0088   00  CD9B00             196         CALL LSUCC
    008B       EB                 197         EX   DE,HL          ; HL := PEK.SUCC
    008C       D1                 198         POP  DE             ; DE := PEK
                                  199 ;
    008D       D5                 200         PUSH DE             ; PEK.SUCC.PRED := PEK.PRED
    008E       13                 201         INC  DE
    008F       13                 202         INC  DE
    0090       23                 203         INC  HL
    0091       23                 204         INC  HL
    0092       1A                 205         LD   A,(DE)
    0093       77                 206         LD   (HL),A
    0094       13                 207         INC  DE
    0095       23                 208         INC  HL
    0096       1A                 209         LD   A,(DE)
    0097       77                 210         LD   (HL),A
    0098       D1                 211         POP  DE
    0099       E1                 212         POP  HL
    009A       C9                 213         RET
                                  214 ;
                                  215         *EJECT
```

```
   LOCATION PLC CODE      ARG     LC   SOURCE STATEMENT ----------------------------------------------------

                                  216  ;
                                  217  ;LSUCC(PEK), HÄMTAR NÄSTA ELEMENT I LISTAN
                                  218  ; IN: DE PEK
                                  219  ; UT: DE PEK.NEXT C=0, OM PEK.NEXT<>NIL
                                  220  ;     DE OFÖRÄNDRAD, C=1 OM PEK.SUCC=NIL
                                  221  ;
    009B    00          009B      222  LSUCC     EQU   *
    009B        F5                223            PUSH  AF
    009C        EB                224            EX    DE,HL
                                  225  ;
    009D        7C                226            LD    A,H
    009E        B5                227            OR    L                ; PEK = NIL ?
    009F    00  CAB100            228            JP    Z,YESNIL
                                  229  ;
    00A2        23                230            INC   HL               ; PEK.SUCC = NIL ?
    00A3        7E                231            LD    A,(HL)
    00A4        2B                232            DEC   HL
    00A5        B6                233            OR    (HL)
    00A6    00  2B09              234            JR    Z,YESNIL
                                  235  ;
    00A8        23                236            INC   HL
    00A9        7E                237            LD    A,(HL)
    00AA        2B                238            DEC   HL
    00AB        6E                239            LD    L,(HL)
    00AC        67                240            LD    H,A
                                  241  ;
    00AD    00          00AD      242  NONIL     EQU   *
    00AD        EB                243            EX    DE,HL
    00AE        F1                244            POP   AF
    00AF        A7                245            AND   A                ; C := 0
    00B0        C9                246            RET
                                  247  ;
    00B1    00          00B1      248  YESNIL    EQU   *
    00B1        EB                249            EX    DE,HL
    00B2        F1                250            POP   AF
    00B3        37                251            SCF                    ; C := 1
    00B4        C9                252            RET
                                  253  ;
                                  254  ;LPRED, HÄMTAR FÖREGÅENDE ELEMENT I LISTAN
                                  255  ; IN: DE PEK
                                  256  ; UT: DE PEK.SUCC C=0, OM PEK.SUCC<>NIL
                                  257  ;     DE OFÖRÄNDRAD C=1, OM PEK.SUCC=NIL
                                  258  ;
    00B5    00          00B5      259  LPRED     EQU   *
    00B5        F5                260            PUSH  AF
                                  261  ;
    00B6    00  CD1C00            262            CALL  HEAD             ; LISTHUVUDET ?
                                  263  ;
    00B9        EB                264            EX    DE,HL
    00BA    00  DAB100            265            JP    C,YESNIL
                                  266  ;
    00BD        23                267            INC   HL
    00BE        23                268            INC   HL
    00BF        7E                269            LD    A,(HL)
    00C0        23                270            INC   HL
    00C1        66                271            LD    H,(HL)
    00C2        6F                272            LD    L,A
    00C3    00  C3AD00            273            JP    NONIL
    00C6                          274            END

   ERRORS :    0   WARNINGS :    0
```

```
ASMZ-4.46 LISTOR.ASM                                    ERRORS:   0    12:00:00   86-02-24   PAGE  7
    CROSS REFERENCE LISTING
    SYMBOL      LOCATION   DECL   REFERENCES
    ----------------------------------------------------------------------

    <BOTRAM       0000        6    38    54
    >DEL          0079      178     9
     FILOP        0065      157   164
     FIOK         0073      165   160   162
    >FIRST        0061      154    10
     FÖRSTA       0043      113   107
    >HEAD         001C       65    10   144   161   166   262
    >INLAST       0035       98     9
     LALOP        0052      137   142
     LAOK         005B      143   140
    >LAST         0051      135    10   110
    >LPRED        00B5      259     9   159   183
    >LSUCC        009B      222     9   139   156   196
    >NEW          0000       36     9
     NEWEXIT      0019       55    53
     NONIL        00AD      242   273
     NOTEMP       0031       86    74    80
     YESNIL       00B1      248   228   234   265
```

```
LOCATION PLC CODE      ARG     LC  SOURCE STATEMENT ----------------------------------------------------

 0000    00                     1          ZPROG REJSTRUC.ASM
 0000                           2          *PAGE 60
                                3 ;
                                4 ;
                                5 ; GLOBALA RUTINER
                                6          GLOBAL WRITELIST, READLIST, FINDTG
                                7 ;
                                8 ; GLOBALA KONSTANTER
                                9          GLOBAL XSUCCL,XSUCCH,XPREDL,XPREDH,XSTATUS,XTG,XREPEAT
                               10          GLOBAL XCOUNT,XANTAL,XSTR
                               11 ;
                               12 ; EXTERNA DATA
                               13          EXTERNAL SUCC, PRED, STATUS, TG, REPEAT, COUNT, ANTAL
                               14          EXTERNAL TGLISTA, STRANG
                               15 ;
                               16 ;
                               17 ; ************************************************************
                               18 ;
                               19 ;        REJSTRUC, INNEHALLER STRUKTUREN FÖR TANGENTLISTAN
                               20 ;        OCH EN RUTIN WRITELIST, SOM LÄGGER IN DATA I DET ELEMENT
                               21 ;        SOM DE PEKAR TILL. PÅ MOTSVARANDE VIS LÄSER READLIST.
                               22 ;
                               23 ;        IN:
                               24 ;        DE  -  PEKARE TILL AKTIV ELEMENT
                               25 ;
                               26 ;        MINNESVARIABLER
                               27 ;        SUCC  -  VIDAREPEKARE
                               28 ;        PRED  -  FÖREGÅENDE PEKARE
                               29 ;        STATUS
                               30 ;        TG    - KOORDINAT
                               31 ;        REPEAT
                               32 ;        COUNT -  HJÄLPVARIABEL
                               33 ;        ANTAL -  ANTAL TECKEN I STRÄNG
                               34 ;
                               35 ;
                               36 ;        VER   DATUM   SIGN      BESKRIVNING
                               37 ;        1.0   851103   SP           -
                               38 ;
                               39 ;
                               40 ; ************************************************************
                               41 ;
 0000                  0000    42 XSUCCL    EQU   0              ; +--------------+
 0000                  0001    43 XSUCCH    EQU   1              ; !     SUCC     !
 0000                  0002    44 XPREDL    EQU   2              ; +--------------+
 0000                  0003    45 XPREDH    EQU   3              ; !     PRED     !
                               46 ;                              ; +--------------+
 0000                  0004    47 XSTATUS   EQU   4              ; !     STATUS   !
                               48 ;                              ; +--------------+
 0000                  0005    49 XTG       EQU   5              ; !      TG      !
                               50 ;                              ; +--------------+
 0000                  0006    51 XREPEAT   EQU   6              ; !     REPEAT   !
                               52                                ; +--------------+
 0000                  0007    53 XCOUNT    EQU   7              ; !     COUNT    !
                               54 ;                              ; +--------------+
 0000                  0008    55 XANTAL    EQU   8              ; !     ANTAL    !
                               56 ;                              ; +--------------+
 0000                  0009    57 XSTR      EQU   9              ; !    STRÄNG-   !
                               58 ;                              ; !    START     !
                               59          *EJECT
```

```
LOCATION PLC CODE      ARG     LC  SOURCE STATEMENT ----------------------------------------------------

0000    00             0000    60 WRITELIST EQU   *
0000       E5                  61           PUSH  HL
0001       D5                  62           PUSH  DE
0002       DDE3                63           EX    (SP),IX
                               64 ;
0004     X 3A0000              65           LD    A,(STATUS)       ; STATUS
0007       DD7704              66           LD    (IX+XSTATUS),A
                               67 ;
000A     X 3A0000              68           LD    A,(TG)           ; TG
000D       DD7705              69           LD    (IX+XTG),A
                               70 ;
0010     X 3A0000              71           LD    A,(REPEAT)       ; REPEAT
0013       DD7706              72           LD    (IX+XREPEAT),A
                               73 ;
0016     X 3A0000              74           LD    A,(COUNT)        ; COUNT
0019       DD7707              75           LD    (IX+XCOUNT),A
                               76 ;
001C     X 3A0000              77           LD    A,(ANTAL)        ; ANTAL
001F       DD7708              78           LD    (IX+XANTAL),A
0022       0600                79           LD    B,0
0024       4F                  80           LD    C,A
                               81 ;
0025       210900              82           LD    HL,XSTR          ; DE PEKAR PA STRANGUTRYMME
0028       19                  83           ADD   HL,DE
0029       EB                  84           EX    DE,HL
                               85 ;
002A     X 2A0000              86           LD    HL,(STRANG)
002D       EDB0                87           LDIR
                               88 ;
002F       DDE3                89           EX    (SP),IX
0031       D1                  90           POP   DE
0032       E1                  91           POP   HL
0033       C9                  92           RET
                               93 ;
                               94           *EJECT
```

```
LOCATION PLC CODE      ARG     LC   SOURCE STATEMENT ----------------------------------------------------

                                95 ;
 0034    00                0034  96 READLIST  EQU   *
 0034        E5                  97           PUSH  HL
 0035        D5                  98           PUSH  DE
 0036        DDE3                99           EX    (SP),IX
                                100 ;
 0038        DD6E00             101           LD    L,(IX+XSUCCL)     ; SUCC
 003B        DD6601             102           LD    H,(IX+XSUCCH)
 003E      X 220000             103           LD    (SUCC),HL
                                104 ;
 0041        DD6E02             105           LD    L,(IX+XPREDL)     ; PRED
 0044        DD6603             106           LD    H,(IX+XPREDH)
 0047      X 220000             107           LD    (PRED),HL
                                108 ;
 004A        DD7E04             109           LD    A,(IX+XSTATUS)      ; STATUS
 004D      X 320000             110           LD    (STATUS),A
                                111 ;
 0050        DD7E05             112           LD    A,(IX+XTG)        ; TG
 0053      X 320000             113           LD    (TG),A
                                114 ;
 0056        DD7E06             115           LD    A,(IX+XREPEAT)    ; REPEAT
 0059      X 320000             116           LD    (REPEAT),A
                                117 ;
 005C        DD7E07             118           LD    A,(IX+XCOUNT)     ; COUNT
 005F      X 320000             119           LD    (COUNT),A
                                120 ;
 0062        DD7E08             121           LD    A,(IX+XANTAL)     ; ANTAL
 0065      X 320000             122           LD    (ANTAL),A
                                123 ;
 0068        210900             124           LD    HL,XSTR
 006B        19                 125           ADD   HL,DE
 006C      X 220000             126           LD    (STRANG),HL
                                127 ;
 006F        DDE3               128           EX    (SP),IX
 0071        D1                 129           POP   DE
 0072        E1                 130           POP   HL
 0073        C9                 131           RET
                                132 ;
                                133           *EJECT
```

```
   LOCATION PLC CODE      ARG    LC   SOURCE STATEMENT ----------------------------------------------------

                                  134  ;
                                  135  ; FINDTG, LETAR I TGLISTAN EFTER TANGENT SOM FINNS I A RETURNERAR
                                  136  ; DE SOM PEKARE TILL ELEMENT, C=1 => TG FANNS EJ
                                  137  ;
    0074    00           0074     138  FINDTG    EQU   *
    0074        E5                139           PUSH  HL
    0075        F5                140           PUSH  AF
    0076      X 2A0000            141           LD    HL,(TGLISTA)
                                  142  ;
    0079    00           0079     143  FL        EQU   *                 ; LISTA = NIL ?
    0079        7C                144           LD    A,H
    007A        B5                145           OR    L
    007B    00  2813              146           JR    Z,NOTFIND
                                  147  ;
    007D        54                148           LD    D,H               ; PEK := LISTA
    007E        5D                149           LD    E,L
                                  150  ;
    007F        23                151           INC   HL                ; LISTA.TG = A ?
    0080        23                152           INC   HL
    0081        23                153           INC   HL
    0082        23                154           INC   HL
    0083        23                155           INC   HL
    0084        F1                156           POP   AF
    0085        BE                157           CP    (HL)
    0086        F5                158           PUSH  AF
    0087    00  280B              159           JR    Z,FIND
    0089        EB                160           EX    DE,HL
    008A        7E                161           LD    A,(HL)
    008B        23                162           INC   HL
    008C        66                163           LD    H,(HL)
    008D        6F                164           LD    L,A
    008E    00  18E9              165           JR    FL
                                  166  ;
    0090    00           0090     167  NOTFIND   EQU   *
    0090        F1                168           POP   AF
    0091        E1                169           POP   HL
    0092        37                170           SCF
    0093        C9                171           RET
                                  172  ;
    0094    00           0094     173  FIND      EQU   *
    0094        F1                174           POP   AF
    0095        E1                175           POP   HL
    0096        A7                176           AND   A
    0097        C9                177           RET
    0098                          178           END

   ERRORS :    0   WARNINGS :    0
```

CROSS REFERENCE LISTING

SYMBOL	LOCATION	DECL	REFERENCES		
<ANTAL	0000	13	77	122	
<COUNT	0000	13	74	119	
FIND	0094	173	159		
>FINDTG	0074	138	6		
FL	0079	143	165		
NOTFIND	0090	167	146		
<PRED	0000	13	107		
>READLIST	0034	96	6		
<REPEAT	0000	13	71	116	
<STATUS	0000	13	65	110	
<STRANG	0000	14	86	126	
<SUCC	0000	13	103		
<TG	0000	13	68	113	
<TGLISTA	0000	14	141		
>WRITELIS	0000	60	6		
>XANTAL	0008	55	10	78	121
>XCOUNT	0007	53	10	75	118
>XPREDH	0003	45	9	106	
>XPREDL	0002	44	9	105	
>XREPEAT	0006	51	9	72	115
>XSTATUS	0004	47	9	66	109
>XSTR	0009	57	10	82	124
>XSUCCH	0001	43	9	102	
>XSUCCL	0000	42	9	101	
>XTG	0005	49	9	69	112

```
ASMZ-4.46 OMVANDL.ASM                              ERRORS:    0    12:00:00    86-02-24    PAGE  1

    LOCATION PLC CODE      ARG     LC  SOURCE STATEMENT ----------------------------------------------------------

                                    1          ZPROG OMVANDL.ASM
                                    2          *PAGE 60
                                    3 ;
                                    4          GLOBAL DECBIN,BINDEC, BIN2DEC
                                    5 ;
                                    6 ;
                                    7 ; ********************************************************
                                    8 ;
                                    9 ; OMVANDL, INNEHALLER RUTINER FÖR BINÄRT TILL ASCII OCH ASCII
                                   10 ; TILL BINÄRT.
                                   11 ;
                                   12 ;
                                   13 ;         VER   DATUM   SIGN      BESKRIVNING
                                   14 ;         1.0   850501   SP           -
                                   15 ;         1.1   851108   SP       BIN2DEC
                                   16 ;
                                   17 ;
                                   18 ;
                                   19 ; ********************************************************
                                   20 ;
                                   21 ;
                                   22 ;
                                   23 ;
                                   24 ;         DECIMAL TILL BINÄR OMVANDLING ;
                                   25 ;         ==============================
                                   26 ;
                                   27 ;         IN       HL    BUFFERT
                                   28 ;         UT        A    TAL
                                   29 ;
                                   30 ;         HL PEKAR PÅ FÖRSTA BYTE EFTER TALET
                                   31 ;
0000    00            0000     32 DECBIN    EQU   *
0000        D5                   33           PUSH  DE
0001        2B                   34           DEC   HL
0002        1E00                 35           LD    E,0
                                   36 ;
0004        23                   37 DBLOOP    INC   HL
0005        7E                   38           LD    A,(HL)
0006        E67F                 39           AND   127
0008        D630                 40           SUB   48
000A    00  3812                 41           JR    C,UTDECBIN      ; MINDRE ÄN "0"
                                   42 ;
000C        FE0A                 43           CP    10
000E    00  300E                 44           JR    NC,UTDECBIN     ; STÖRRE ÄN "9"
                                   45 ;
0010        57                   46           LD    D,A             ; E = 10*E+A
0011        7B                   47           LD    A,E
0012        CB27                 48           SLA   A
0014        CB27                 49           SLA   A
0016        CB27                 50           SLA   A
0018        83                   51           ADD   A,E
0019        83                   52           ADD   A,E
001A        82                   53           ADD   A,D
001B        5F                   54           LD    E,A
001C    00  18E6                 55           JR    DBLOOP
                                   56 ;
001E        7B                   57 UTDECBIN  LD    A,E
001F        D1                   58           POP   DE
0020        C9                   59           RET
                                   60 ;
                                   61           *EJECT
```

```
LOCATION PLC CODE      ARG    LC   SOURCE STATEMENT ----------------------------------------------------------

                              62  ;
                              63  ;         BINÄR TILL DECIMAL OMVANDLING
                              64  ;         ============================
                              65  ;
                              66  ;         IN    HL       BUFFERTPEKARE
                              67  ;         IN    A        TAL ATT OMVANDLA
                              68  ;
                              69  ;         HL PEKAR PÅ FÖRSTA TAL EFTER "A" STRÄNG
                              70  ;
0021    00                    0021  71  BINDEC   EQU   *
0021        C5                      72          PUSH  BC
                              73  ;          CP    100
                              74  ;          JR    C,TIOTAL
0022        0664                    75          LD    B,100
0024    00  CD3600                  76          CALL  MASK
0027        23                      77          INC   HL
                              78  ;          JR    BIN2
                              79  ;TIOTAL    CP    10
                              80  ;          JR    C,ENTAL
                              81  ;BIN2      EQU   *
002B        060A                    82          LD    B,10            ; TIOTAL
002A    00  CD3600                  83          CALL  MASK
002D        23                      84          INC   HL
002E        C630                    85  ENTAL   ADD   48
0030        77                      86          LD    (HL),A
0031        23                      87          INC   HL
0032        3620                    88          LD    (HL),32
0034        C1                      89          POP   BC
0035        C9                      90          RET
                              91  ;
0036        3630                    92  MASK    LD    (HL),48
0038        B8                      93  MASKLOOP CP   B
0039    00  3001                    94          JR    NC,B1
003B        C9                      95          RET
003C        34                      96  B1      INC   (HL)
003D        90                      97          SUB   B
003E    00  18F8                    98          JR    MASKLOOP
                              99  ;
                             100  ;
                             101          *EJECT
```

```
   LOCATION PLC CODE      ARG     LC   SOURCE STATEMENT ----------------------------------------------------------

                                  102  ;
                                  103  ;        BINÄR TILL DECIMAL OMVANDLING 2-BITAR
                                  104  ;        ====================================
                                  105  ;
                                  106  ;        IN    HL        BUFFERT PEKARE
                                  107  ;        IN    DE        TAL ATT OMVANDLA
                                  108  ;
                                  109  ;        HL PEKAR PÅ FÖRSTA "LEDIGA" PLATS I BUFFERT
                                  110  ;
   0040    00                0040  111  BIN2DEC  EQU   *
   0040        C5                  112           PUSH  BC
   0041        F5                  113           PUSH  AF
   0042        011027              114           LD    BC,10000
   0045    00  CD6400              115           CALL  EXP
   0048        01E803              116           LD    BC,1000
   004B    00  CD6400              117           CALL  EXP
   004E        016400              118           LD    BC,100
   0051    00  CD6400              119           CALL  EXP
   0054        010A00              120           LD    BC,10
   0057    00  CD6400              121           CALL  EXP
   005A        7B                  122           LD    A,E
   005B        C630                123           ADD   48
   005D        77                  124           LD    (HL),A
   005E        23                  125           INC   HL
   005F        3620                126           LD    (HL)," "
   0061        F1                  127           POP   AF
   0062        C1                  128           POP   BC
   0063        C9                  129           RET
                                   130  ;
   0064        AF                  131  EXP      XOR   A
   0065        EB                  132           EX    DE,HL
   0066    00                0066  133  EXPL     EQU   *
   0066        ED42                134           SBC   HL,BC
   0068    00  3803                135           JR    C,EXOOK
   006A        3C                  136           INC   A
   006B    00  18F9                137           JR    EXPL
   006D    00                006D  138  EXOOK    EQU   *
   006D        09                  139           ADD   HL,BC
   006E        EB                  140           EX    DE,HL
   006F        C630                141           ADD   48
   0071        77                  142           LD    (HL),A
   0072        23                  143           INC   HL
   0073        C9                  144           RET
   0074                            145           END

   ERRORS :    0   WARNINGS :    0
```

CROSS REFERENCE LISTING

SYMBOL	LOCATION	DECL	REFERENCES			
B1	003C	96	94			
>BIN2DEC	0040	111	4			
>BINDEC	0021	71	4			
DBLOOP	0004	37	55			
>DECBIN	0000	32	4			
?ENTAL	002E	85				
EXOOK	006D	138	135			
EXP	0064	131	115	117	119	121
EXPL	0066	133	137			
MASK	0036	92	76	83		
MASKLOOP	0038	93	98			
UTDECBIN	001E	57	41	44		

```
ASMZ-4.46 REJDEF.ASM                              ERRORS:    0    12:00:00    86-02-24    PAGE  1

    LOCATION PLC CODE      ARG     LC   SOURCE STATEMENT ----------------------------------------------------------

     0000    00                      1          ZPROG REJDEF.ASM
     0000                            2          *PAGE 60
                                     3  ;
                                     4  ;
                                     5  ; GLOBALA DATA
                                     6          GLOBAL STACK
                                     7          GLOBAL IBPEKIN, IBPEKUT, IBSTART, IBEND
                                     8          GLOBAL UBPEKIN, UBPEKUT, UBSTART, UBEND, UBANTAL
                                     9          GLOBAL BUFFERT
                                    10          GLOBAL BOTRAM, STARTRAM
                                    11          GLOBAL SUCC,PRED,STATUS, TG, REPEAT, COUNT, ANTAL, STRÄNG
                                    12          GLOBAL TGLISTA, TGPRED
                                    13          GLOBAL PEK,TIME
                                    14          GLOBAL VARV, STUDS, AUTOR, PROGSTAT, DIODSTAT
                                    15  ;
                                    16  ; ***************************************************************
                                    17  ;
                                    18  ;
                                    19  ;         VER   DATUM   SIGN      BESKRIVNING
                                    20  ;         1.0   850926   GP           -
                                    21  ;
                                    22  ;
                                    23  ; ***************************************************************
                                    24  ;
                                    25          *EJECT
```

```
LOCATION PLC CODE      ARG     LC   SOURCE STATEMENT ----------------------------------------------------

                                26 ;
                                27 ;         DEFINITIONER
                                28 ;         ============
                                29 ;
0000                            30           DEFS  256              ; STACKDJUP 256 BYTE
0100    00            0100      31 STACK     EQU   *                ; STACK
                                32 ;
0100        00                  33 STUDS     DEFB  0                ; KONTAKTSTUDSTID
0101        00                  34 AUTOR     DEFB  0                ; TID INNAN AUTOREPEAT BÖRJAR
0102        00                  35 TIME      DEFB  0
0103        00                  36 VARV      DEFB  0
0104        00                  37 PROGSTAT  DEFB  0
0105        00                  38 DIODSTAT  DEFB  0
                                39 ;
0106        0000                40 TGLISTA   DEFW  0
0108    00  0601                41 TGPRED    DEFW  TGLISTA
                                42 ;
010A        0000                43 PEK       DEFW  0                ; HJÄLPPEKARE
010C        0000                44 SUCC      DEFW  0                ; VIDAREPEKARE
010E        0000                45 PRED      DEFW  0                ; FÖREGAENDE PEKARE
0110        00                  46 STATUS    DEFB  0
0111        00                  47 TG        DEFB  0
0112        00                  48 REPEAT    DEFB  0
0113        00                  49 COUNT     DEFB  0
0114        00                  50 ANTAL     DEFB  0
0115        0000                51 STRÄNG    DEFW  0
                                52 ;
                                53 ;
0117                            54 BUFFERT   DEFS  40
                                55 ;
013F        0000                56 IBPEKIN   DEFW  0
0141        0000                57 IBPEKUT   DEFW  0
0143                            58 IBSTART   DEFS  80
0193    00            0193      59 IBEND     EQU   *
                                60 ;
0193        00                  61 UBANTAL   DEFB  0
0194        0000                62 UBPEKIN   DEFW  0
0196        0000                63 UBPEKUT   DEFW  0
0198                            64 UBSTART   DEFS  80
01E8    00            01E8      65 UBEND     EQU   *
                                66 ;
                                67 ;
01E8    00  EA01                68 BOTRAM    DEFW  STARTRAM
01EA    00            01EA      69 STARTRAM  EQU   *
                                70 ;
01EA                            71           END

ERRORS :    0   WARNINGS :    0
```

CROSS REFERENCE LISTING

SYMBOL	LOCATION	DECL	REFERENCES
>ANTAL	0114	50	11
>AUTOR	0101	34	14
>BOTRAM	01E8	68	10
>BUFFERT	0117	54	9
>COUNT	0113	49	11
>DIODSTAT	0105	38	14
>IBEND	0193	59	7
>IBPEKIN	013F	56	7
>IBPEKUT	0141	57	7
>IBSTART	0143	58	7
>PEK	010A	43	13
>PRED	010E	45	11
>PROGSTAT	0104	37	14
>REPEAT	0112	48	11
>STACK	0100	31	6
>STARTRAM	01EA	69	10 68
>STATUS	0110	46	11
>STRANG	0115	51	11
>STUDS	0100	33	14
>SUCC	010C	44	11
>TG	0111	47	11
>TGLISTA	0106	40	12 41
>TGPRED	0108	41	12
>TIME	0102	35	13
>UBANTAL	0193	61	8
>UBEND	01E8	65	8
>UBPEKIN	0194	62	8
>UBPEKUT	0196	63	8
>UBSTART	0198	64	8
>VARV	0103	36	14

```
ASMZ-4.46 TEST                                  ERRORS:    0    12:00:00    86-02-24    PAGE  1

   LOCATION PLC CODE      ARG     LC  SOURCE STATEMENT ----------------------------------------------------------

                                   1          ZPROG TEST
                                   2          *PAGE 60
                                   3 ;
                                   4          EXTERNAL BUFFERT,RECEIVE
                                   5          EXTERNAL HEADLOOP, BINDEC
                                   6          EXTERNAL INITMEM, KLOCKA
                                   7 ;
                                   8          GLOBAL SKRSTR, ENDBYTE
                                   9          GLOBAL SIOADTA,SIOACMD
                                  10          GLOBAL RESET
                                  11 ;
                                  12 ; ***************************************************************
                                  13 ;        EGEN TANGENTBORDSRUTIN.
                                  14 ;
                                  15 ;        FUNGERAR MOT AVBROTT MOT TANGENTBORDET PA MOTSVARANDE
                                  16 ;        SÄTT SOM MOT V24 SNITT I ENKORTSDATORN.
                                  17 ;
                                  18 ; ***************************************************************
                                  19 ;
                                  20 ;
   0000                 0022      21 SIOADTA   EQU   34
   0000                 0023      22 SIOACMD   EQU   35
   0000                 000D      23 ENDBYTE   EQU   13              ; CR = SLUT PA CMDSTRÄNG
   0000   00            0000      24 TANG      EQU   *
                                  25 ;
   0000   00            0000      26 RESET     EQU   *
   0000      3E00                 27          LD    A,0
   0002      D301                 28          OUT   1,A              ; NOLLSTÄLL ALLA I/O KORT
                                  29 ;
   0004    X 210000               30          LD    HL,KLOCKA
   0007      22D6FF               31          LD    (65494),HL
                                  32 ;
   000A    X CD0000               33          CALL  INITMEM          ; INITIERAR VARIABLER MM
                                  34 ;
   000D   00 111700               35          LD    DE,TANGENT
   0010      ED53B4FF             36          LD    (65460),DE
                                  37 ;
   0014    X C30000               38          JP    HEADLOOP
                                  39 ;
   0017   00            0017      40 TANGENT   EQU   *
   0017    X C30000               41          JP    RECEIVE
                                  42 ;
                                  43 ;
   001A      0000                 44 STACK     DEFB  0,0
                                  45 ;
                                  46 ;
   001C   00            001C      47 LÄSSTR    EQU   *
   001C      010002               48          LD    BC,512           ; MAX 512 TECKEN
   001F      CD0500               49          CALL  5
   0022      C9                   50          RET
                                  51 ;
   0023   00            0023      52 SKRSTR    EQU   *
   0023      D5                   53          PUSH  DE
   0024      CD0B00               54          CALL  11
   0027      D1                   55          POP   DE
   0028      C9                   56          RET
                                  57 ;
   0029      FB                   58 EIRETI    EI
   002A      ED4D                 59          RETI
                                  60 ;
```

```
LOCATION PLC CODE      ARG     LC   SOURCE STATEMENT ----------------------------------------------------

                                61  ;
 002C    00                002C  62  DOS      EQU   *
 002C        213E04              63           LD    HL,1086
 002F        22B4FF              64           LD    (65460),HL
 0032        21763A              65           LD    HL,14966
 0035        22D6FF              66           LD    (65494),HL       ; KLOCK AVBROTTSRUTIN
 0038        F1                  67           POP   AF
 0039    00  CD2900              68           CALL  EIRETI
 003C    00  ED731A00            69           LD    (STACK),SP
 0040    00  2A1A00              70           LD    HL,(STACK)
 0043    00  CD4900              71           CALL  SKRORD
 0046        C303C1              72           JP    0C103H           ; ATERSTART CMDINT
                                73  ;
 0049    00                0049  74  SKRORD   EQU   *
 0049        F5                  75           PUSH  AF
 004A        E5                  76           PUSH  HL
 004B        C5                  77           PUSH  BC
 004C        D5                  78           PUSH  DE
 004D        7C                  79           LD    A,H
 004E        45                  80           LD    B,L
 004F      X 210000              81           LD    HL,BUFFERT
 0052      X CD0000              82           CALL  BINDEC
 0055        78                  83           LD    A,B
 0056        23                  84           INC   HL
 0057        363A                85           LD    (HL),":"
 0059      X CD0000              86           CALL  BINDEC
 005C        360D                87           LD    (HL),13
 005E        23                  88           INC   HL
 005F        360A                89           LD    (HL),10
 0061      X 210000              90           LD    HL,BUFFERT
 0064        010900              91           LD    BC,9
 0067        CD0B00              92           CALL  11
 006A        D1                  93           POP   DE
 006B        C1                  94           POP   BC
 006C        E1                  95           POP   HL
 006D        F1                  96           POP   AF
 006E        C9                  97           RET
 006F    00  0000                98           END   TANG

ERRORS :    0   WARNINGS :    0
```

ASMI-4.46 TEST ERRORS: 0 12:00:00 86-02-24 PAGE 3

CROSS REFERENCE LISTING

SYMBOL	LOCATION	DECL	REFERENCES	
<BINDEC	0000	5	82	86
<BUFFERT	0000	4	81	90
?DOS	002C	62		
EIRETI	0029	58	68	
>ENDBYTE	000D	23	8	
<HEADLOOP	0000	5	38	
<INITMEM	0000	6	33	
<KLOCKA	0000	6	30	
?LASSTR	001C	47		
<RECEIVE	0000	4	41	
>RESET	0000	26	10	
>SIOACMD	0023	22	9	
>SIOADTA	0022	21	9	
SKRORD	0049	74	71	
>SKRSTR	0023	52	8	
STACK	001A	44	69	70
TANG	0000	24	98	
TANGENT	0017	40	35	

```
ASM2-4.46 LISTTEST.ASM                          ERRORS:    0    12:00:00    86-02-24    PAGE  1

   LOCATION PLC CODE      ARG     LC   SOURCE STATEMENT ----------------------------------------------------

    0000    00                      1          ZPROG LISTTEST.ASM
    0000                            2          *PAGE 60
                                    3 ;
                                    4 ;
                                    5          EXTERNAL BINDEC, BIN2DEC, READLIST
                                    6          EXTERNAL STATUS,TG,REPEAT,SUCC,PRED,ANTAL,STRÄNG
                                    7          EXTERNAL BUFFERT,TGLISTA,LSUCC, HEAD
                                    8          EXTERNAL SKRSTR
                                    9 ;
                                   10          GLOBAL SKRPOST, SKRLIST
                                   11 ;
                                   12 ;
                                   13 ;
                                   14 ; ********************************************************
                                   15 ; LISTTEST, INNEHALLER SKRLISTA SOM SKRIVER UT HELA LISTAN OCH
                                   16 ; SKRPOST SOM SKRIVER UT DEN POST DE PEKAR PA
                                   17 ;
                                   18 ;
                                   19 ;
                                   20 ;          VER   DATUM   SIGN      BESKRIVNING
                                   21 ;          1.0   851103   SP           -
                                   22 ;          1.1   851107   SP       KLARAR TOM LISTA OCH LISTHUVUD
                                   23 ;
                                   24 ;
                                   25 ;
                                   26 ; ********************************************************
                                   27 ;
                                   28 ;
                                   29          *EJECT
```

```
LOCATION PLC CODE     ARG    LC  SOURCE STATEMENT ----------------------------------------------------

                             30 ;
                             31 ; SKRPOST(PEK), SKRIVER UT POSTENS INNEHALL PA SKARMEN
                             32 ; I FORMEN   STATUS,TG,REPEAT   SUCC,PRED   ANTAL,"STRANG"
                             33 ; IN: DE PEKARE TILL POST
                             34 ; UT: OFORANDRAT
                             35 ;
 0000    00           0000   36 SKRPOST  EQU   *
 0000       D5               37          PUSH  DE
 0001       C5               38          PUSH  BC
 0002       E5               39          PUSH  HL
                             40 ;
 0003       7A               41          LD    A,D
 0004       B3               42          OR    E
 0005    00 CA8700           43          JP    Z,EMPTY
                             44 ;
 0008     X CD0000           45          CALL  HEAD              ; PEKARE = LISTHUVUD ?
 000B    00 DA8700           46          JP    C,EMPTY
                             47 ;
 000E     X CD0000           48          CALL  READLIST
                             49 ;
 0011     X 210000           50          LD    HL,BUFFERT
 0014     X 3A0000           51          LD    A,(STATUS)
 0017     X CD0000           52          CALL  BINDEC
 001A       23               53          INC   HL
                             54 ;
 001B     X 3A0000           55          LD    A,(TG)
 001E       E638             56          AND   00111000B
 0020       0F               57          RRCA
 0021       0F               58          RRCA
 0022       0F               59          RRCA
 0023       C641             60          ADD   65                ; A:H
 0025       77               61          LD    (HL),A
 0026       23               62          INC   HL
 0027     X 3A0000           63          LD    A,(TG)
 002A       E607             64          AND   00000111B
 002C       C631             65          ADD   49                ; 1:8
 002E       77               66          LD    (HL),A
 002F       23               67          INC   HL
 0030       3620             68          LD    (HL)," "
 0032       23               69          INC   HL
 0033       3620             70          LD    (HL)," "
 0035       23               71          INC   HL
                             72 ;
 0036     X 3A0000           73          LD    A,(REPEAT)
 0039     X CD0000           74          CALL  BINDEC
 003C       23               75          INC   HL
 003D       3620             76          LD    (HL)," "
 003F       23               77          INC   HL
 0040       3620             78          LD    (HL)," "
 0042       23               79          INC   HL
                             80 ;
 0043     X ED5B0000         81          LD    DE,(SUCC)
 0047     X CD0000           82          CALL  BIN2DEC
 004A       363A             83          LD    (HL),":"
 004C       23               84          INC   HL
                             85 ;
 004D     X ED5B0000         86          LD    DE,(PRED)
 0051     X CD0000           87          CALL  BIN2DEC
 0054       23               88          INC   HL
                             89 ;
```

```
LOCATION PLC CODE      ARG     LC   SOURCE STATEMENT ----------------------------------------------------

 0055        3620              90          LD    (HL)," "
 0057        23                91          INC   HL
 0058        3620              92          LD    (HL)," "
 005A      X 3A0000            93          LD    A,(ANTAL)
 005D      X CD0000            94          CALL  BINDEC
 0060        23                95          INC   HL
                               96 ;
 0061      X 210000            97          LD    HL,BUFFERT
 0064        011F00            98          LD    BC,31
 0067      X CD0000            99          CALL  SKRSTR
                              100 ;
 006A      X 3A0000            101         LD    A,(ANTAL)
 006D        4F                102         LD    C,A
 006E        0600              103         LD    B,0
 0070      X 2A0000            104         LD    HL,(STRÄNG)
 0073      X CD0000            105         CALL  SKRSTR
                              106 ;
 0076      X 210000            107         LD    HL,BUFFERT
 0079        360D              108         LD    (HL),13
 007B        23                109         INC   HL
 007C        360A              110         LD    (HL),10
 007E      X 210000            111         LD    HL,BUFFERT
 0081        010200            112         LD    BC,2
 0084      X CD0000            113         CALL  SKRSTR
                              114 ;
 0087    00          0087      115 EMPTY   EQU   *
 0087        E1                116         POP   HL
 0088        C1                117         POP   BC
 0089        D1                118         POP   DE
 008A        C9                119         RET
                              120 ;
                              121         *EJECT
```

```
   LOCATION PLC CODE      ARG     LC   SOURCE STATEMENT ----------------------------------------------------

                                  122  ;
                                  123  ; SKRLIST, SKRIVER UT HELA LISTAN TGLISTA ENLIST FORMAT I SKRPOST
                                  124  ; INGA PARAMETRAR
                                  125  ;
    008B    00            008B    126  SKRLIST   EQU   *
    008B        D5                  127           PUSH  DE
    008C      X ED5B0000            128           LD    DE,(TGLISTA)
    0090    00            0090    129  SKLOOP    EQU   *
    0090    00  CD0000            130           CALL  SKRPOST
    0093      X CD0000            131           CALL  LSUCC
    0096    00  30F8              132           JR    NC,SKLOOP
    0098        D1                133           POP   DE
    0099        C9                134           RET
                                  135  ;
    009A                          136           END

    ERRORS :    0   WARNINGS :    0
```

```
ASM2-4.46 LISTTEST.ASM                          ERRORS:   0    12:00:00   86-02-24   PAGE  5
    CROSS REFERENCE LISTING
    SYMBOL      LOCATION   DECL   REFERENCES  ----------------------------------------------------------------

    <ANTAL        0000        6    93   101
    <BIN2DEC      0000        5    82    87
    <BINDEC       0000        5    52    74    94
    <BUFFERT      0000        7    50    97   107   111
     EMPTY        0087      115    43    46
    <HEAD         0000        7    45
    <LSUCC        0000        7   131
    <PRED         0000        6    86
    <READLIST     0000        5    48
    <REPEAT       0000        6    73
     SKLOOP       0090      129   132
    >SKRLIST      008B      126    10
    >SKRPOST      0000       36    10   130
    <SKRSTR       0000        8    99   105   113
    <STATUS       0000        6    51
    <STRÄNG       0000        6   104
    <SUCC         0000        6    81
    <TG           0000        6    55    63
    <TGLISTA      0000        7   128
```

Länkningsförfarande

Samtliga program är asemeblerade med Luxors asemblator ASMZ, och länkade med motsvarande Estab.

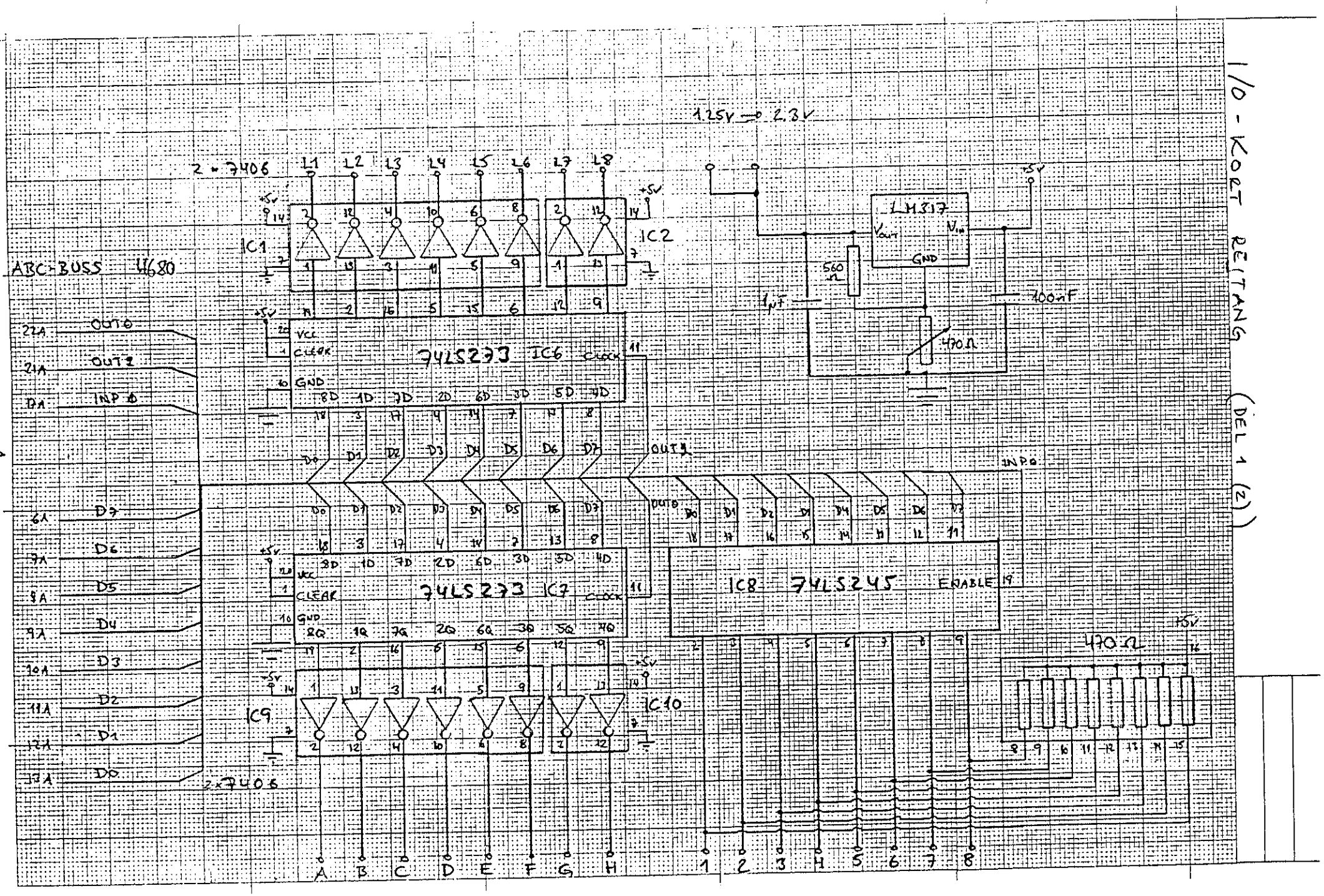
Följande kommandofil har använts vid länkningen av originalversionen:

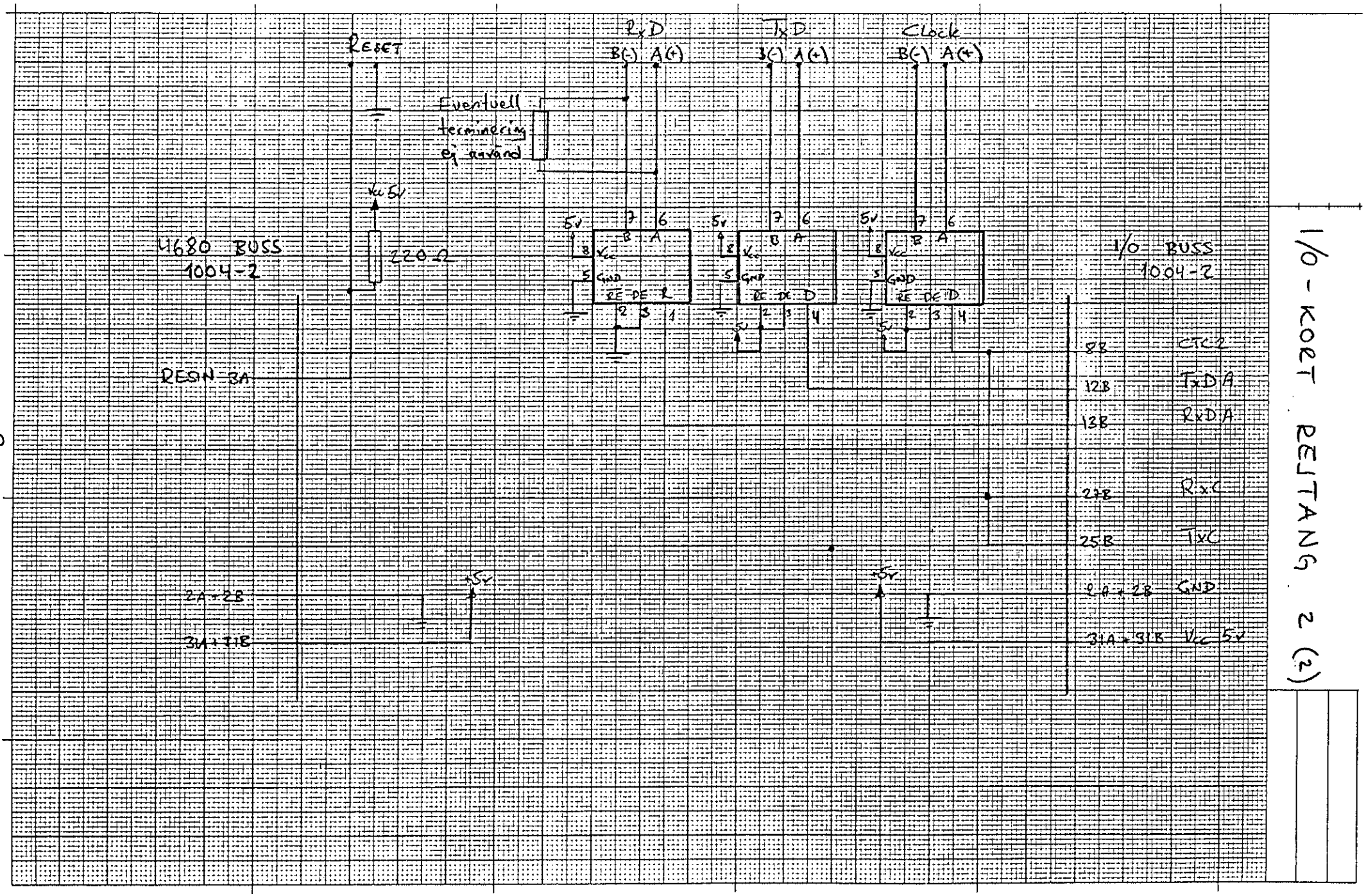
```
TASK REJPROM
ORG 0
INC INITSIO
INC REJINTER
INC SKRSTR
INC REJINIT
INC REJHEAD
INC REJCMD
INC REJLEX
INC LISTOR
INC REJSTRUC
INC OMVANDL
ORG 57344
INC REJDEF
CHECK
END
```

Vilket visar vilka de ingående modulerna är.

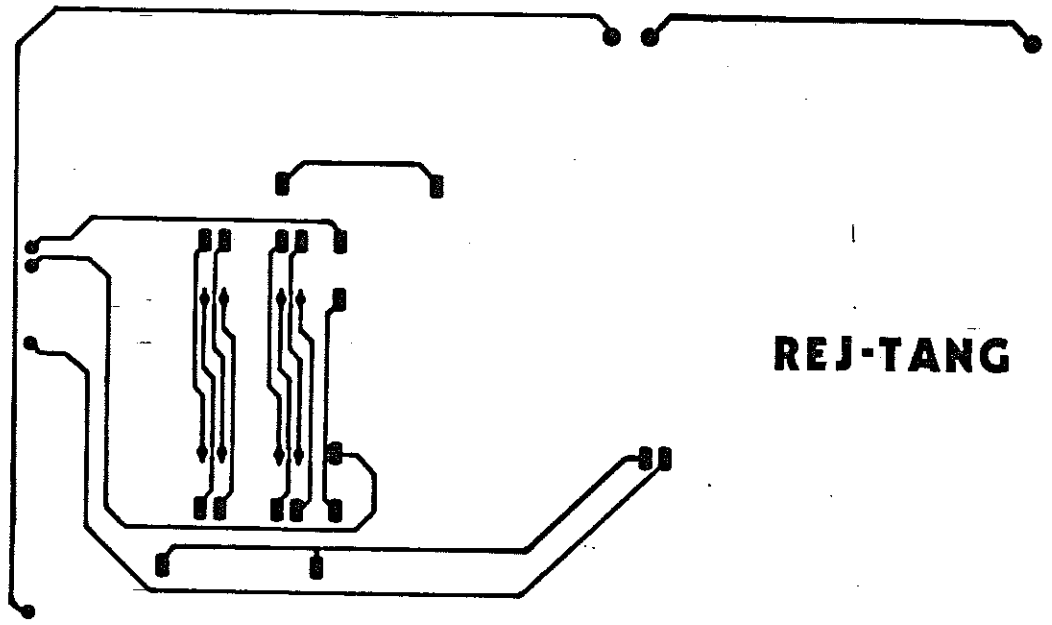
För utveckling av programmet har vissa moduler bytts för att simulera enkortsdatorn. Detta möjliggör utvärdering av programmet under körning mot en av Luxors datorer i 800 serien. Den kommando fil som då använts är:

```
TASK REJ
ORG 55000
INC TEST
INC REJINTER
INC LISTTEST
INC REJHEAD
INC REJCMD
INC REJINIT
INC REJLEX
INC LISTOR
INC REJSTRUC
INC OMVANDL
INC REJDEF
CHECK
END
```

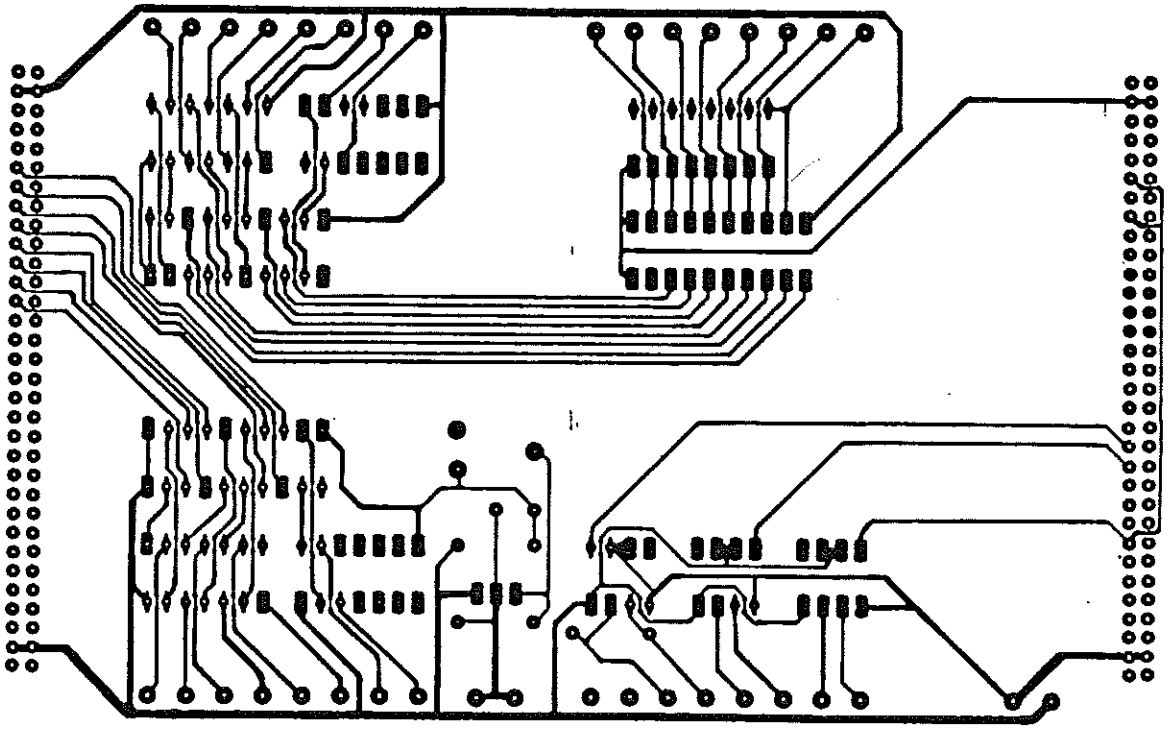

I/O - KORT REITANG (DEL 1 (2))
ABC-BUSS 4680
2 x 7406
IC1
IC2
L1 L2 L3 L4 L5 L6 L7 L8
1,25V — 2,3V
LM317
560 Ω
1 µF
100nF
470 Ω
74LS273 IC6
74LS273 IC7
IC8 74LS245
IC9
IC10
2 x 7406
OUT0
OUT1
INP 0
D7 D6 D5 D4 D3 D2 D1 D0
ENABLE
A B C D E F G H
1 2 3 4 5 6 7 8
-1-


RESET
RxD
B(-) A(+)
TxD
B(-) A(+)
Clock
B(-) A(+)
Eventuell terminering ej använd
+5V
220 Ω
4680 BUSS 1004-2
RESN 3A
2A + 2B
3A + 3B
5V
7 6
B A
8 Vcc
5 GND
RE DE R
RE DE D
2 3 1
2 3 4
8B
12B
13B
24B
25B
1 A + 2B
31A + 31B
CTC2
TxD A
RxD A
RxC
TxC
GND
Vcc 5V
I/O BUSS 1004-2
I/O - KORT REJTANG 2 (2)
-2-

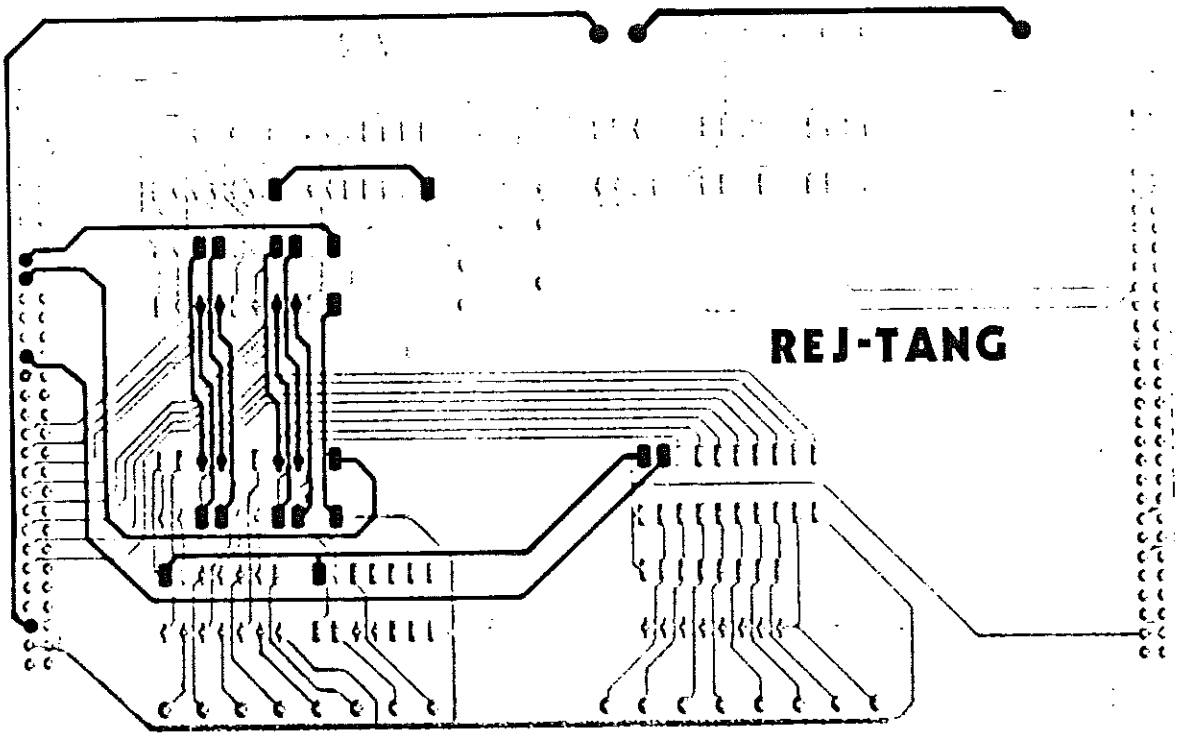
LAYOUT I/O-KORT



REJ-TANG



KOMPONENT PLACERING I/O-KORT



LVSDIODER 1,2-2,2V RxD TxD CLOCK

L1 L2 L3 L4 L5 L6 L7 L8 Vcc RES GND - + - + - + GND +5V

660Ω 220Ω

IC 1 74LS06 | IC 2 74LS06 | LM317 | IC 3 75176 | IC 4 75176 | IC 5 75176

100nF

1µF

IC 6 74LS273

470Ω

4680 Buss

"V24" Buss

IC 7 74LS273 | IC 8 74LS245

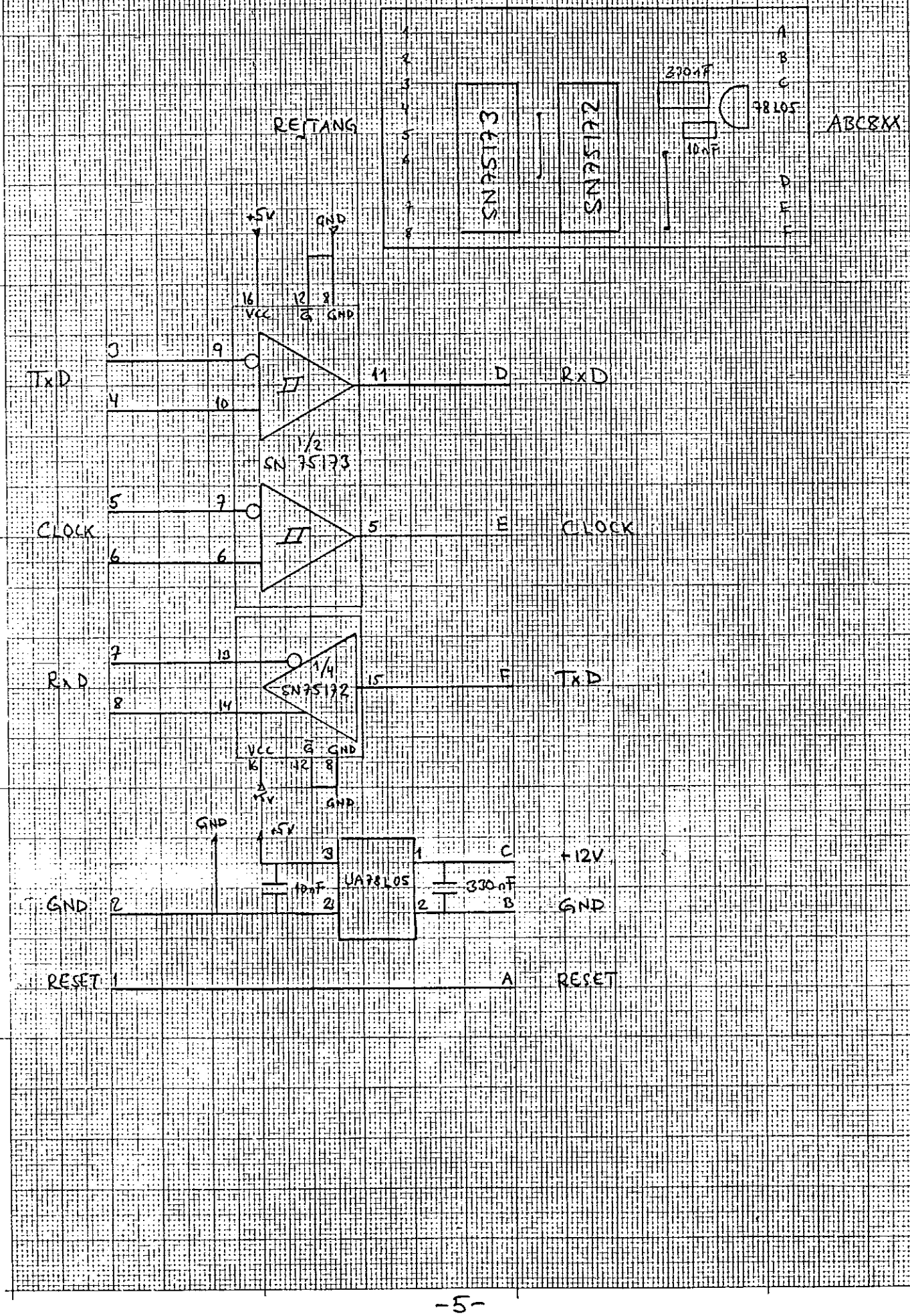
IC 9 74LS06 | IC 10 74LS06 | 4116R-02 | 470Ω

A B C D E F G H

8 7 6 5 4 3 2 1

TANGENTER

RS-485 → TTL INTERFACE

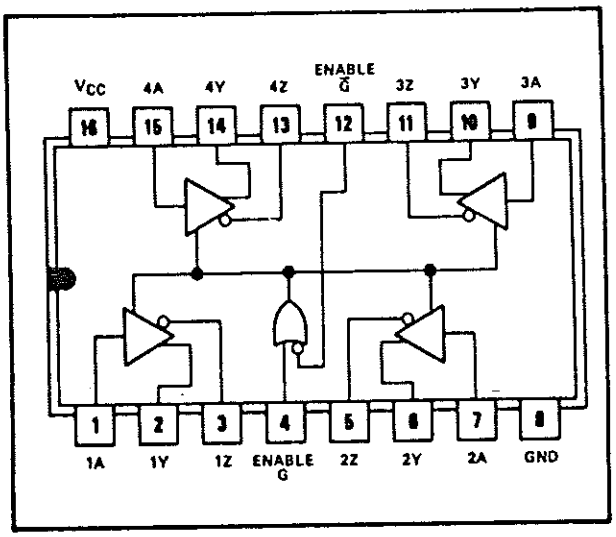


TYPE SN75172
QUADRUPLE DIFFERENTIAL LINE DRIVER

BULLETIN NO. DL-S 12769, OCTOBER 1980

- Meets EIA Standard RS-422A and CCITT Recommendations V.11 and X.27
- Meets EIA Subcommittee TR30.1 Draft Standard PN1360 (as of April 1980)
- Designed for Multipoint Transmission on Long Bus Lines in Noisy Environments
- 3-State Outputs
- Common-Mode Output Voltage Range . . . −7 V to 12 V
- Active-High and Active-Low Enables
- Thermal Shutdown Protection
- Positive and Negative Current Limiting
- Operates from Single 5-Volt Supply
- Low Power Requirements
- Functionally Interchangeable With AM26LS31

J OR N
DUAL-IN-LINE PACKAGE (TOP VIEW)



5

description

The SN75172 is a monolithic quadruple differential line driver with three-state outputs. It is designed to meet the requirements of EIA Standard RS-422A and CCITT Recommendations V.11 and X.27. The device is optimized for balanced multipoint bus transmission at rates up to 4 megabits per second. Each driver features wide positive and negative common-mode output voltage ranges making it suitable for party-line applications in noisy environments.

FUNCTION TABLE (EACH DRIVER)

INPUT	ENABLES		OUTPUTS	
A	G	$\overline{G}$	Y	Z
H	H	X	H	L
L	H	X	L	H
H	X	L	H	L
L	X	L	L	H
X	L	H	Z	Z

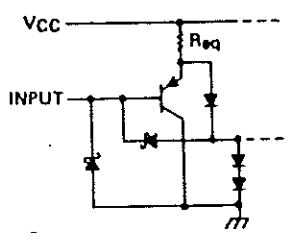
H = high level
L = low level
X = irrelevant
Z = high impedance (off)

The SN75172 provides positive- and negative-current limiting and thermal shutdown for protection from line fault conditions on the transmission-bus line. Shutdown occurs at a junction temperature of approximately 150°C. This device offers optimum performance when used with the SN75173 or SN75175 quadruple differential line receivers.

The SN75172 is characterized for operation from 0°C to 70°C.

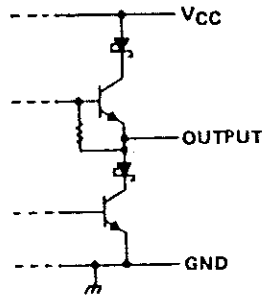
schematics of inputs and outputs

EQUIVALENT OF EACH INPUT



Data Inputs: R_{eq} = 3 kΩ NOM
Enable Inputs: R_{eq} = 8 kΩ NOM

TYPICAL OF ALL OUTPUTS



TYPE SN75172
QUADRUPLE DIFFERENTIAL LINE DRIVER

absolute maximum ratings over operating free-air temperature range (unless otherwise noted)

Supply voltage, V_{CC} (see Note 1) . . . . . 7 V
Input voltage . . . . . 5.5 V
Continuous total dissipation at (or below) 25°C free-air temperature (see Note 2): J package . . . . . 1375 mW
N package . . . . . 1150 mW
Operating free-air temperature range . . . . . 0°C to 70°C
Storage temperature range . . . . . −65°C to 150°C
Lead temperature 1/16 inch (1,6 mm) from case for 60 seconds: J package . . . . . 300°C
Lead temperature 1/16 inch (1,6 mm) from case for 10 seconds: N package . . . . . 260°C

NOTES: 1. All voltage values are with respect to the network ground terminal.
2. For operation above 25°C free-air temperature, derate the J package to 880 mW at 70°C at the rate of 11 mW/°C and the N package to 736 mW at 70°C at the rate of 9.2 mW/°C. In the J package, SN75172 chips are alloy-mounted.

recommended operating conditions

	MIN	NOM	MAX	UNIT
Supply voltage, V_{CC}	4.75	5	5.25	V
Common-mode output voltage, V_{OC}	−7†		12	V
High-level output current, I_{OH}			−60	mA
Low-level output current, I_{OL}			60	mA
Operating free-air temperature, T_A	0		70	°C

†The algebraic convention, where the less-positive (more-negative) limit is designated minimum, is used in this data sheet with common-mode output voltage only.

electrical characteristics over recommended ranges of supply voltage and operating free-air temperature (unless other noted)

PARAMETER		TEST CONDITIONS		MIN	TYP‡	MAX	UNIT
V_{IH}	High-level input voltage			2			V
V_{IL}	Low-level input voltage					0.8	V
V_{IK}	Input clamp voltage	I_I = −18 mA				−1.5	V
V_{OH}	High-level output voltage	V_{IH} = 2 V, V_{IL} = 0.8 V, I_{OH} = −33 mA			3.7		V
V_{OL}	Low-level output voltage	V_{IH} = 2 V, V_{IL} = 0.8 V, I_{OL} = 33 mA			1.1		V
$\lvert V_{OD1}\rvert$	Differential output voltage	I_O = 0				$2V_{OD2}$	V
$\lvert V_{OD2}\rvert$	Differential output voltage	R_L = 100 Ω,	See Figure 1	2			V
		R_L = 60 Ω,	See Figure 1	1.5			
$\Delta\lvert V_{OD}\rvert$	Change in magnitude of differential output voltage§	R_L = 60 Ω or 100 Ω, See Figure 1				±0.2	V
V_{OC}	Common-mode output voltage¶					3	V
$\Delta\lvert V_{OC}\rvert$	Change in magnitude of common-mode output voltage§					±0.2	V
I_O	Output current with power off	V_{CC} = 0,	V_O = −7 V to 12			±100	μA
I_{OZ}	High-impedance-state output current	V_O = −7 V to 12 V				±100	μA
I_{IH}	High-level input current	V_I = 2.7 V				20	μA
I_{IL}	Low-level input current	V_I = 0.5 V				−360	μA
I_{OS}	Short-circuit output current	V_O = −7 V				−180	mA
		V_O = V_{CC}				180	
		V_O = 12 V				500	
I_{CC}	Supply current (all drivers)	No load	Outputs enabled		38	60	mA
			Outputs disabled		18	40	

‡All typical values are at V_{CC} = 5 V and T_A = 25°C.
§$\Delta\lvert V_{OD}\rvert$ and $\Delta\lvert V_{OC}\rvert$ are the changes in magnitude of V_{OD} and V_{OC}, respectively, that occur when the input is changed from a high level to a low level.
¶In EIA Standard RS-422A, V_{OC}, which is the average of the two output voltages with respect to ground, is called output offset voltage, V_{OS}.

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TYPE SN75172
QUADRUPLE DIFFERENTIAL LINE DRIVER

switching characteristics, V_{CC} = 5 V, T_A = 25°C

PARAMETER		TEST CONDITIONS		MIN	TYP	MAX	UNIT
t_{DD}	Differential-output delay time	R_L = 60 Ω,	See Figure 2		35	50	ns
t_{TD}	Differential-output transition time				50	75	ns
t_{PLH}	Propagation delay time, low-to-high-level output	R_L = 27 Ω,	See Figure 3		16	25	ns
t_{PHL}	Propagation delay time, high-to-low-level output				44	65	ns
t_{PZH}	Output enable time to high level	R_L = 110 Ω,	See Figure 4		60	80	ns
t_{PZL}	Output enable time to low level	R_L = 110 Ω,	See Figure 5		30	45	ns
t_{PHZ}	Output disable time from high level	R_L = 110 Ω,	See Figure 4		51	75	ns
t_{PLZ}	Output disable time from low level	R_L = 110 Ω,	See Figure 5		18	30	ns

PARAMETER MEASUREMENT INFORMATION

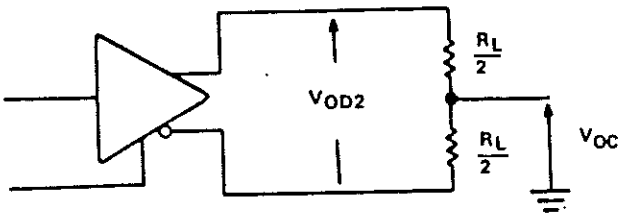
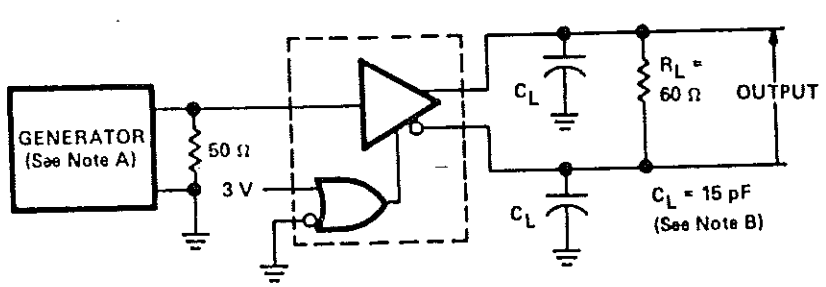
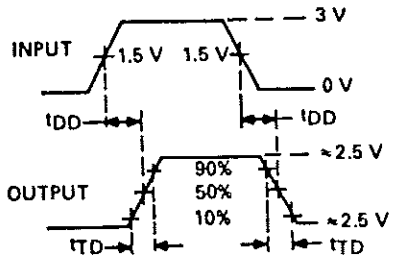


FIGURE 1–DIFFERENTIAL AND COMMON-MODE OUTPUT VOLTAGES



TEST CIRCUIT



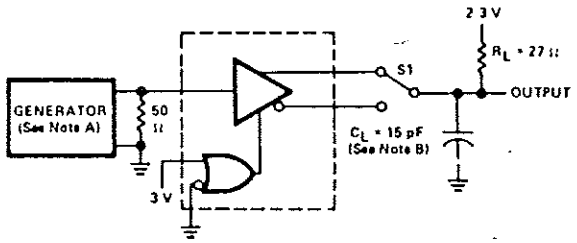
VOLTAGE WAVEFORMS

NOTES A. The input pulse is supplied by a generator having the following characteristics $t_r \leq 5$ ns, $t_f \leq 5$ ns, PRR = 1 MHz, duty cycle = 50%, Z_o = 50 Ω.
B. C_L includes probe and stray capacitance.
C. All diodes are 1N916 or 1N3064.

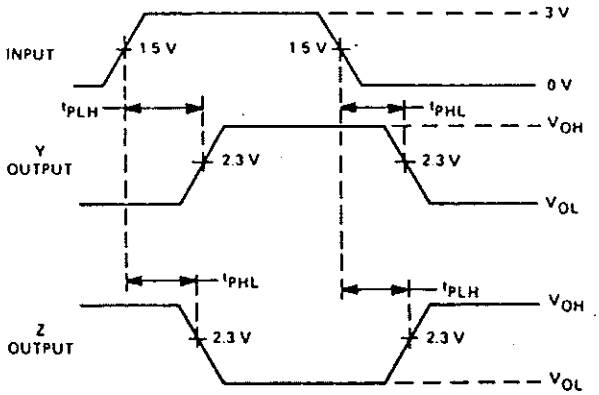
FIGURE 2–DIFFERENTIAL-OUTPUT DELAY AND TRANSITION TIMES

TYPE SN75172
QUADRUPLE DIFFERENTIAL LINE DRIVER

PARAMETER MEASUREMENT INFORMATION

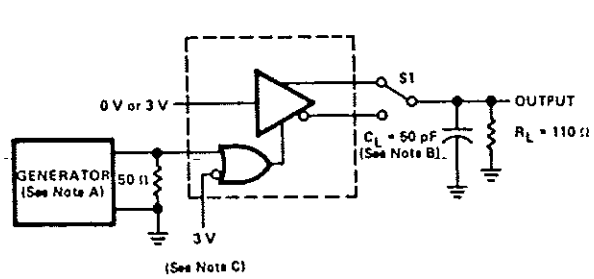


TEST CIRCUIT

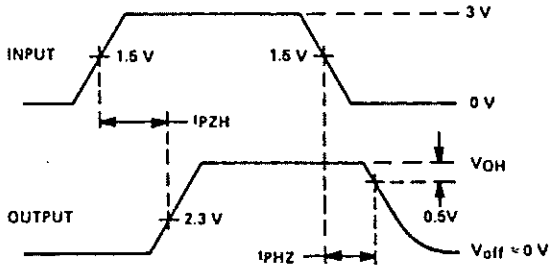


VOLTAGE WAVEFORMS

FIGURE 3–PROPAGATION DELAY TIMES

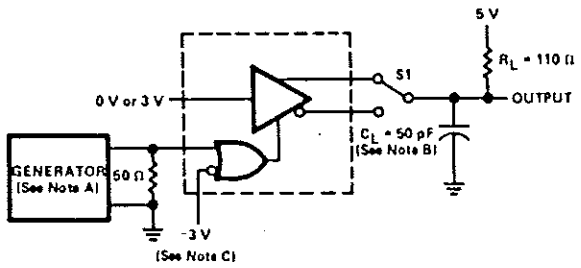


TEST CIRCUIT

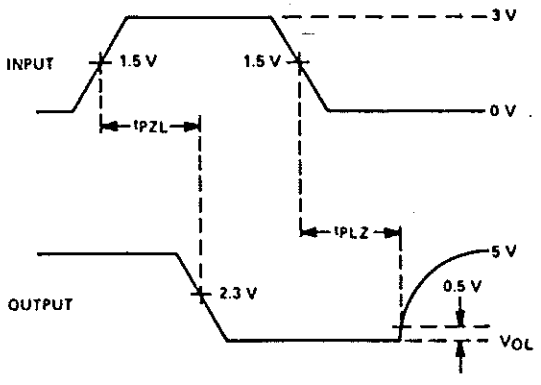


VOLTAGE WAVEFORMS

FIGURE 4–t_{PZH} AND t_{PHZ}



TEST CIRCUIT



VOLTAGE WAVEFORMS

FIGURE 5–t_{PZL} AND t_{PLZ}

NOTES: A. The input pulse is supplied by a generator having the following characteristics: $t_r \leq 5$ ns, $t_f \leq 5$ ns, PRR = 1 MHz, duty cycle = 50%, Z_{out} = 50 Ω.

B. C_L include probe and jig capacitance.

C. To test the active low enable $\overline{G}$, ground G and apply an inverted waveform to $\overline{G}$.

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TYPICAL CHARACTERISTICS

HIGH-LEVEL OUTPUT VOLTAGE vs HIGH-LEVEL OUTPUT CURRENT

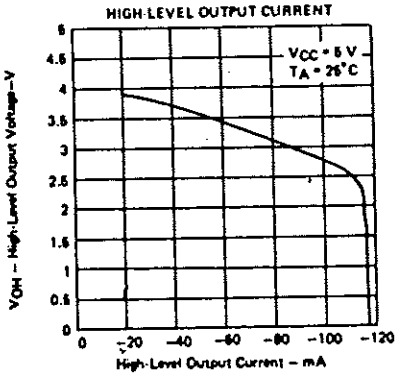


FIGURE 6

LOW-LEVEL OUTPUT VOLTAGE vs LOW-LEVEL OUTPUT CURRENT

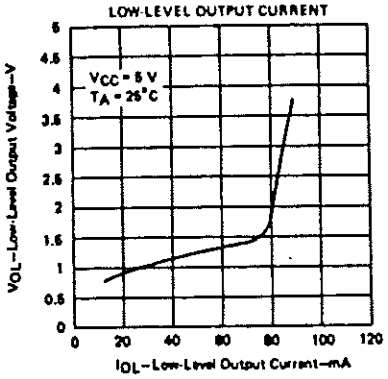


FIGURE 7

DIFFERENTIAL OUTPUT VOLTAGE vs OUTPUT CURRENT

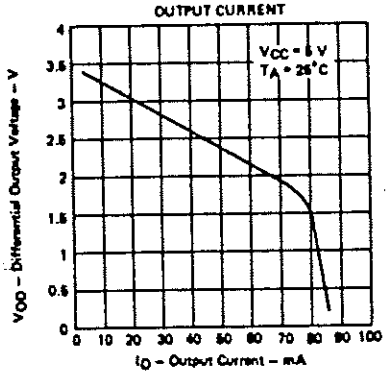


FIGURE 8

OUTPUT CURRENT vs OUTPUT VOLTAGE

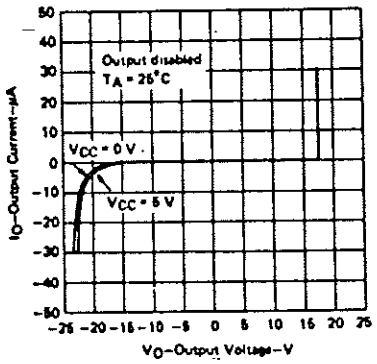


FIGURE 9

SUPPLY CURRENT vs SUPPLY VOLTAGE

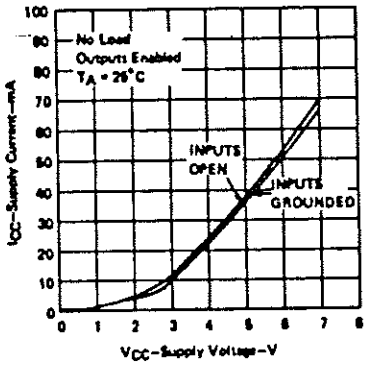


FIGURE 10

SUPPLY CURRENT vs SUPPLY VOLTAGE

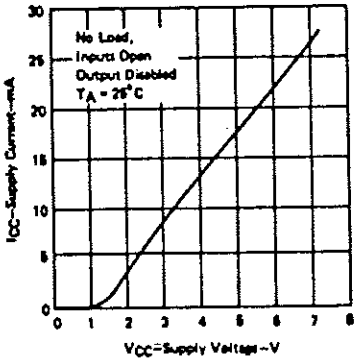
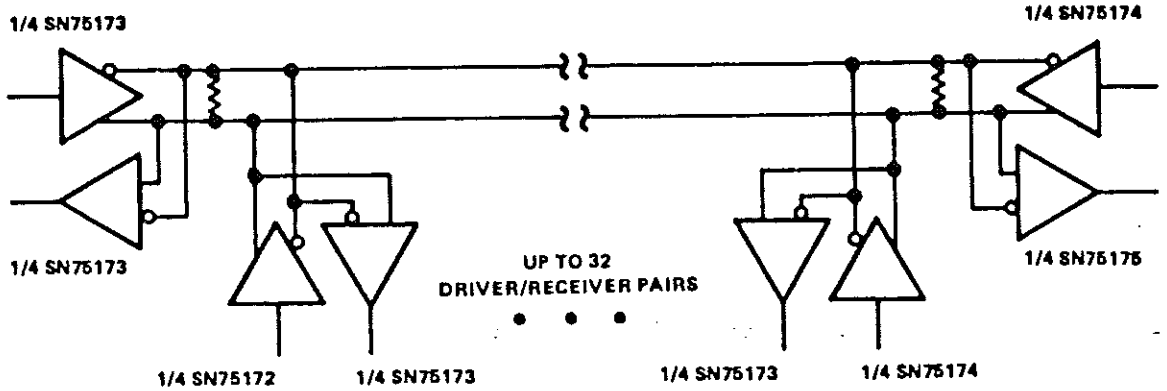


FIGURE 11

TYPICAL APPLICATION



NOTE: The line length should be terminated at both ends in its characteristic impedance. Stub lengths off the main line should be kept as short as possible.

FIGURE 12

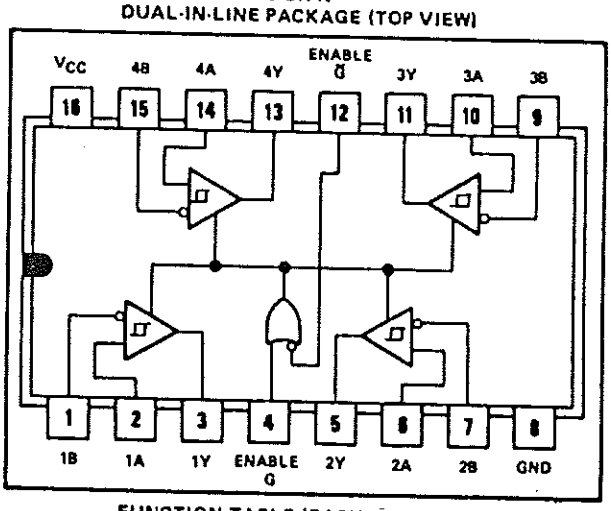
INTERFACE CIRCUITS

TYPE SN75173
QUADRUPLE DIFFERENTIAL LINE RECEIVER

BULLETIN NO. DL-S 12770, OCTOBER 1980

- Meets EIA Standards RS-422A and RS-423A
- Meets CCITT Recommendations V.10, V.11 X.26, and X.27
- Meets EIA Subcommittee TR30.1 Draft Standard PN1360 (as of April 1980)
- Designed for Multipoint Bus Transmission on Long Bus Lines in Noisy Environments
- 3-State Outputs
- Common-Mode Input Voltage Range . . . −12 V to 12 V
- Input Sensitivity . . . ±200 mV
- Input Hysteresis . . . 50 mV Typ
- High Input Impedance . . . 12 kΩ Min
- Operates from Single 5-Volt Supply
- Low Power Requirements
- Plug-In Replacement for AM26LS32

J OR N
DUAL-IN-LINE PACKAGE (TOP VIEW)



description

The SN75173 is a monolithic quadruple differential line receiver with three state outputs. It is designed to meet the requirements of EIA Standards RS-422A and RS-423A and several CCITT recommendations. The device is optimized for balanced multipoint bus transmission at rates up to 10 megabits per second. Each receiver features an active-high enable and an active-low enable common to all four receivers. It also features high input impedance, input hysteresis for increased noise immunity, and input sensitivity of ±200 millivolts over a common-mode input voltage range of −12 volts to 12 volts. The SN75173 is designed for optimum performance when used with the SN75172 or SN75174 quadruple differential line drivers.

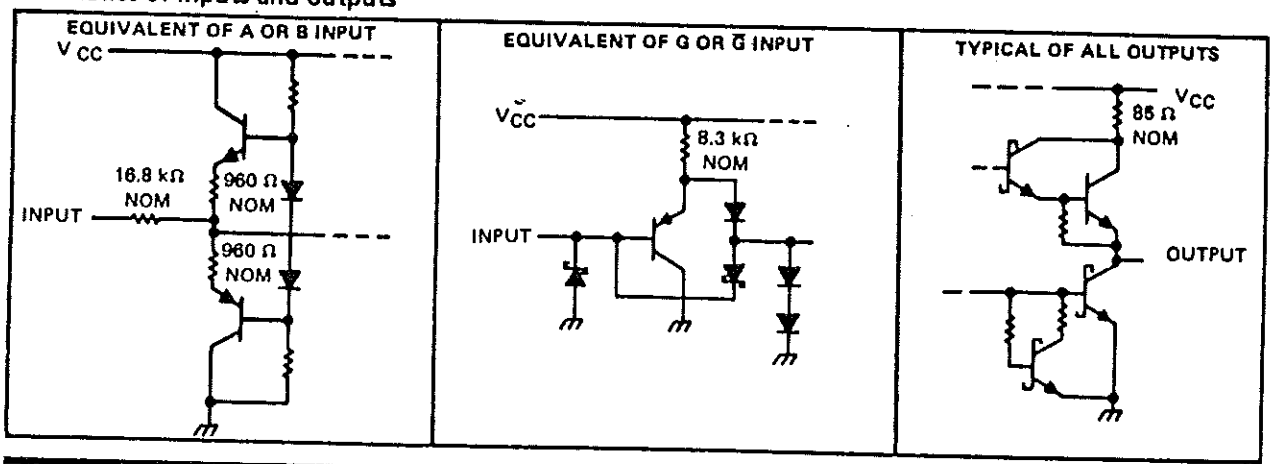
The SN75173 is characterized for operation from 0°C to 70°C.

FUNCTION TABLE (EACH RECEIVER)

DIFFERENTIAL INPUTS A − B	ENABLES G	ENABLES $\overline{G}$	OUTPUT Y
$V_{ID} > 0.2$ V	H	X	H
	X	L	H
−0.2 V < V_{ID} < 0.2 V	H	X	?
	X	L	?
$V_{ID} < -0.2$ V	H	X	L
	X	L	L
X	L	H	Z

H = high level
L = low level
X = irrelevant
? = indeterminate
Z = high-impedance (off)

schematics of inputs and outputs



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absolute maximum ratings over operating free-air temperature range (unless otherwise noted)

Supply voltage, V_{CC} (see Note 1) . . . . . 7 V
Input voltage, A or B inputs . . . . . ±25 V
Differential input voltage (see Note 2) . . . . . ±25 V
Enable input voltage . . . . . 7 V
Low-level output current . . . . . 50 mA
Continuous total dissipation at (or below) 25°C free-air temperature (see Note 3): J Package . . . . . 1025 mW
N Package . . . . . 1150 mW
Operating free-air temperature range . . . . . 0°C to 70°C
Storage temperature range . . . . . −65°C to 150°C
Lead temperature 1/16 inch (1,6 mm) from case for 60 seconds: J Package . . . . . 300°C
Lead temperature 1/16 inch (1,6 mm) from case for 10 seconds: N Package . . . . . 260°C

NOTES: 1. All voltage values, except differential input voltage, are with respect to network ground terminal.
2. Differential-input voltage is measured at the noninverting input with respect to the corresponding inverting input.
3. For operation above 25°C free-air temperature, derate the J package to 656 mW at 70°C at the rate of 8.2 mW/°C and the N package to 736 mW at 70°C at the rate of 9.2 mW/°C. In the J package, SN75173 chips are glass-mounted.

recommended operating conditions

	MIN	NOM	MAX	UNIT
Supply voltage, V_{CC}	4.75	5	5.25	V
Common-mode input voltage, V_{IC}			±12	V
Differential input voltage, V_{ID}			±12	V
High-level output current, I_{OH}			−400	μA
Low-level output current, I_{OL}			16	mA
Operating free-air temperature, T_A	0		70	°C

electrical characteristics over recommended ranges of common-mode input voltage, supply voltage, and operating free-air temperature (unless otherwise noted)

	PARAMETER	TEST CONDITIONS		MIN	TYP†	MAX	UNIT
V_{TH}	Differential-input high-threshold voltage	V_O = 2.7 V,	I_O = −0.4 mA			0.2	V
V_{TL}	Differential-input low-threshold voltage	V_O = 0.5 V,	I_O = 16 mA	−0.2‡			V
$V_{T+} - V_{T-}$	Hysteresis§				50		mV
V_{IH}	High-level enable input voltage			2			V
V_{IL}	Low-level enable input voltage					0.8	V
V_{IK}	Enable-input clamp voltage	I_I = −18 mA				−1.5	V
V_{OH}	High-level output voltage	V_{ID} = 200 mV,	I_{OH} = −400 μA	2.7			V
V_{OL}	Low-level output voltage	V_{ID} = −200 mV,	I_{OL} = 8 mA			0.45	V
			I_{OL} = 16 mA			0.5	
I_{OZ}	High-impedance-state output current	V_O = 0.4 V to 2.4 V				±20	μA
I_I	Line input current	Other input at 0 V, See Note 4	V_I = 12 V			1	mA
			V_I = −7 V			−0.8	
I_{IH}	High-level enable-input current	V_{IH} = 2.7 V				20	μA
I_{IL}	Low-level enable-input current	V_{IL} = 0.4 V				−100	μA
r_I	Input resistance			12			kΩ
I_{OS}	Short-circuit output current¶			−15		−85	mA
I_{CC}	Supply current	Outputs disabled				70	mA

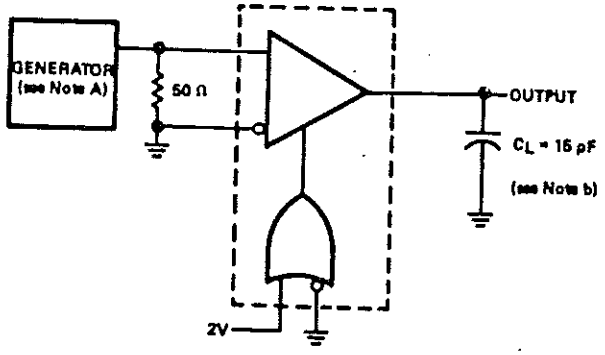
†All typical values are at V_{CC} = 5 V, T_A = 25°C
‡The algebraic convention, where the less-positive (more-negative) limit is designated minimum, is used in this data sheet for threshold voltage levels only.
§Hysteresis is the difference between the positive-going input threshold voltage, V_{T+}, and the negative-going input threshold voltage, V_{T-}. See Figure 4.
¶Not more than one output should be shorted at a time and the duration of the short-circuit should not exceed one second.
NOTE 4: Refer to EIA Standard RS-422A and RS-423A for exact conditions.

TYPE SN75173
QUADRUPLE DIFFERENTIAL LINE RECEIVER

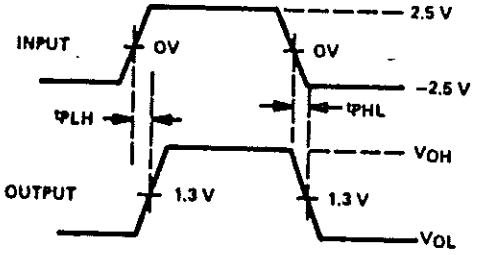
switching characteristics, V_{CC} = 5 V, T_A = 25°C

	PARAMETER	TEST CONDITIONS		MIN	TYP	MAX	UNIT
t_{PLH}	Propagation delay time, low-to-high-level output	V_{ID} = −2.5 V to 2.5 V, See Figure 1	C_L = 15 pF,		20	35	ns
t_{PHL}	Propagation delay time, high-to-low-level output				22	35	ns
t_{PZH}	Output enable time to high level	C_L = 15 pF,	See Figure 2		17	22	ns
t_{PZL}	Output enable time to low level	C_L = 15 pF,	See Figure 3		20	25	ns
t_{PHZ}	Output disable time from high level	C_L = 5 pF,	See Figure 2		21	30	ns
t_{PLZ}	Output disable time from low level	C_L = 5 pF,	See Figure 3		30	40	ns

PARAMETER MEASUREMENT INFORMATION

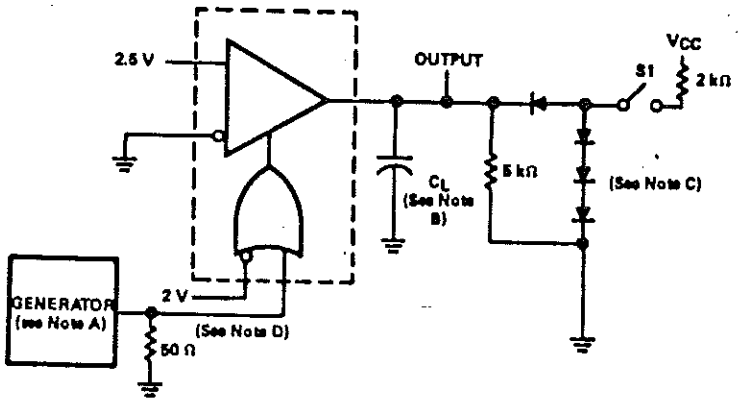


TEST CIRCUIT

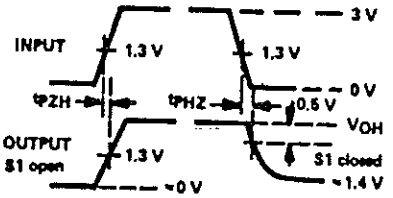


VOLTAGE WAVEFORMS

FIGURE 1 – t_{PLH}, t_{PHL}



TEST CIRCUIT



VOLTAGE WAVEFORMS

FIGURE 2 – t_{PHZ}, t_{PZH}

NOTES: A. The input pulse is supplied by a generator having the following characteristics: PRR = 1 MHz, duty cycle = 50%, t_r = t_f = 6 ns, Z_{out} = 50 Ω.
B. C_L includes probe and jig capacitance.
C. All diodes are in 916 or equivalent.
D. To test the active low enable $\overline{G}$, ground G and apply an inverted input waveform to $\overline{G}$.

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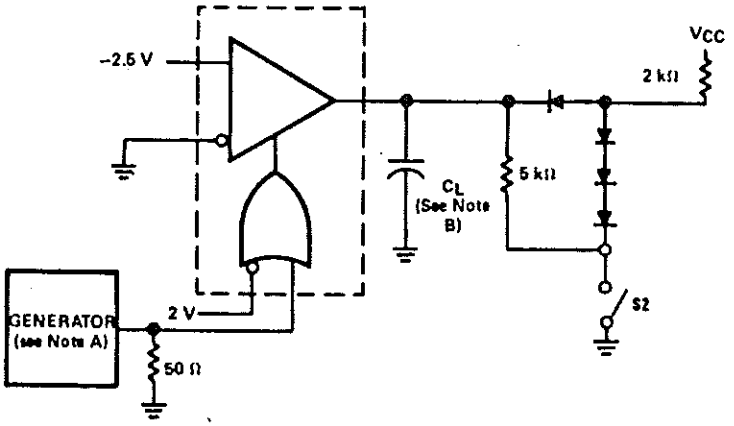
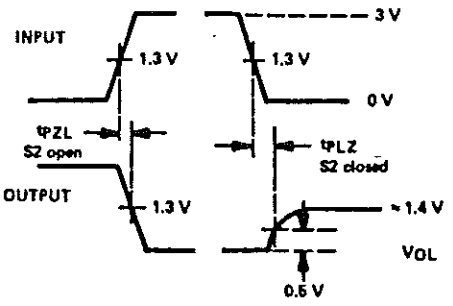
PARAMETER MEASUREMENT INFORMATION



TEST CIRCUIT



VOLTAGE WAVEFORMS

5

NOTES: A. The input pulse is supplied by a generator having the following characteristics: PRR = 1 MHz, duty cycle, = 50%, $t_r = t_f = 6$ ns, $Z_{out} = 50\ \Omega$.
B. C_L includes probe and jig capacitance.
C. All diodes are in 916 or equivalent.
D. To test the active low enable $\overline{G}$, ground G and apply an inverted input waveform to $\overline{G}$.

FIGURE 3 – t_{PZL}, t_{PLZ}

TYPICAL CHARACTERISTICS

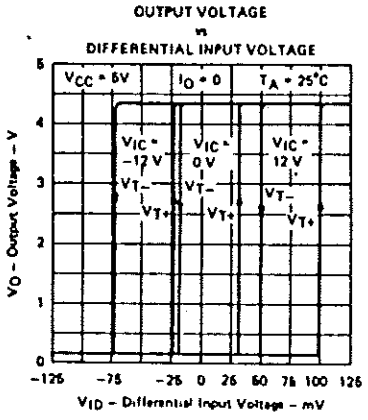


FIGURE 4

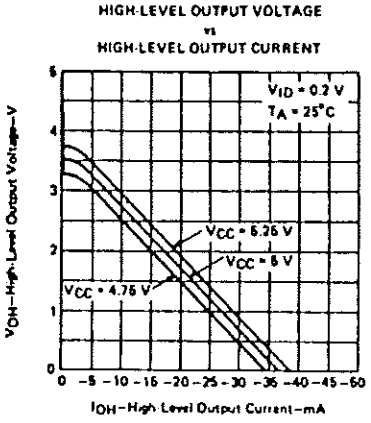


FIGURE 5

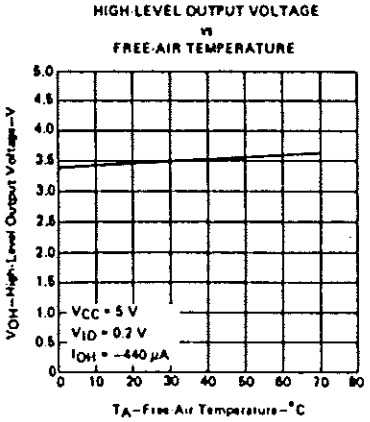


FIGURE 6

TYPICAL CHARACTERISTICS

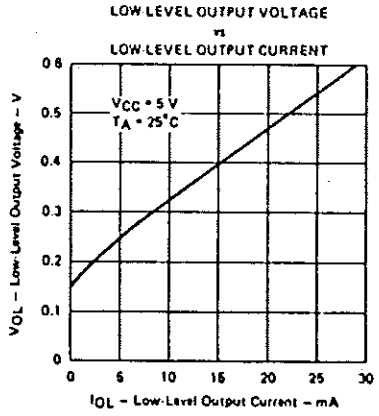


FIGURE 7

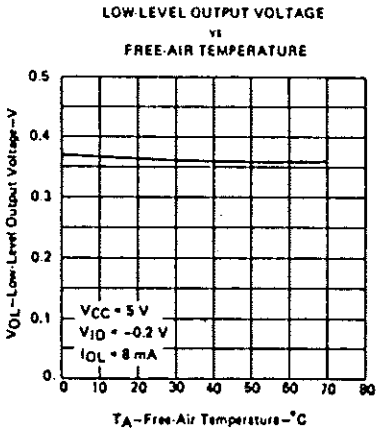


FIGURE 8

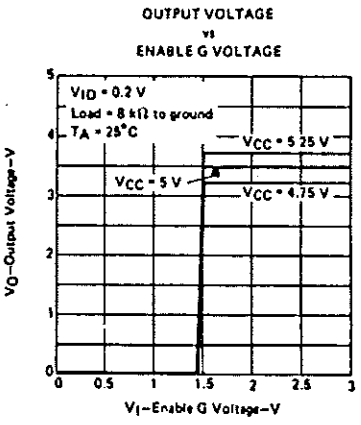


FIGURE 9

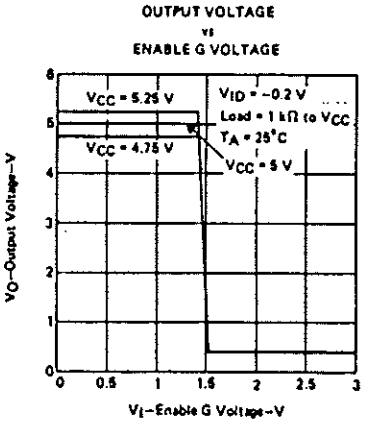
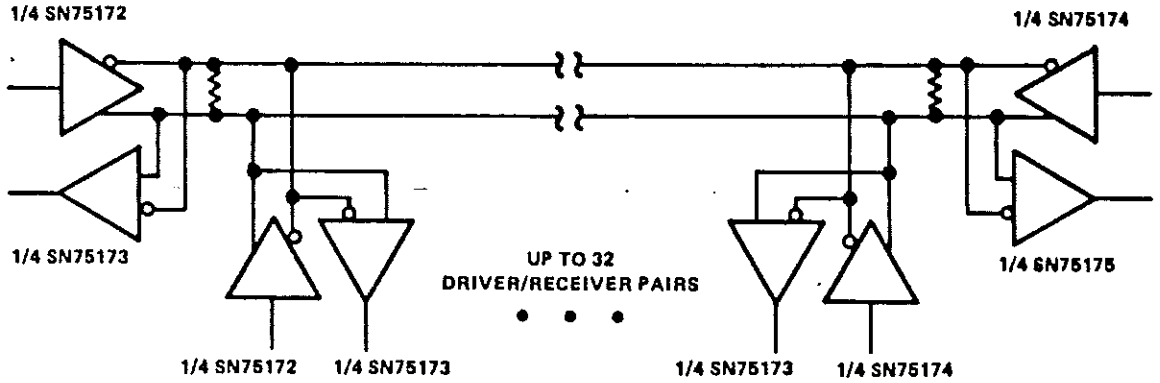


FIGURE 10

TYPICAL APPLICATION



NOTE: The line should be terminated at both ends in its characteristic impedance. Stub lengths off the main line should be kept as short as possible.

FIGURE 11

TEXAS INSTRUMENTS
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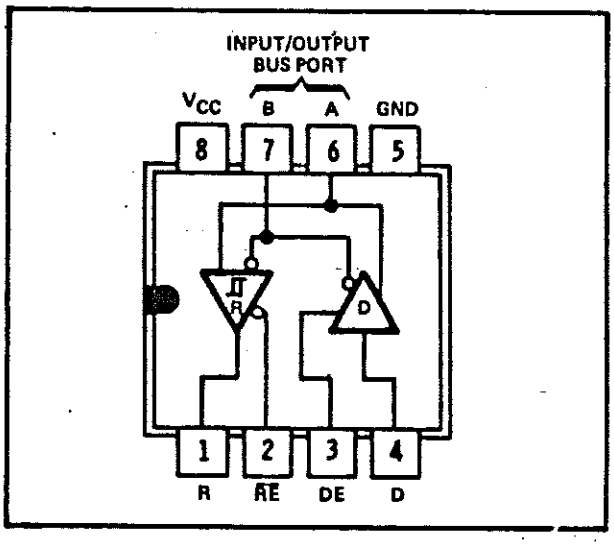
TYPE SN75176 DIFFERENTIAL BUS TRANSCEIVER

BULLETIN NO. DL-S 12790, OCTOBER 1980

- Bidirectional Transceiver
- Meets EIA Standard RS-422A and CCITT Recommendations V.11 and X.27
- Meets EIA Subcommittee TR30.1 Draft Standard PN1360 (as of April 1980)
- Designed for Multipoint Transmission on Long Bus Lines in Noisy Environments
- 3-State Driver and Receiver Outputs
- Individual Driver and Receiver Enables
- Wide Positive and Negative Input/Output Bus Voltage Ranges
- Driver Output Capability . . . ± 60 mA Max
- Thermal Shutdown Protection
- Driver Positive and Negative Current Limiting
- Receiver Input Impedance . . . 12 kΩ Min
- Receiver Input Sensitivity . . . ±200 mV
- Receiver Input Hysteresis . . . 50 mV Typ
- Operates from Single 5-Volt Supply
- Low Power Requirements

JG OR P
DUAL-IN-LINE PACKAGE
(TOP VIEW)



FUNCTION TABLE (DRIVER)

INPUT	ENABLE	OUTPUTS	
D	DE	A	B
H	H	H	L
L	H	L	H
X	L	Z	Z

FUNCTION TABLE (RECEIVER)

DIFFERENTIAL INPUTS	ENABLE	OUTPUT
A – B	$\overline{RE}$	R
$V_{ID} > 0.2$ V	L	H
-0.2 V $< V_{ID} < 0.2$ V	L	?
$V_{ID} < -0.2$ V	L	L
X	H	Z

H = high level, L = low level, ? = indeterminate,
X = irrelevant, Z = high impedance (off)

description

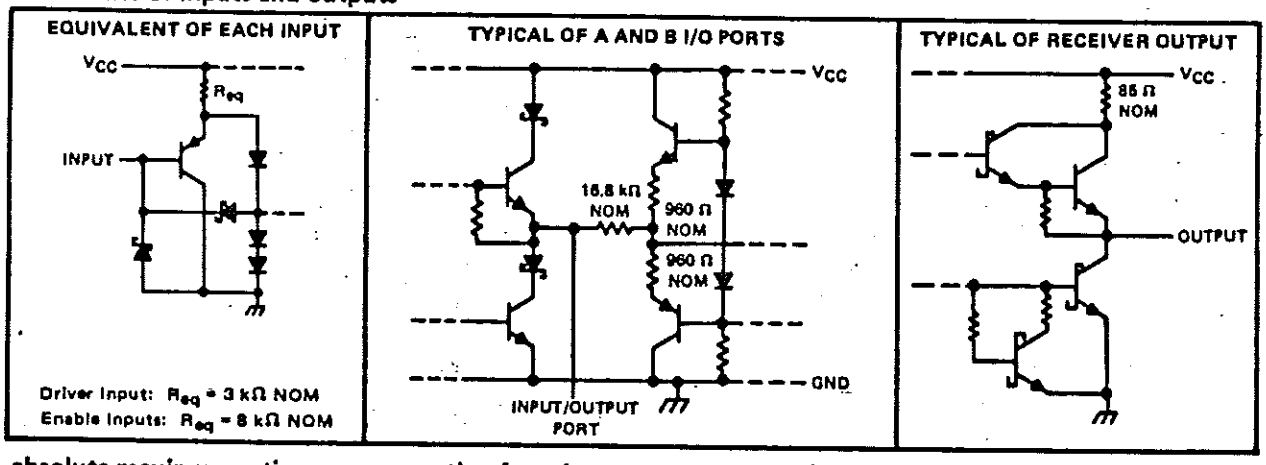
The SN75176 differential bus transceiver is a monolithic integrated circuit designed for bidirectional data communication on multipoint bus transmission lines. It is designed for balanced transmission lines and meets EIA Standard RS-422A, the EIA Subcommittee TR30.1 Draft Standard PN1360, and CCITT Recommendations V.11 and X.27.

The SN75176 combines a three-state differential line driver and a differential-input line receiver both of which operate from a single 5-volt power supply. The driver and receiver have an active enable that can be externally connected to function as a direction control. The driver differential-outputs and the receiver differential-inputs are internally connected to form differential input/output (I/O) bus ports that are designed to offer minimum loading to the bus whenever the driver is disabled or V_{CC} = 0 volts. These ports feature wide positive and negative common-mode voltage ranges making the device suitable for party-line applications.

The driver is designed to handle loads up to 60 milliamperes of sink or source current. The driver features positive- and negative-current limiting and thermal shutdown for protection from line fault conditions. Thermal shutdown is designed to occur at a junction temperature of approximately 150°C. The receiver features a minimum input impedance of 12 kΩ, an input sensitivity of ±200 millivolts, and a typical input hysteresis of 50 millivolts.

The SN75176 can be used in transmission line applications employing the SN75172 and SN75174 quadruple differential line drivers and the SN75173 and SN75175 quadruple differential line receivers.

schematics of inputs and outputs



absolute maximum ratings over operating free-air temperature range (unless otherwise noted)

Supply voltage, V_{CC} (see Note 1) . . . . . 7 V
Voltage at any bus terminal . . . . . −10 V to 15 V
Enable input voltage . . . . . 5.5 V
Continuous total dissipation at (or below) 25°C free-air temperature (see Note 2): JG Package . . . . . 825 mW
P Package . . . . . 1000 mW
Operating free-air temperature range . . . . . 0°C to 70°C
Storage temperature range . . . . . −65°C to 150°C
Lead temperature 1/16 inch (1,6 mm) from case for 60 seconds: JG Package . . . . . 300°C
Lead temperature 1/16 inch (1,6 mm) from case for 10 seconds: P Package . . . . . 260°C

NOTES: 1. All voltage values, except differential input/output bus voltage, are with respect to network ground terminal.
2. For operation above 25°C free-air temperature, derate the JG package to 528 mW at 70°C at the rate of 8.6 mW/°C and the P package to 640 mW at 70°C at the rate of 8.0 mW/°C. In the JG package, SN75176 chips are glass-mounted.

recommended operating conditions

		MIN	NOM	MAX	UNIT
Supply voltage, V_{CC}		4.75	5	5.25	V
Voltage at any bus terminal (separately or common-mode), V_I or V_{IC}		−7†		12	V
Differential input voltage, V_{ID} (see Note 3)				±12	V
High-level output current, I_{OH}	Driver			−60	mA
	Receiver			−400	μA
Low-level output current, I_{OL}	Driver			60	mA
	Receiver			16	
Operating free-air temperature, T_A		0		70	°C

†The algebraic convention, where the less-positive (more-negative) limit is designated minimum, is used in this data sheet for common-mode input voltage and threshold voltage levels only.
NOTE 3: Differential-input/output bus voltage is measured at the noninverting terminal A with respect to the inverting terminal B.

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DRIVER SECTION

driver electrical characteristics over recommended ranges of supply voltage and operating free-air temperature (unless otherwise noted)

PARAMETER		TEST CONDITIONS		MIN	TYP†	MAX	UNIT
V_{IH}	High-level input voltage			2			V
V_{IL}	Low-level input voltage					0.8	V
V_{IK}	Input clamp voltage	I_I = −18 mA				−1.5	V
V_{OH}	High-level output voltage	V_{IH} = 2 V, I_{OH} = −33 mA	V_{IL} = 0.8 V,		3.7		V
V_{OL}	Low-level output voltage	V_{IH} = 2 V, I_{OL} = 33 mA	V_{IL} = 0.8 V,		1.1		V
$\lvert V_{OD1}\rvert$	Differential output voltage	I_O = 0				$2V_{OD2}$	V
$\lvert V_{OD2}\rvert$	Differential output voltage	R_L = 100 Ω,	See Figure 9	2	2.7		V
		R_L = 54 Ω,	See Figure 9	1.5	2.4		
$\Delta\lvert V_{OD}\rvert$	Change in magnitude of differential output voltage‡	R_L = 54 Ω or 100 Ω,	See Figure 9			±0.2	V
V_{OC}	Common-mode output voltage§					3	V
$\Delta\lvert V_{OC}\rvert$	Change in magnitude of common-mode output voltage‡					±0.2	V
I_O	Output current	Output disabled, See Note 4	V_O = 12 V			1	mA
			V_O = −7 V			−0.8	
I_{IH}	High-level input current	V_I = 2.4 V				20	μA
I_{IL}	Low-level input current	V_I = 0.4 V				−360	μA
I_{OS}	Short-circuit output current	V_O = −7 V				−180	mA
		V_O = V_{CC}				180	
		V_O = 12 V				500	
I_{CC}	Supply current (total package)	No load	Outputs enabled			35	mA
			Outputs disabled			30	

†All typical values are at V_{CC} = 5 V and T_A = 25°C.
‡$\Delta\lvert V_{OD}\rvert$ and $\Delta\lvert V_{OC}\rvert$ are the changes in magnitude of V_{OD} and V_{OC}, respectively, that occur when the input is changed from a high level to a low level.
§In EIA Standard RS-422A, V_{OC}, which is the average of the two output voltages with respect to ground, is called output offset voltage, V_{OS}.
NOTE 4: This applies for both power on and power off. Refer to EIA Standard RS-422A for exact conditions.

driver switching characteristics, V_{CC} = 5 V, T_A = 25°C

PARAMETER		TEST CONDITIONS		MIN	TYP	MAX	UNIT
t_{DD}	Differential-output delay time	R_L = 60 Ω,	See Figure 11		35	50	ns
t_{TD}	Differential-output transition time				50	75	ns
t_{PLH}	Propagation delay time, low-to-high-level output	R_L = 27 Ω,	See Figure 12		16	25	ns
t_{PHL}	Propagation delay time, high-to-low-level output				44	65	ns
t_{PZH}	Output enable time to high level	R_L = 110 Ω,	See Figure 13		60	80	ns
t_{PZL}	Output enable time to low level	R_L = 110 Ω,	See Figure 14		30	45	ns
t_{PHZ}	Output disable time from high level	R_L = 110 Ω,	See Figure 13		51	75	ns
t_{PLZ}	Output disable time from low level	R_L = 110 Ω,	See Figure 14		18	30	ns

RECEIVER SECTION

receiver electrical characteristics over recommended ranges of common-mode input voltage, supply voltage, and operating free-air temperature (unless otherwise noted)

PARAMETER		TEST CONDITIONS		MIN	TYP†	MAX	UNIT
V_{TH}	Differential-input high-threshold voltage	V_O = 2.7 V, I_O = −0.4 mA				0.2	V
V_{TL}	Differential-input low-threshold voltage	V_O = 0.5 V, I_O = 8 mA		−0.2¶			V
$V_{T+} - V_{T-}$	Hysteresis§				50		mV
V_{IH}	High-level enable input voltage			2			V
V_{IL}	Low-level enable input voltage					0.8	V
V_{IK}	Enable-input clamp voltage	I_I = −18 mA				−1.5	V
V_{OH}	High-level output voltage	V_{ID} = 200 mV, I_{OH} = −400 μA, See Figure 10		2.7			V
V_{OL}	Low-level output voltage	V_{ID} = −200 mV, See Figure 10	I_{OL} = 8 mA			0.45	V
			I_{OL} = 16 mA			0.5	
I_{OZ}	High-impedance-state output current	V_O = 0.4 V to 2.4 V				±20	μA
I_I	Line input current	Other input = 0 V, See Note 4	V_I = 12 V			1	mA
			V_I = −7 V			−0.8	
I_{IH}	High-level enable-input current	V_{IH} = 2.7 V				20	μA
I_{IL}	Low-level enable-input current	V_{IL} = 0.4 V				−100	μA
r_i	Input resistance			12			kΩ
I_{OS}	Short-circuit output current			−15		−85	mA
I_{CC}	Supply current (total package)	No load	Outputs enabled			35	mA
			Outputs disabled			30	

†All typical values are at V_{CC} = 5 V, T_A = 25°C.

¶The algebraic convention, where the less-positive (more-negative) limit is designated minimum, is used in this data sheet for common-mode input voltage and threshold voltage levels only.

§Hysteresis is the difference between the positive-going input threshold voltage, V_{T+}, and the negative-going input threshold voltage, V_{T-}. See Figure 4.

NOTE 4: This applies for both power on and power off. Refer to EIA Standard RS-422A for exact conditions.

receiver switching characteristics, V_{CC} = 5 V, T_A = 25°C

PARAMETER		TEST CONDITIONS		MIN	TYP	MAX	UNIT
t_{PLH}	Propagation delay time, low-to-high-level output	V_{ID} = −2.5 V to 2.5 V, C_L = 15 pF,	See Figure 15		26	35	ns
t_{PHL}	Propagation delay time, high-to-low-level output				27	35	ns
t_{PZH}	Output enable time to high level	C_L = 15 pF,	See Figure 16		13	30	ns
t_{PZL}	Output enable time to low level				19	30	ns
t_{PHZ}	Output disable time from high level	C_L = 5 pF,	See Figure 16		26	35	ns
t_{PLZ}	Output disable time from low level				27	35	ns

TYPICAL CHARACTERISTICS

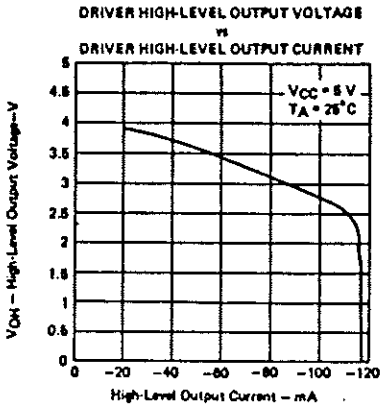

FIGURE 1

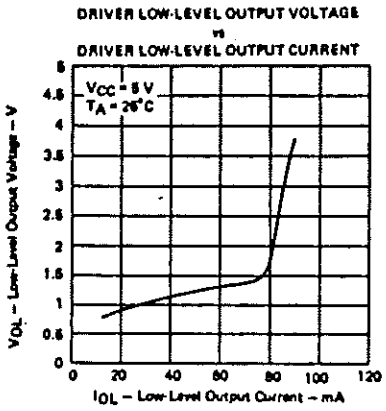

FIGURE 2

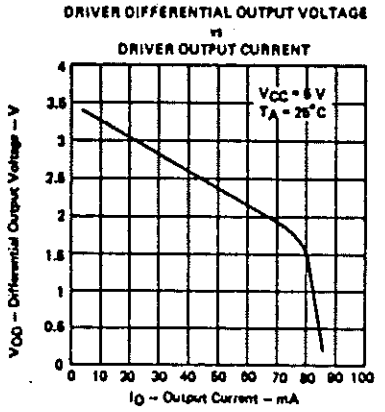

FIGURE 3

TEXAS INSTRUMENTS
INCORPORATED
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TYPICAL CHARACTERISTICS

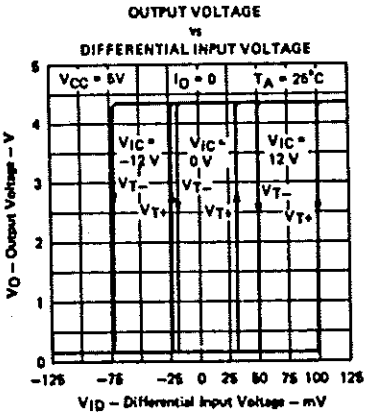


FIGURE 4

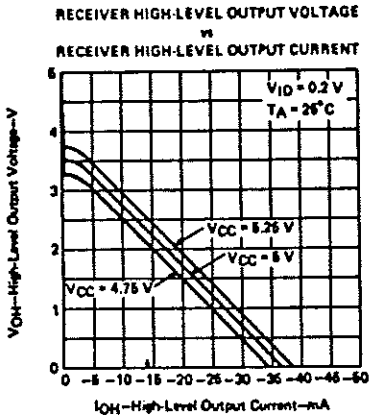


FIGURE 5

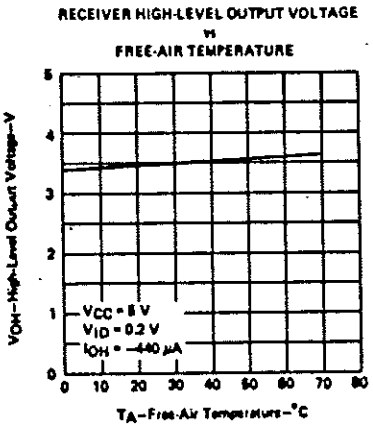


FIGURE 6

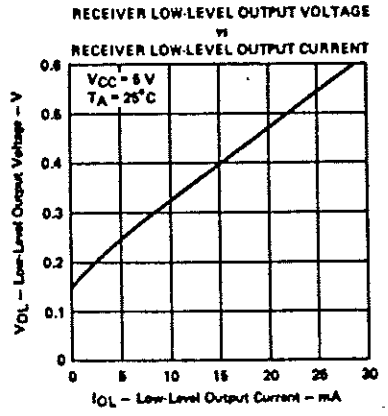


FIGURE 7

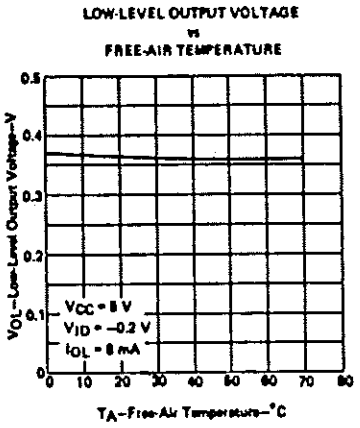


FIGURE 8

PARAMETER MEASUREMENT INFORMATION

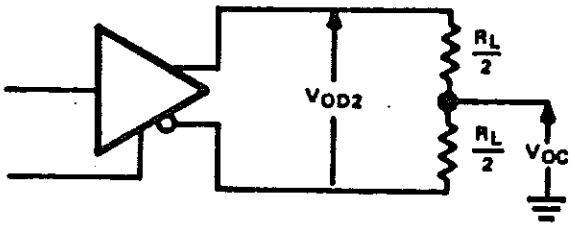


FIGURE 9–DRIVER V_{OD} AND V_{OC}

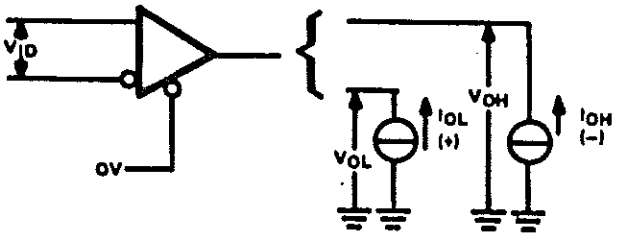
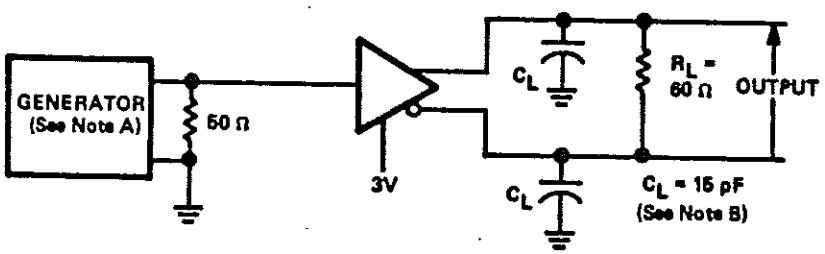
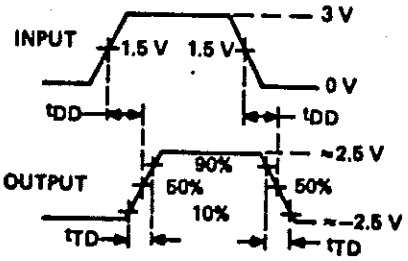


FIGURE 10–RECEIVER V_{OH} AND V_{OL}

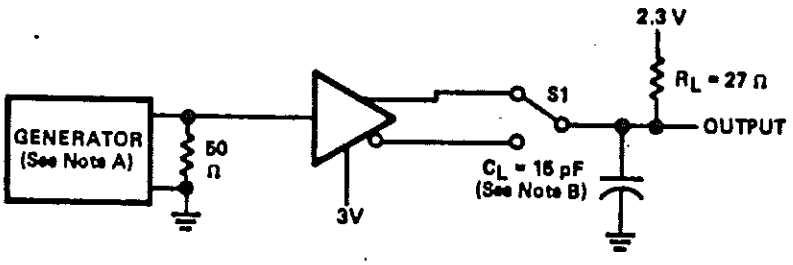


TEST CIRCUIT

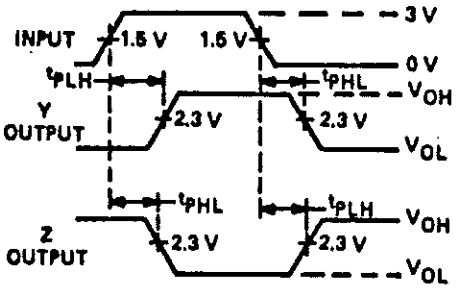


VOLTAGE WAVEFORMS

FIGURE 11–DRIVER DIFFERENTIAL-OUTPUT DELAY AND TRANSITION TIMES



TEST CIRCUIT



VOLTAGE WAVEFORMS

FIGURE 12–DRIVER PROPAGATION TIMES

NOTES: A. The input pulse is supplied by a generator having the following characteristics: PRR = 1 MHz, 50% duty cycle, $t_r \leq 6$ ns, $t_f \leq 6$ ns, Z_{out} = 50 Ω.
B. C_L includes probe and jig capacitance.

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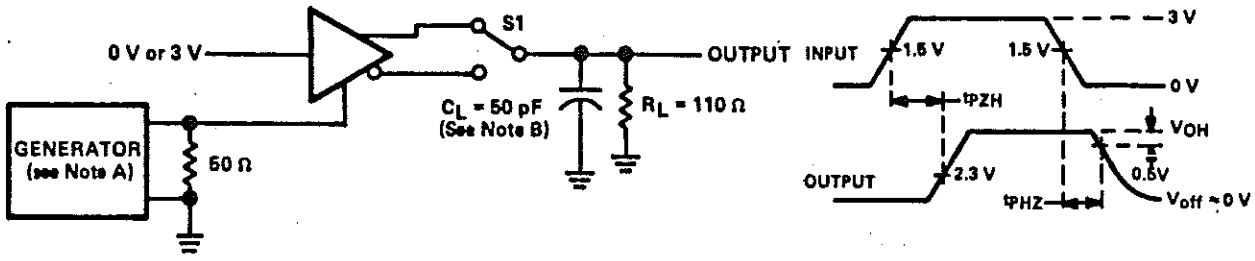
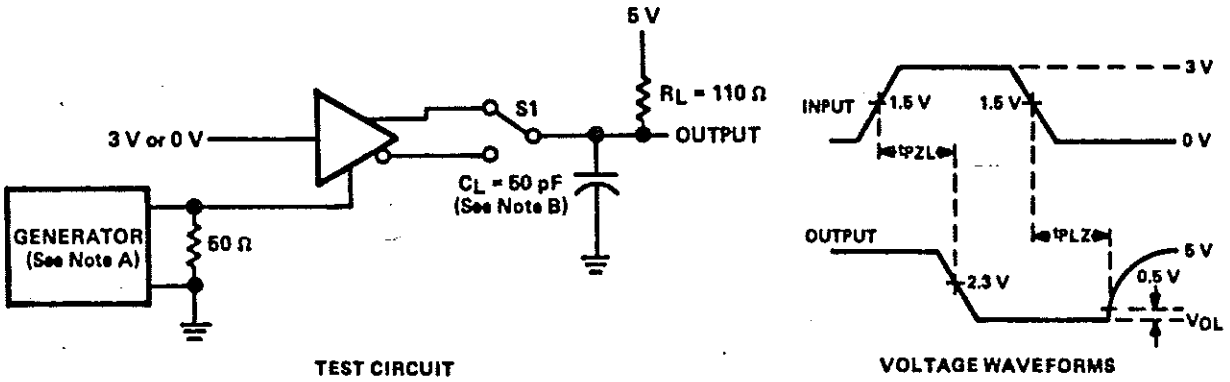
PARAMETER MEASUREMENT INFORMATION



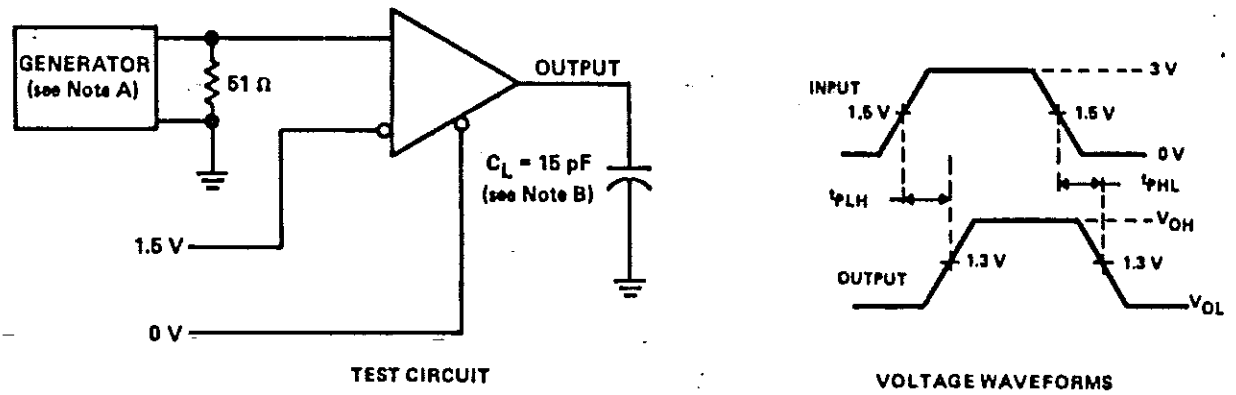
TEST CIRCUIT VOLTAGE WAVEFORMS

FIGURE 13–DRIVER ENABLE AND DISABLE TIMES



TEST CIRCUIT VOLTAGE WAVEFORMS

FIGURE 14–DRIVER ENABLE AND DISABLE TIMES



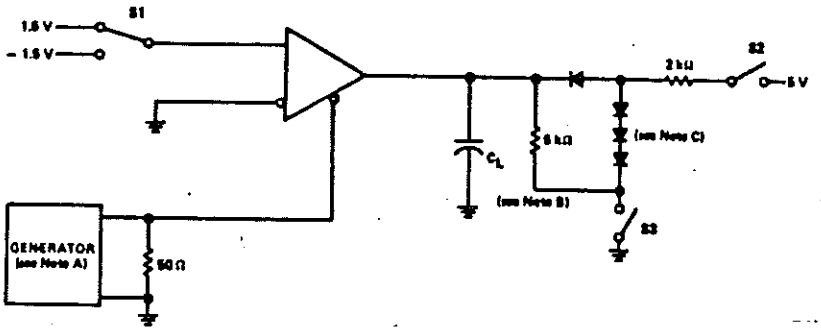
TEST CIRCUIT VOLTAGE WAVEFORMS

FIGURE 15–RECEIVER PROPAGATION DELAY TIMES

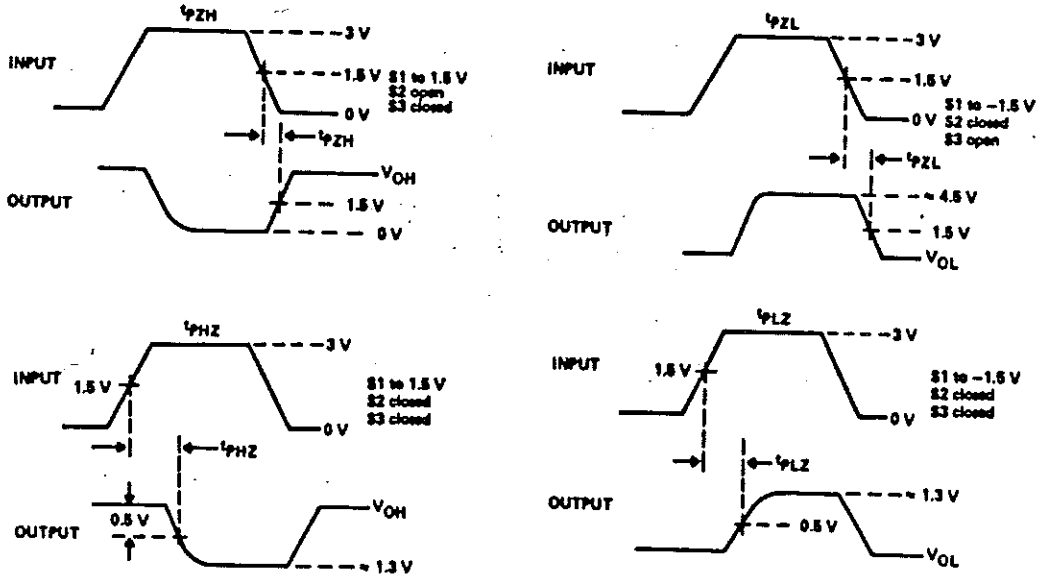
NOTES: A. The input pulse is supplied by a generator having the following characteristics: PRR = 1 MHz, 50% duty cycle, t_r < 6 ns, t_f < 6 ns, Z_{out} = 50 Ω.
B. C_L includes probe and jig capacitance.

TYPE SN75176
DIFFERENTIAL BUS TRANSCEIVER

PARAMETER MEASUREMENT INFORMATION



TEST CIRCUIT

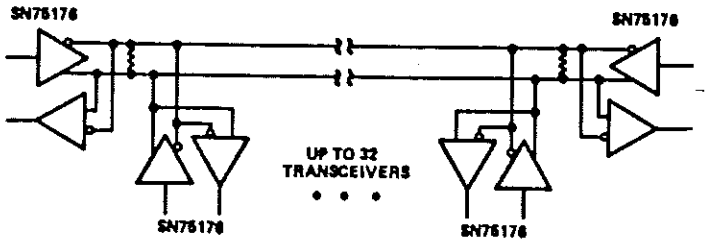


VOLTAGE WAVEFORMS

NOTES: A. The input pulse is supplied by a generator having the following characteristics: PRR = 1 MHz, duty cycle ≈ 50%, t_r = t_f = 6 ns.
B. C_L includes probe and stray capacitance.
C. All diodes are 1N916 or equivalent.

FIGURE 16–RECEIVER ENABLE AND DISABLE TIMES

TYPICAL APPLICATION



NOTE: The line length should be terminated at both ends in its characteristic impedance. Stubs lengths off the mainline should be kept as short as possible.

FIGURE 17

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National Semiconductor

LM78XX Series Voltage Regulators

General Description

The LM78XX series of three terminal regulators is available with several fixed output voltages making them useful in a wide range of applications. One of these is local on card regulation, eliminating the distribution problems associated with single point regulation. The voltages available allow these regulators to be used in logic systems, instrumentation, HiFi, and other solid state electronic equipment. Although designed primarily as fixed voltage regulators these devices can be used with external components to obtain adjustable voltages and currents.

The LM78XX series is available in an aluminum TO-3 package which will allow over 1.0A load current if adequate heat sinking is provided. Current limiting is included to limit the peak output current to a safe value. Safe area protection for the output transistor is provided to limit internal power dissipation. If internal power dissipation becomes too high for the heat sinking provided, the thermal shutdown circuit takes over preventing the IC from overheating.

Considerable effort was expended to make the LM78XX series of regulators easy to use and minimize the number of external components. It is not necessary to bypass the output, although this does improve transient response. Input bypassing is needed only if the regulator is located far from the filter capacitor of the power supply.

For applications requiring other voltages, see LM117 data sheet.

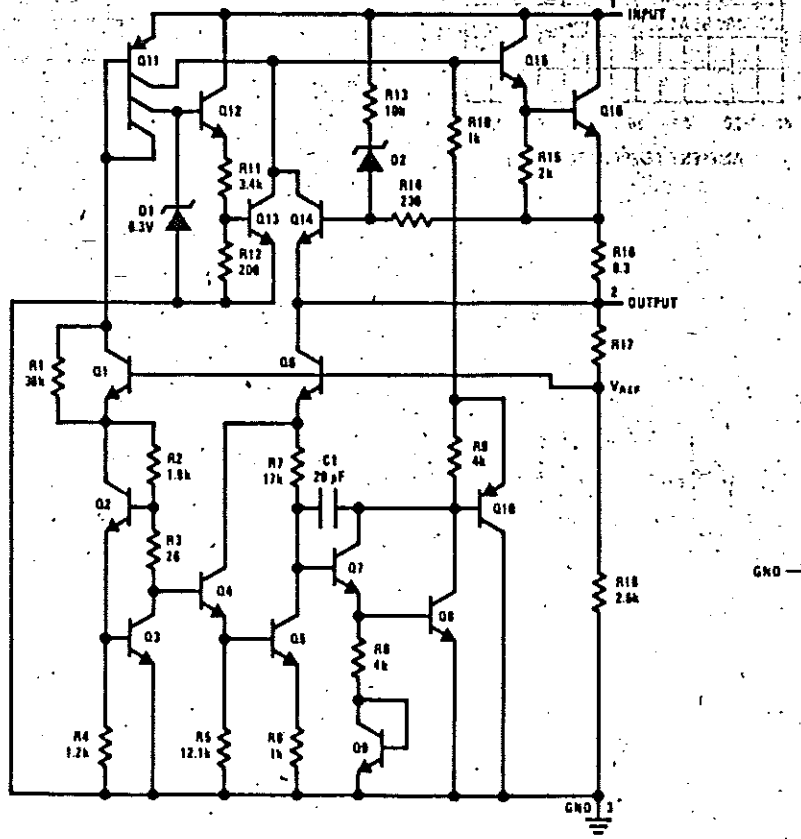
Features

- Output current in excess of 1A
- Internal thermal overload protection
- No external components required
- Output transistor safe area protection
- Internal short circuit current limit
- Available in the aluminum TO-3 package

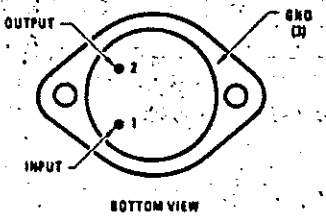
Voltage Range

LM7805C	5V
LM7812C	12V
LM7815C	15V

Schematic and Connection Diagrams



Metal Can Package
TO-3 (K)
Aluminum



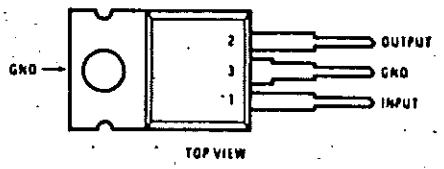
BOTTOM VIEW

Order Numbers:

LM7805CK
LM7812CK
LM7815CK

See NS Package KC02A

Plastic Package
TO-220 (T)



TOP VIEW

Order Numbers:

LM7805CT
LM7812CT
LM7815CT

See NS Package T03B

Absolute Maximum Ratings

Input Voltage (V_O = 5V, 12V and 15V)	35V
Internal Power Dissipation (Note 1)	Internally Limited
Operating Temperature Range (T_A)	0°C to +70°C
Maximum Junction Temperature	
(K Package)	150°C
(T Package)	125°C
Storage Temperature Range	−65°C to +150°C
Lead Temperature (Soldering, 10 seconds)	
TO-3 Package K	300°C
TO-220 Package T	230°C

Electrical Characteristics LM78XXC (Note 2) 0°C ≤ Tj ≤ 125°C unless otherwise noted.

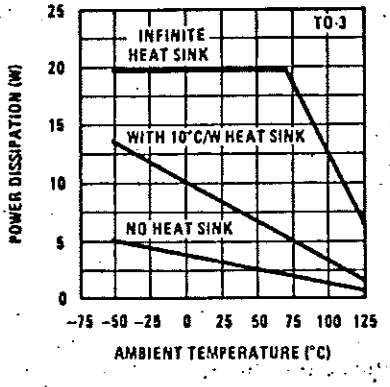
OUTPUT VOLTAGE			5V			12V			15V			UNITS
INPUT VOLTAGE (unless otherwise noted)			10V			19V			23V			
PARAMETER	CONDITIONS		MIN	TYP	MAX	MIN	TYP	MAX	MIN	TYP	MAX	
V_O Output Voltage	Tj = 25°C, 5 mA ≤ I_O ≤ 1A		4.8	5	5.2	11.5	12	12.5	14.4	15	15.6	V
	P_D ≤ 15W, 5 mA ≤ I_O ≤ 1A, V_{MIN} ≤ V_{IN} ≤ V_{MAX}		4.75 (7 ≤ V_{IN} ≤ 20)		5.25	11.4 (14.5 ≤ V_{IN} ≤ 27)		12.6	14.25 (17.5 ≤ V_{IN} ≤ 30)		15.75	V V
ΔV_O Line Regulation	I_O = 500 mA	Tj = 25°C, ΔV_{IN}		3 (7 ≤ V_{IN} ≤ 25)	50		4 (14.5 ≤ V_{IN} ≤ 30)	120		4 (17.5 ≤ V_{IN} ≤ 30)	150	mV V
		0°C ≤ Tj ≤ +125°C, ΔV_{IN}		(8 ≤ V_{IN} ≤ 20)	50		(15 ≤ V_{IN} ≤ 27)	120		(18.5 ≤ V_{IN} ≤ 30)	150	mV V
	I_O ≤ 1A	Tj = 25°C, ΔV_{IN}		(7.3 ≤ V_{IN} ≤ 20)	50		(14.6 ≤ V_{IN} ≤ 27)	120		(17.7 ≤ V_{IN} ≤ 30)	150	mV V
		0° ≤ Tj ≤ +125°C, ΔV_{IN}		(8 ≤ IN ≤ 12)	25		(16 ≤ V_{IN} ≤ 22)	60		(20 ≤ V_{IN} ≤ 26)	75	mV V
ΔV_O Load Regulation	Tj = 25°C	5 mA ≤ I_O ≤ 1.5A		10	50		12	120		12	150	mV
		250 mA ≤ I_O ≤ 750 mA			25			60			75	mV
	5 mA ≤ I_O ≤ 1A, 0°C ≤ Tj ≤ +125°C				50			120			150	mV
I_Q Quiescent Current	I_O ≤ 1A	Tj = 25°C			8			8			8	mA
		0°C ≤ Tj ≤ +125°C			8.5			8.5			8.5	mA
ΔI_Q Quiescent Current Change	5 mA ≤ I_O ≤ 1A				0.5			0.5			0.5	mA
	Tj = 25°C, I_O ≤ 1A, V_{MIN} ≤ V_{IN} ≤ V_{MAX}			(7.5 ≤ V_{IN} ≤ 20)	1.0		(14.8 ≤ V_{IN} ≤ 27)	1.0		(17.9 ≤ V_{IN} ≤ 30)	1.0	mA V
	I_O ≤ 500 mA, 0°C ≤ Tj ≤ +125°C, V_{MIN} ≤ V_{IN} ≤ V_{MAX}			(7 ≤ V_{IN} ≤ 25)	1.0		(14.5 ≤ V_{IN} ≤ 30)	1.0		(17.5 ≤ V_{IN} ≤ 30)	1.0	mA V
Output Noise Voltage	T_A = 25°C, 10 Hz ≤ f ≤ 100 kHz			40			75			90		μV
$\frac{\Delta V_{IN}}{\Delta V_{OUT}}$ Ripple Rejection	f = 120 Hz	I_O ≤ 1A, Tj = 25°C or I_O ≤ 500 mA, 0°C ≤ Tj ≤ +125°C	62	80		55	72		54	70		dB
	V_{MIN} ≤ V_{IN} ≤ V_{MAX}		62 (8 ≤ V_{IN} ≤ 18)			55 (15 ≤ V_{IN} ≤ 25)			54 (18.5 ≤ V_{IN} ≤ 28.5)			dB V
Dropout Voltage	Tj = 25°C, I_{OUT} = 1A			2.0			2.0			2.0		V
Output Resistance	f = 1 kHz			8			18			19		mΩ
Short-Circuit Current	Tj = 25°C			2.1			1.5			1.2		A
Peak Output Current	Tj = 25°C			2.4			2.4			2.4		A
Average TC of V_{OUT}	0°C ≤ Tj ≤ +125°C, I_O = 5 mA			0.6			1.5			1.8		mV/°C
Input Voltage Required to Maintain Line Regulation	Tj = 25°C, I_O ≤ 1A		7.3			14.6			17.7			V

Note 1: Thermal resistance of the TO-3 package (K, KC) is typically 4°C/W junction to case and 35°C/W case to ambient. Thermal resistance of the TO-220 package (T) is typically 4°C/W junction to case and 50°C/W case to ambient.

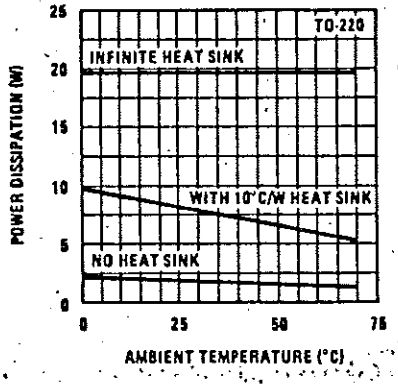
Note 2: All characteristics are measured with capacitor across the input of 0.22 μF, and a capacitor across the output of 0.1 μF. All characteristics except noise voltage and ripple rejection ratio are measured using pulse techniques (t_W ≤ 10 ms, duty cycle ≤ 5%). Output voltage changes due to changes in internal temperature must be taken into account separately.

Typical Performance Characteristics

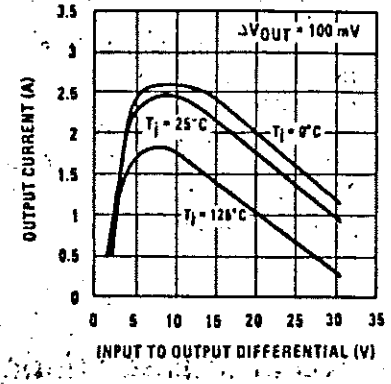
Maximum Average Power Dissipation



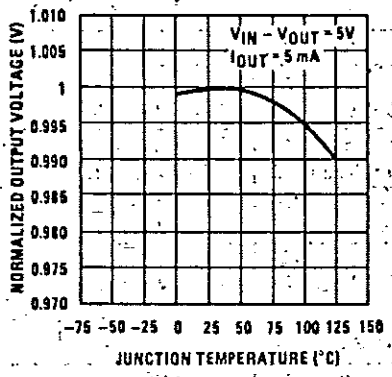
Maximum Average Power Dissipation



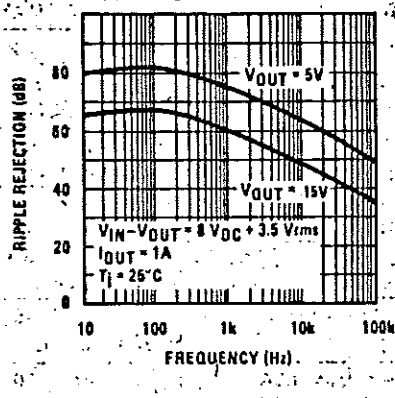
Peak Output Current



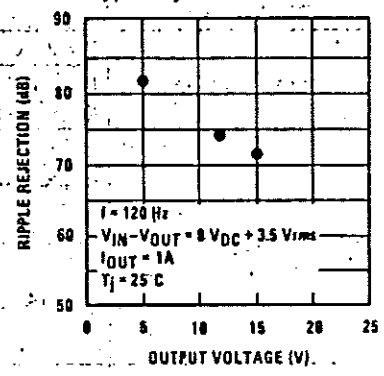
Output Voltage (Normalized to 1V at $T_J = 25°C$)



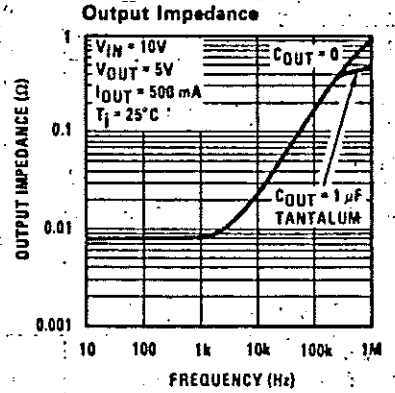
Ripple Rejection



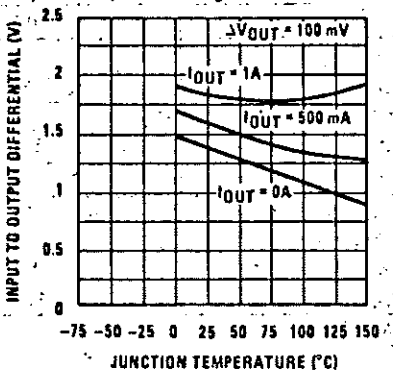
Ripple Rejection



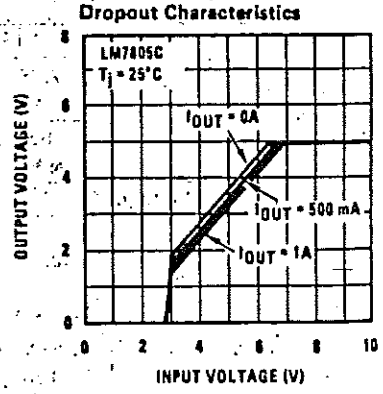
Output Impedance



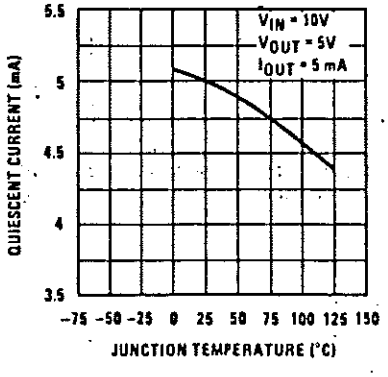
Dropout Voltage



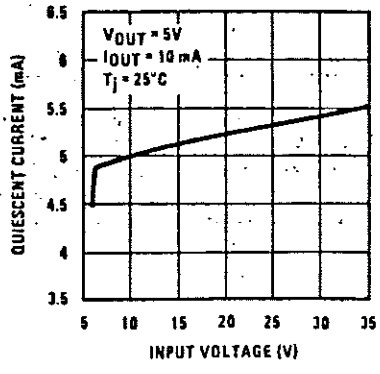
Dropout Characteristics



Quiescent Current



Quiescent Current



LM78LXX Series 3-Terminal Positive Regulators

General Description

The LM78LXX series of three terminal positive regulators is available with several fixed output voltages making them useful in a wide range of applications. When used as a zener diode/resistor combination replacement, the LM78LXX usually results in an effective output impedance improvement of two orders of magnitude, and lower quiescent current. These regulators can provide local on card regulation, eliminating the distribution problems associated with single point regulation. The voltages available allow the LM78LXX to be used in logic systems, instrumentation, HiFi, and other solid state electronic equipment. Although designed primarily as fixed voltage regulators these devices can be used with external components to obtain adjustable voltages and currents.

The LM78LXX is available in the metal three lead TO-39 (H) and the plastic TO-92 (Z). With adequate heat sinking the regulator can deliver 100 mA output current. Current limiting is included to limit the peak output current to a safe value. Safe area protection for the output transistor is provided to limit internal power dissipation. If internal power dissipation becomes too high for the heat sinking provided, the thermal shutdown circuit takes over preventing the IC from overheating.

For applications requiring other voltages, see LM117 data sheet.

Features

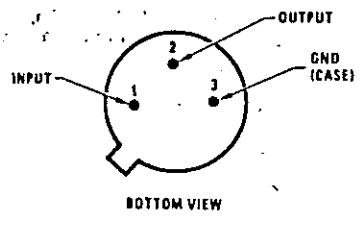
- Output voltage tolerances of ±5% (LM78LXXAC) and ±10% (LM78LXXC) over the temperature range
- Output current of 100 mA
- Internal thermal overload protection
- Output transistor safe area protection
- Internal short circuit current limit
- Available in plastic TO-92 and metal TO-39 low profile packages

Voltage Range

LM78L05	5V
LM78L12	12V
LM78L15	15V

Connection Diagrams

Metal Can Package



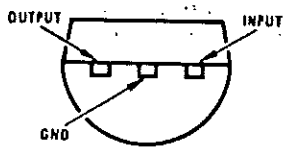
BOTTOM VIEW

Order Numbers:

LM78L05ACH	LM78L05CH
LM78L12ACH	LM78L12CH
LM78L15ACH	LM78L12CH

See NS Package H03A

Plastic Package



BOTTOM VIEW

Order Numbers:

LM78L05ACZ	LM78L05CZ
LM78L12ACZ	LM78L12CZ
LM78L15ACZ	LM78L15CZ

See NS Package Z03A

Absolute Maximum Ratings

Input Voltage	V_O = 5V	30V
	V_O = 12V and 15V	35V
Internal Power Dissipation (Note 1)		Internally Limited
Operating Temperature Range		0°C to +70°C
Maximum Junction Temperature		125°C
Storage Temperature Range		
Metal Can (H Package)		−65°C to +150°C
Molded TO-92 (Z Package)		−55°C to +150°C
Lead Temperature (Soldering, 10 seconds)		300°C

LM78LXXAC Electrical Characteristics (Note 2)

T_J = 0°C to +125°C, I_O = 40 mA, C_{IN} = 0.33μF, C_O = 0.1μF (unless noted)

LM78LXXAC OUTPUT VOLTAGE			5V			12V			15V			UNITS
INPUT VOLTAGE (unless otherwise noted)			10V			19V			23V			
PARAMETER		CONDITIONS	MIN	TYP	MAX	MIN	TYP	MAX	MIN	TYP	MAX	
V_O	Output Voltage (Note 4)	T_J = 25°C	4.8	5	5.2	11.5	12	12.5	14.4	15	15.6	V
		1 mA ≤ I_O ≤ 70 mA	4.75		5.25	11.4		12.6	14.25		15.75	V
		1 mA ≤ I_O ≤ 40 mA and V_{MIN} ≤ V_{IN} ≤ V_{MAX}	4.75		5.25 (7 ≤ V_{IN} ≤ 20)	11.4		12.6 (14.5 ≤ V_{IN} ≤ 27)	14.25		15.75 (17.5 ≤ V_{IN} ≤ 30)	V
ΔV_O	Line Regulation	T_J = 25°C		10	54 (8 ≤ V_{IN} ≤ 20)		20	110 (16 ≤ V_{IN} ≤ 27)		25	140 (20 ≤ V_{IN} ≤ 30)	mV V
				18	75 (7 ≤ V_{IN} ≤ 20)		30	180 (14.5 ≤ V_{IN} ≤ 27)		37	250 (17.5 ≤ V_{IN} ≤ 30)	mV V
ΔV_O	Load Regulation	T_J = 25°C, 1 mA ≤ I_O ≤ 40 mA		5	30		10	50		12	75	mV
		T_J = 25°C, 1 mA ≤ I_O ≤ 100 mA		20	60		30	100		35	150	mV
ΔV_O	Long Term Stability			12			24			30		mV/1000 hrs
I_Q	Quiescent Current	T_J = 25°C		3	5		3	5		3.1	5	mA
		T_J = 125°C			4.7			4.7			4.7	
ΔI_Q	Quiescent Current Change	1 mA ≤ I_O ≤ 40 mA			0.1			0.1			0.1	mA
		V_{MIN} ≤ V_{IN} ≤ V_{MAX}			1.0 (8 ≤ V_{IN} ≤ 20)			1.0 (16 ≤ V_{IN} ≤ 27)			1.0 (20 ≤ V_{IN} ≤ 30)	mA V
V_n	Output Noise Voltage	T_J = 25°C, (Note 3) f = 10 Hz – 10 kHz		40			80			90		μV
$\frac{\Delta V_{IN}}{\Delta V_{OUT}}$	Ripple Rejection	f = 120 Hz	47	62	(8 ≤ V_{IN} ≤ 16)	40	54	(15 ≤ V_{IN} ≤ 25)	37	51	(18.5 ≤ V_{IN} ≤ 28.5)	dB V
	Input Voltage Required to Maintain Line Regulation	T_J = 25°C	7			14.5			17.5			V

Note 1: Thermal resistance of the Metal Can Package (H) without a heat sink is 15°C/W junction to case and 140°C/W junction to ambient. Thermal resistance of the TO-92 package is 180°C/W junction to ambient with 0.4" leads from a PC board and 160°C/W junction to ambient with 0.125" lead length to a PC board.

Note 2: The maximum steady state usable output current and input voltage are very dependent on the heat sinking and/or lead length of the package. The data above represent pulse test conditions with junction temperatures as indicated at the initiation of test.

Note 3: Recommended minimum load capacitance of 0.01μF to limit high frequency noise bandwidth.

Note 4: The temperature coefficient of V_{OUT} is typically within ±0.01% V_O/°C.

bsolute Maximum Ratings

.: Voltage	V_O = 5V	30V
	V_O = 12V and 15V	35V
rnal Power Dissipation (Note 1)		Internally Limited
rating Temperature Range		0°C to +70°C
mum Junction Temperature		125°C
age Temperature Range		
Metal Can (H Package)		−65°C to +150°C
Molded TO-92		−55°C to +150°C
d Temperature (Soldering, 10 seconds)		300°C

M78LXXC Electrical Characteristics (Note 2)

0°C to +125°C, I_O = 40 mA, C_{IN} = 0.33μF, C_O = 0.1μF (unless noted)

LM78LXXC OUTPUT VOLTAGE			5V			12V			15V			UNITS
INPUT VOLTAGE (unless otherwise noted)			10V			19V			23V			
	PARAMETER	CONDITIONS	MIN	TYP	MAX	MIN	TYP	MAX	MIN	TYP	MAX	
V_O	Output Voltage (Note 4)	T_J = 25°C	4.6	5	5.4	11.1	12	12.9	13.8	15	16.2	V
		1 mA ≤ I_O ≤ 70 mA or	4.5		5.5	10.8		13.2	13.5		16.5	V
		1 mA ≤ I_O ≤ 40 mA and ΔV_{IN}	(7 ≤ V_{IN} ≤ 20)			(14.5 ≤ V_{IN} ≤ 27)			(18 ≤ V_{IN} ≤ 30)			V
ΔV_O	Line Regulation	T_J = 25°C		10	150		20	200		25	250	mV
			(8 ≤ V_{IN} ≤ 20)			(16 ≤ V_{IN} ≤ 27)			(20 ≤ V_{IN} ≤ 30)			V
				18	200		30	250		30	300	mV
			(7 ≤ V_{IN} ≤ 20)			(14.5 ≤ V_{IN} ≤ 27)			(18 ≤ V_{IN} ≤ 30)			V
ΔV_O	Load Regulation	T_J = 25°C, 1 mA ≤ I_O ≤ 40 mA		5	30		10	50		12	75	mV
		T_J = 25°C, 1 mA ≤ I_O ≤ 100 mA		20	60		30	100		35	150	mV
ΔV_O	Long Term Stability			12			24			30		mV/1000 hrs
I_Q	Quiescent Current	T_J = 25°C		3	6		3	6.5		3.1	6.5	mA
		T_J = 125°C			5.5			6			6	
ΔI_Q	Quiescent Current	T_J = 25°C, 1 mA ≤ I_O ≤ 40 mA			0.2			0.2			0.2	mA
	Change				1.5			1.5			1.5	mA
		T_J = 25°C	(8 ≤ V_{IN} ≤ 20)			(16 ≤ V_{IN} ≤ 27)			(20 ≤ V_{IN} ≤ 30)			V
V_n	Output Noise Voltage	T_J = 25°C, (Note 3)		40			80			90		μV
		f = 10 Hz – 10 kHz										
$\frac{\Delta V_{IN}}{\Delta V_{OUT}}$	Ripple Rejection	f = 125 Hz	40	60		36	52		33	49		dB
			(8 ≤ V_{IN} ≤ 18)			(15 ≤ V_{IN} ≤ 25)			(18.5 ≤ V_{IN} ≤ 28.5)			V
	Input Voltage Required to Maintain Line Regulation	T_J = 25°C		7			14.5			18		V

e 1: Thermal resistance of the Metal Can Package (H) without a heat sink is 15°C/W junction to case and 140°C/W junction to am-
nt. Thermal resistance of the TO-92 package is 180°C/W junction to ambient with 0.4" leads from a PC board and 160°C/W junction
mbient with 0.125" lead length to a PC board.

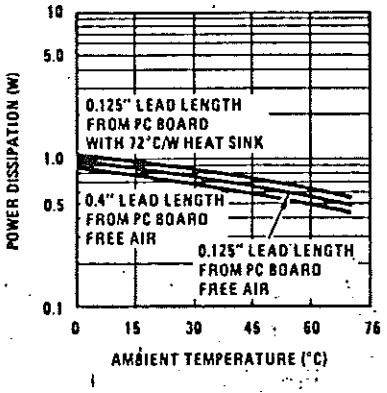
e 2: The maximum steady state usable output current and input voltage are very dependent on the heat sinking and/or lead length
he package. The data above represent pulse test conditions with junction temperatures as indicated at the initiation of test.

e 3: Recommended minimum load capacitance of 0.01μF to limit high frequency noise bandwidth.

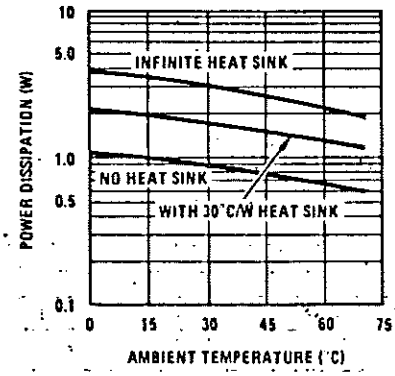
e 4: The temperature coefficient of V_{OUT} is typically within ±0.01% V_O/°C.

Typical Performance Characteristics

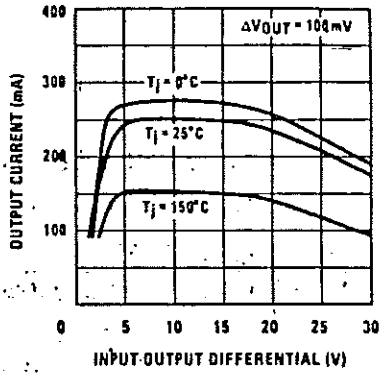
Maximum Average Power Dissipation (Plastic Package)



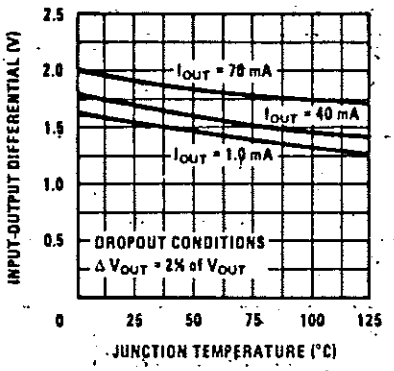
Maximum Average Power Dissipation (Metal Can Package)



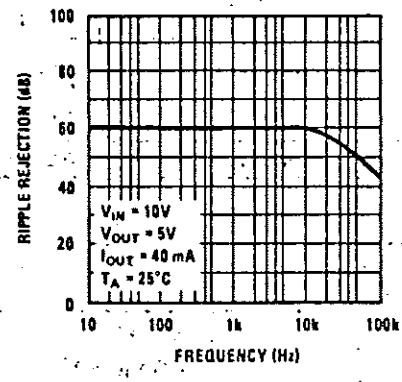
Peak Output Current



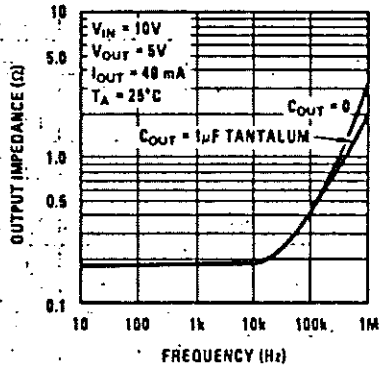
Dropout Voltage



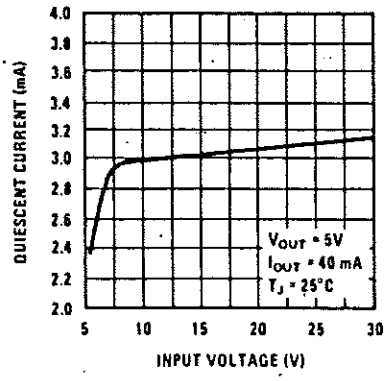
Ripple Rejection



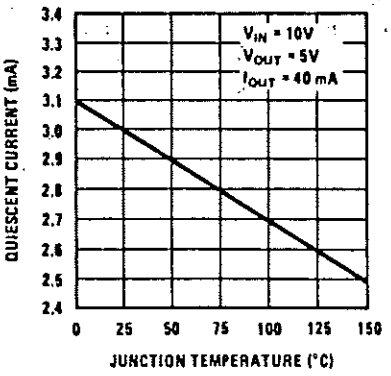
Output Impedance



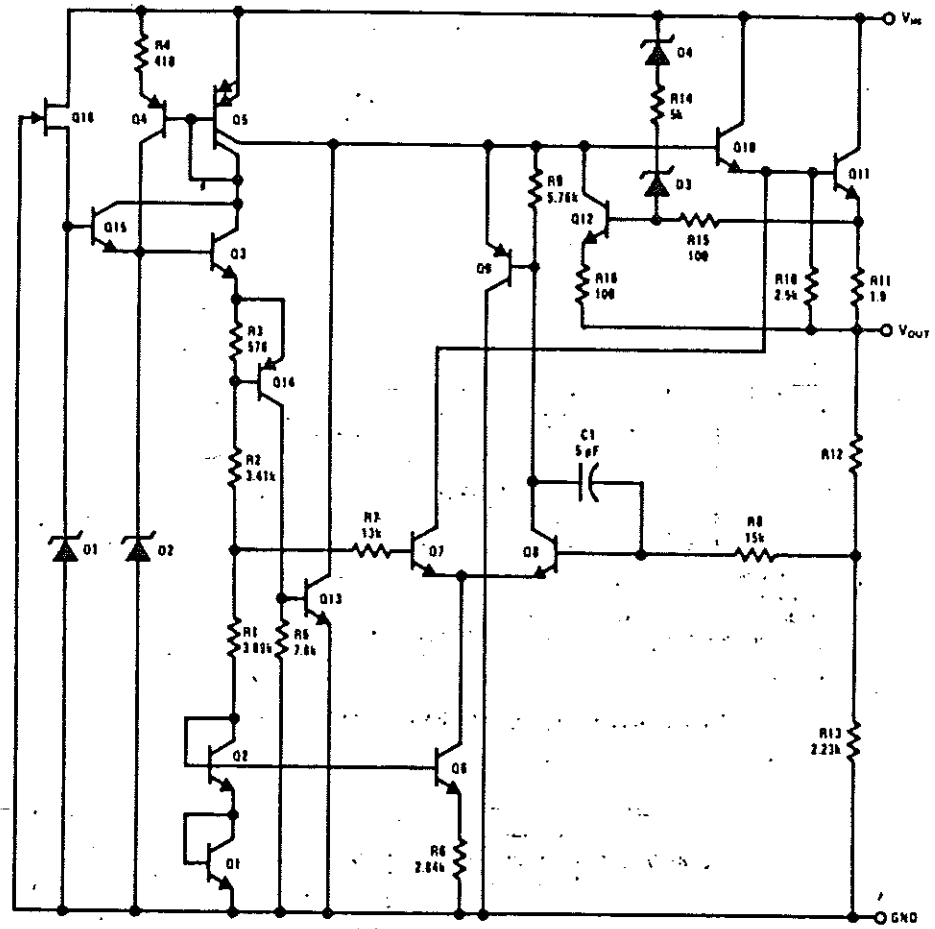
Quiescent Current



Quiescent Current

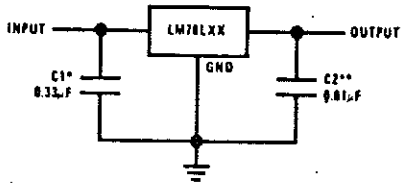


Equivalent Circuit



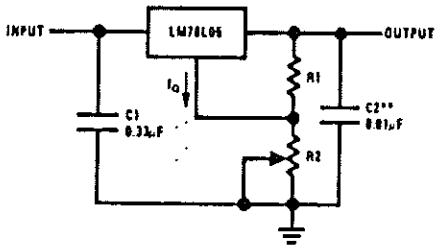
LM78LXX

Typical Applications



*Required if the regulator is located far from the power supply filter.
**See Note 3 in the electrical characteristics table.

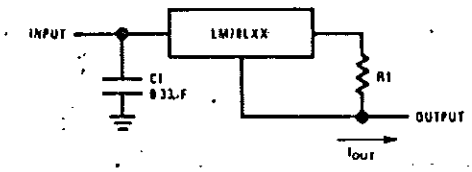
Fixed Output Regulator



$V_{OUT} = 5V + (5V/R1 + I_Q)\,R2$
$5V/R1 > 3\,I_Q$, load regulation $(L_r) \approx [(R1 + R2)/R1]$ (L_r of LM78L05)

Adjustable Output Regulator

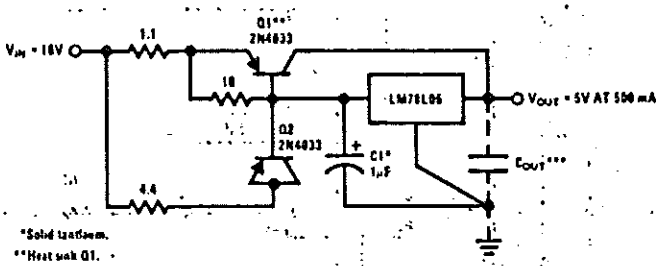
Typical Applications (Continued)



$I_{OUT} = (V_{23}/R1) + I_Q$

$\Delta I_Q = 1.5$ mA over line and load changes

Current Regulator



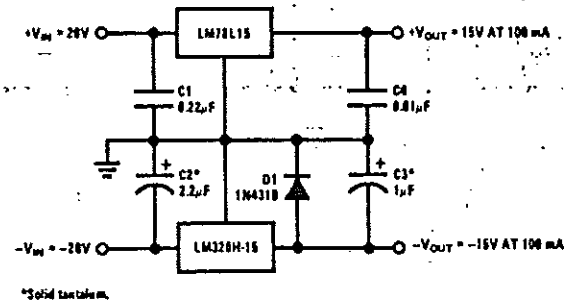
*Solid tantalum.

**Heat sink Q1.

***Optional: Improves ripple rejection and transient response.

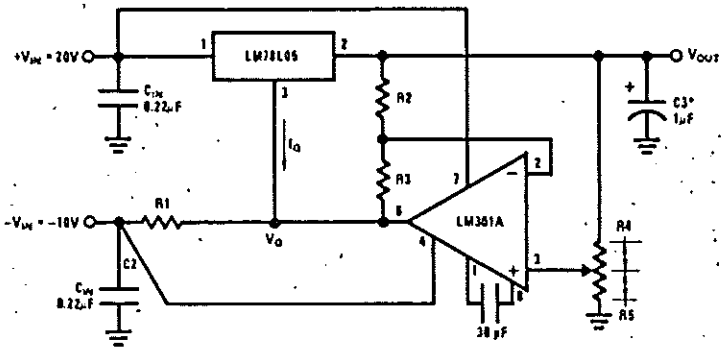
Load Regulation: $0.5\% \le I_L \le 250$ mA pulsed with $t_{ON} = 50$ ms.

5V, 500 mA Regulator with Short Circuit Protection



*Solid tantalum.

±15V, 100 mA Dual Power Supply



*Solid tantalum.

$V_{OUT} = V_O + 5V$, $R1 = (-V_{IN}/I_{Q\,LM78L05})$

$V_{OUT} = 5V\,(R2/R4)$ for $(R2 + R3) = (R4 + R5)$

A 0.5V output will correspond to $(R2/R4) = 0.1$, $(R3/R4) = 0.9$

Variable Output Regulator 0.5V – 18V

National Semiconductor

Voltage Regulators

LM117/LM217/LM317 3-Terminal Adjustable Regulator

General Description

The LM117/LM217/LM317 are adjustable 3-terminal positive voltage regulators capable of supplying in excess of 1.5A over a 1.2V to 37V output range. They are exceptionally easy to use and require only two external resistors to set the output voltage. Further, both line and load regulation are better than standard fixed regulators. Also, the LM117 is packaged in standard transistor packages which are easily mounted and handled.

In addition to higher performance than fixed regulators, the LM117 series offers full overload protection available only in IC's. Included on the chip are current limit, thermal overload protection and safe area protection. All overload protection circuitry remains fully functional even if the adjustment terminal is disconnected.

Besides replacing fixed regulators, the LM117 is useful in a wide variety of other applications. Since the regulator is "floating" and sees only the input-to-output differential voltage, supplies of several hundred volts can be regulated as long as the maximum input to output differential is not exceeded.

Also, it makes an especially simple adjustable switching regulator, a programmable output regulator, or by connecting a fixed resistor between the adjustment and output, the LM117 can be used as a precision current regulator. Supplies with electronic shutdown can be achieved by clamping the adjustment terminal to ground which programs the output to 1.2V where most loads draw little current.

The LM117K, LM217K and LM317K are packaged in standard TO-3 transistor packages while the LM117H, LM217H and LM317H are packaged in a solid Kovar base TO-5 transistor package. The LM117 is rated for operation from −55°C to +150°C, the LM217 from −25°C to +150°C and the LM317 from 0°C to +125°C. The LM317T and LM317MP, rated for operation over a 0°C to +125°C range, are available in a TO-220 plastic package and a TO-202 package, respectively.

For applications requiring greater output current in excess of 3A and 5A, see LM150 series and LM138 series data sheets, respectively. For the negative complement, see LM137 series data sheet.

Features

- Adjustable output down to 1.2V
- Guaranteed 1.5A output current
- Line regulation typically 0.01%/V
- Load regulation typically 0.1%
- Current limit constant with temperature
- 100% electrical burn-in
- Eliminates the need to stock many voltages
- Standard 3-lead transistor package
- 80 dB ripple rejection

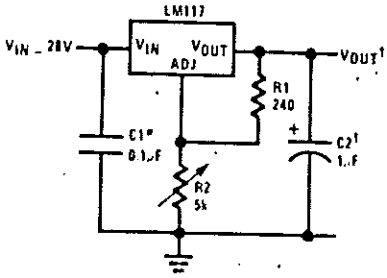
Normally, no capacitors are needed unless the device is situated far from the input filter capacitors in which case an input bypass is needed. An optional output capacitor can be added to improve transient response. The adjustment terminal can be bypassed to achieve very high ripple rejections ratios which are difficult to achieve with standard 3-terminal regulators.

LM117 Series Packages and Power Capability

DEVICE	PACKAGE	RATED POWER DISSIPATION	DESIGN LOAD CURRENT
LM117	TO-3	20W	1.5A
LM217 LM317	TO-39	2W	0.5A
LM317T	TO-220	15W	1.5A
LM317M	TO-202	7.5W	0.5A

Typical Applications

1.2V–25V Adjustable Regulator

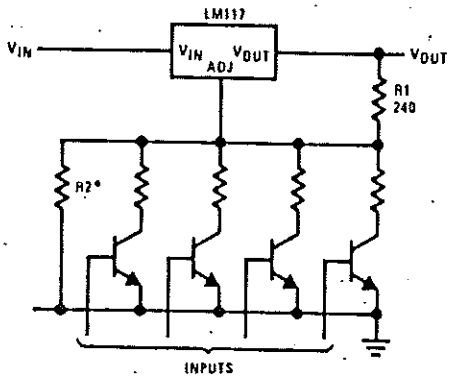


†Optional—improves transient response

*Needed if device is far from filter capacitors

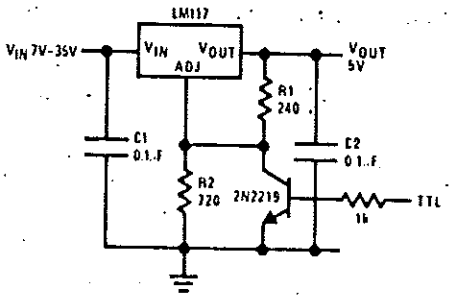
††$V_{OUT} = 1.25V \left(1 + \frac{R2}{R1}\right)$

Digitally Selected Outputs



*Sets maximum V_{OUT}

5V Logic Regulator with Electronic Shutdown*



* Min output ≈ 1.2V

Absolute Maximum Ratings

Power Dissipation	Internally limited
Input–Output Voltage Differential	40V
Operating Junction Temperature Range	
LM117	−55°C to +150°C
LM217	−25°C to +150°C
LM317	0°C to +125°C
Storage Temperature	−65°C to +150°C
Lead Temperature (Soldering, 10 seconds)	300°C

Preconditioning

Burn-In in Thermal Limit	100% All Devices

Electrical Characteristics (Note 1)

PARAMETER	CONDITIONS	LM117/217			LM317			UNIT
		MIN	TYP	MAX	MIN	TYP	MAX	
Line Regulation	$T_A = 25°C$, $3V \le V_{IN} - V_{OUT} \le 40V$ (Note 2)		0.01	0.02		0.01	0.04	%/V
Load Regulation	$T_A = 25°C$, $10\ mA \le I_{OUT} \le I_{MAX}$							
	$V_{OUT} \le 5V$, (Note 2)		5	15		5	25	mV
	$V_{OUT} \ge 5V$, (Note 2)		0.1	0.3		0.1	0.5	%
Thermal Regulation	$T_A = 25°C$, 20 ms Pulse		0.03	0.07		0.04	0.07	%/W
Adjustment Pin Current			50	100		50	100	μA
Adjustment Pin Current Change	$10\ mA \le I_L \le I_{MAX}$ $2.5V \le (V_{IN}-V_{OUT}) \le 40V$		0.2	5		0.2	5	μA
Reference Voltage	$3 \le (V_{IN}-V_{OUT}) \le 40V$, (Note 3) $10\ mA \le I_{OUT} \le I_{MAX}$, $P \le P_{MAX}$	1.20	1.25	1.30	1.20	1.25	1.30	V
Line Regulation	$3V \le V_{IN} - V_{OUT} \le 40V$, (Note 2)		0.02	0.05		0.02	0.07	%/V
Load Regulation	$10\ mA \le I_{OUT} \le I_{MAX}$, (Note 2)							
	$V_{OUT} \le 5V$		20	50		20	70	mV
	$V_{OUT} \ge 5V$		0.3	1		0.3	1.5	%
Temperature Stability	$T_{MIN} \le T_j \le T_{MAX}$		1			1		%
Minimum Load Current	$V_{IN}-V_{OUT} = 40V$		3.5	5		3.5	10	mA
Current Limit	$V_{IN}-V_{OUT} \le 15V$							
	K and T Package	1.5	2.2		1.5	2.2		A
	H and P Package	0.5	0.8		0.5	0.8		A
	$V_{IN}-V_{OUT} = 40V$, $T_j = +25°C$							
	K and T Package	0.30	0.4		0.15	0.4		A
	H and P Package	0.15	0.20		0.075	0.20		A
RMS Output Noise, % of V_{OUT}	$T_A = 25°C$, $10\ Hz \le f \le 10\ kHz$		0.003			0.003		%
Ripple Rejection Ratio	$V_{OUT} = 10V$, $f = 120\ Hz$		65			65		dB
	$C_{ADJ} = 10\mu F$	66	80		66	80		dB
Long-Term Stability	$T_A = 125°C$		0.3	1		0.3	1	%
Thermal Resistance, Junction to Case	H Package		12	15		12	15	°C/W
	K Package		2.3	3		2.3	3	°C/W
	T Package					4		°C/W
	P Package					12		°C/W

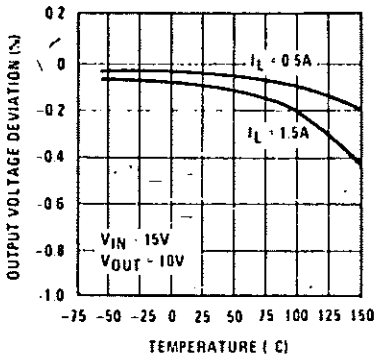
Note 1: Unless otherwise specified, these specifications apply: $-55°C \le T_j \le +150°C$ for the LM117, $-25°C \le T_j \le +150°C$ for the LM217 and $0°C \le T_j \le +125°C$ for the LM317; $V_{IN}-V_{OUT} = 5V$ and $I_{OUT} = 0.1A$ for the TO-5 and TO-202 packages and $I_{OUT} = 0.5A$ for the TO-3 package and TO-220 package. Although power dissipation is internally limited, these specifications are applicable for power dissipations of 2W for the TO-5 and TO-202 and 20W for the TO-3 and TO-220. I_{MAX} is 1.5A for the TO-3 and TO-220 package and 0.5A for the TO-5 and TO-202 package.

Note 2: Regulation is measured at constant junction temperature, using pulse testing with a low duty cycle. Changes in output voltage due to heating effects are covered under the specification for thermal regulation.

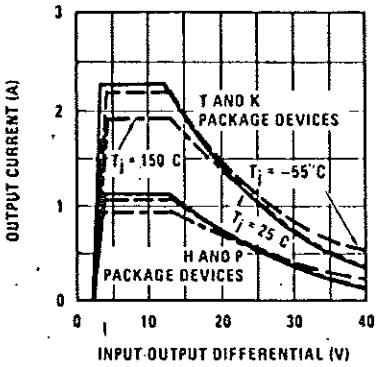
Note 3: Selected devices with tightend tolerance reference voltage available.

Typical Performance Characteristics

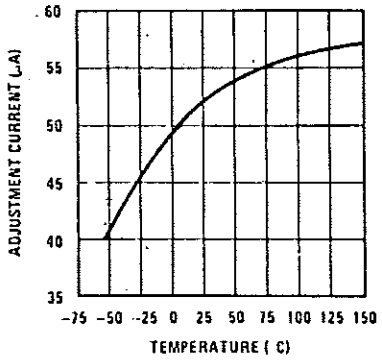
Load Regulation



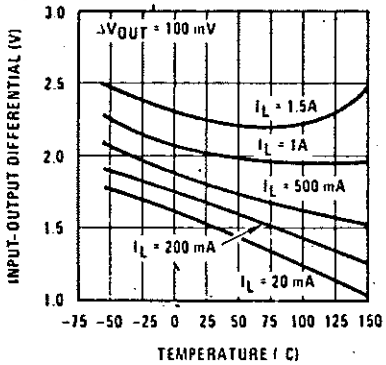
Current Limit



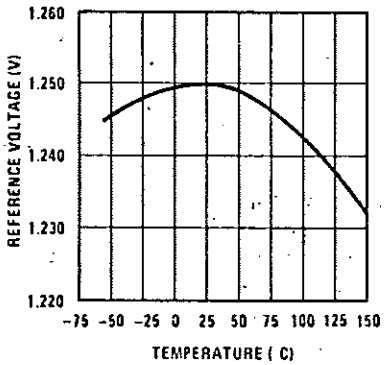
Adjustment Current



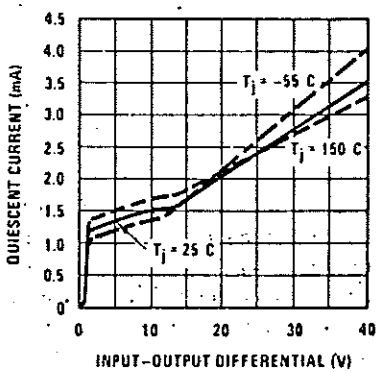
Dropout Voltage



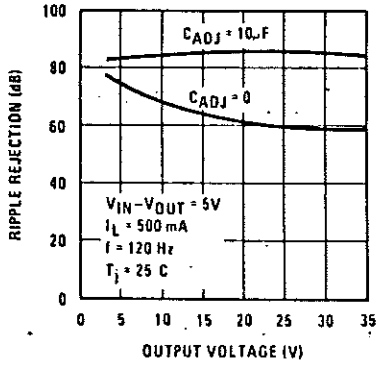
Temperature Stability



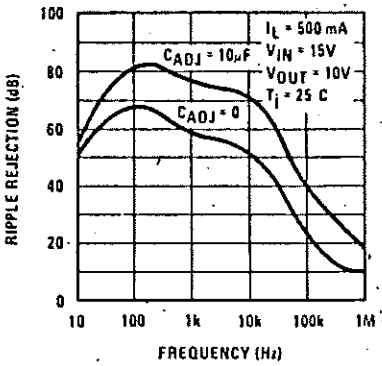
Minimum Operating Current



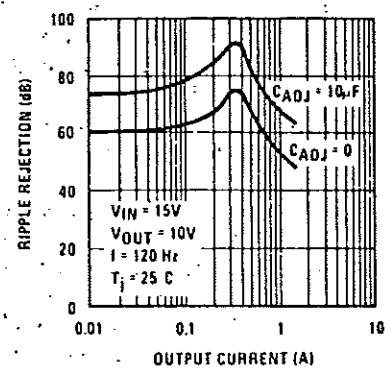
Ripple Rejection



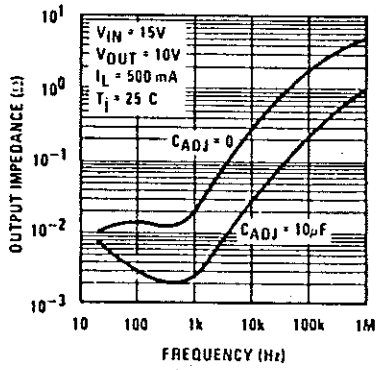
Ripple Rejection



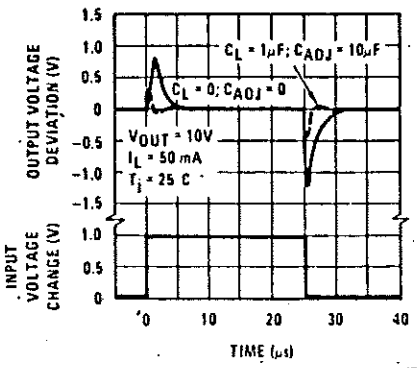
Ripple Rejection



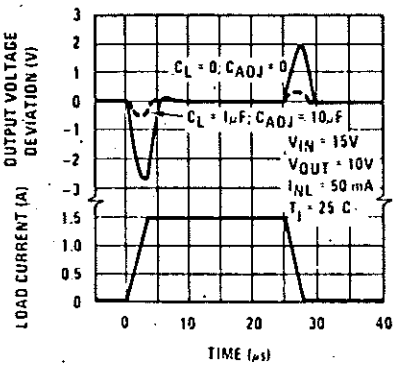
Output Impedance



Line Transient Response



Load Transient Response



Application Hints

In operation, the LM117 develops a nominal 1.25V reference voltage, V_{REF}, between the output and adjustment terminal. The reference voltage is impressed across program resistor R1 and, since the voltage is constant, a constant current I_1 then flows through the output set resistor R2, giving an output voltage of

$$V_{OUT} = V_{REF}\left(1 + \frac{R2}{R1}\right) + I_{ADJ}R2$$

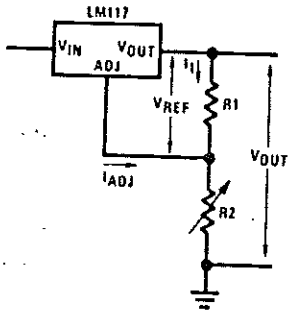


FIGURE 1.

Since the 100μA current from the adjustment terminal represents an error term, the LM117 was designed to minimize I_{ADJ} and make it very constant with line and load changes. To do this, all quiescent operating current is returned to the output establishing a minimum load current requirement. If there is insufficient load on the output, the output will rise.

External Capacitors

An input bypass capacitor is recommended. A 0.1μF disc or 1μF solid tantalum on the input is suitable input bypassing for almost all applications. The device is more sensitive to the absence of input bypassing when adjustment or output capacitors are used but the above values will eliminate the possibility of problems.

The adjustment terminal can be bypassed to ground on the LM117 to improve ripple rejection. This bypass capacitor prevents ripple from being amplified as the output voltage is increased. With a 10μF bypass capacitor 80 dB ripple rejection is obtainable at any output level. Increases over 10μF do not appreciably improve the ripple rejection at frequencies above 120 Hz. If the bypass capacitor is used, it is sometimes necessary to include protection diodes to prevent the capacitor from discharging through internal low current paths and damaging the device.

In general, the best type of capacitors to use are solid tantalum. Solid tantalum capacitors have low impedance even at high frequencies. Depending upon capacitor construction, it takes about 25μF in aluminum electrolytic to equal 1μF solid tantalum at high frequencies. Ceramic capacitors are also good at high frequencies; but some types have a large decrease in capacitance at frequencies around 0.5 MHz. For this reason, 0.01μF disc may seem to work better than a 0.1μF disc as a bypass.

Although the LM117 is stable with no output capacitors, like any feedback circuit, certain values of external capacitance can cause excessive ringing. This occurs with values between 500 pF and 5000 pF. A 1μF solid tantalum (or 25μF aluminum electrolytic) on the output swamps this effect and insures stability.

Load Regulation

The LM117 is capable of providing extremely good load regulation but a few precautions are needed to obtain maximum performance. The current set resistor connected between the adjustment terminal and the output terminal (usually 240Ω) should be tied directly to the output of the regulator rather than near the load. This eliminates line drops from appearing effectvely in series with the reference and degrading regulation. For example, a 15V regulator with 0.05Ω resistance between the regulator and load will have a load regulation due to line resistance of 0.05Ω x I_L. If the set resistor is connected near the load the effective line resistance will be 0.05Ω (1 + R2/R1) or in this case, 11.5 times worse.

Figure 2 shows the effect of resistance between the regulator and 240Ω set resistor.

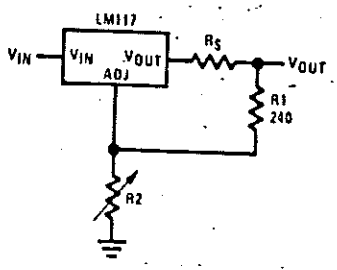


FIGURE 2. Regulator with Line Resistance in Output Lead

With the TO-3 package, it is easy to minimize the resistance from the case to the set resistor, by using two separate leads to the case. However, with the TO-5 package, care should be taken to minimize the wire length of the output lead. The ground of R2 can be returned near the ground of the load to provide remote ground sensing and improve load regulation.

Protection Diodes

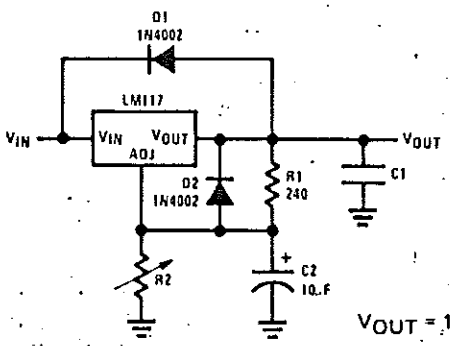
When external capacitors are used with *any* IC regulator it is sometimes necessary to add protection diodes to prevent the capacitors from discharging through low current points into the regulator. Most 10μF capacitors have low enough internal series resistance to deliver 20A spikes when shorted. Although the surge is short, there is enough energy to damage parts of the IC.

When an output capacitor is connected to a regulator and the input is shorted, the output capacitor will discharge into the output of the regulator. The discharge

Application Hints (Continued)

current depends on the value of the capacitor, the output voltage of the regulator, and the rate of decrease of V_{IN}. In the LM117, this discharge path is through a large junction that is able to sustain 15A surge with no problem. This is not true of other types of positive regulators. For output capacitors of 25μF or less, there is no need to use diodes.

The bypass capacitor on the adjustment terminal can discharge through a low current junction. Discharge occurs when *either* the input or output is shorted. Internal to the LM117 is a 50Ω resistor which limits the peak discharge current. No protection is needed for output voltages of 25V or less and 10μF capacitance. *Figure 3* shows an LM117 with protection diodes included for use with outputs greater than 25V and high values of output capacitance.



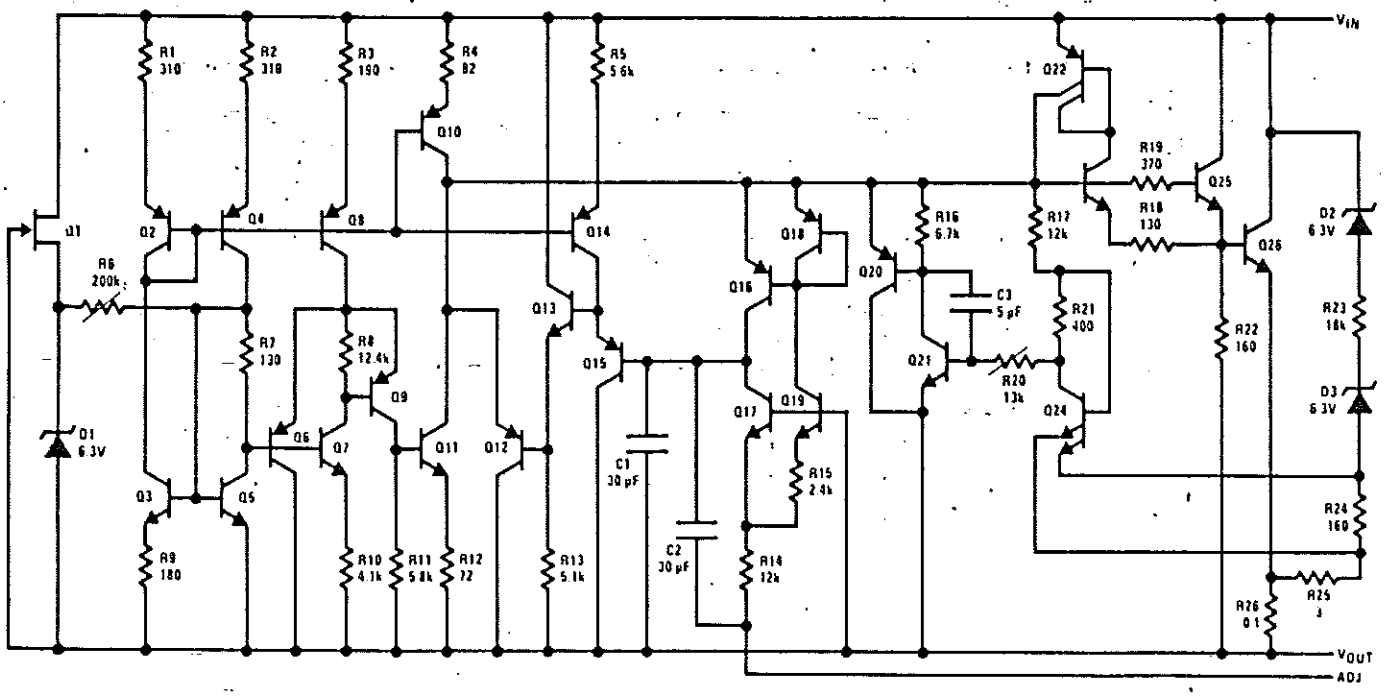
$$V_{OUT} = 1.25V \left(1 + \frac{R2}{R1}\right) + R2 I_{ADJ}$$

D1 protects against C1

D2 protects against C2

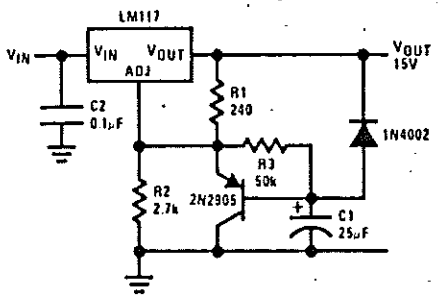
FIGURE 3. Regulator with Protection Diodes

Schematic Diagram

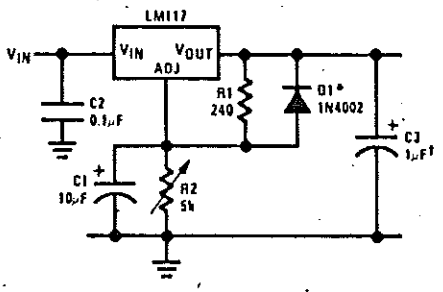


Typical Applications (Continued)

Slow Turn-On 15V Regulator



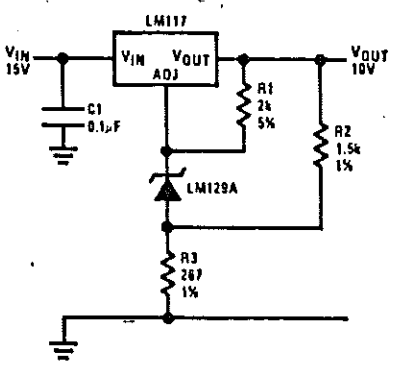
Adjustable Regulator with Improved Ripple Rejection



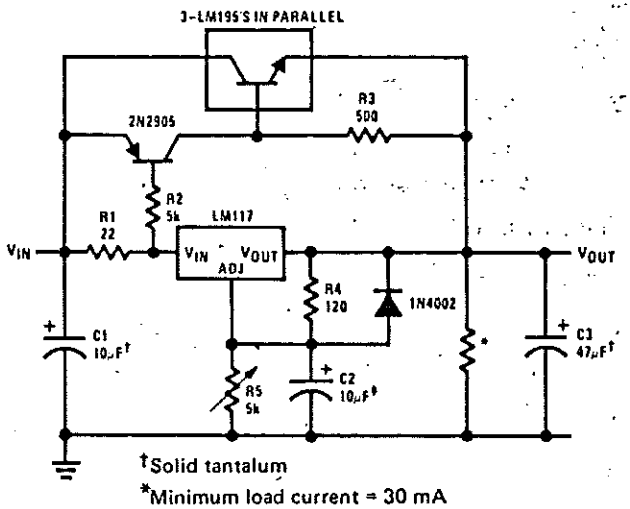
†Solid tantalum

*Discharges C1 if output is shorted to ground

High Stability 10V Regulator



High Current Adjustable Regulator

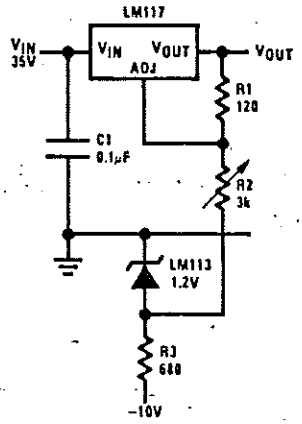


†Solid tantalum

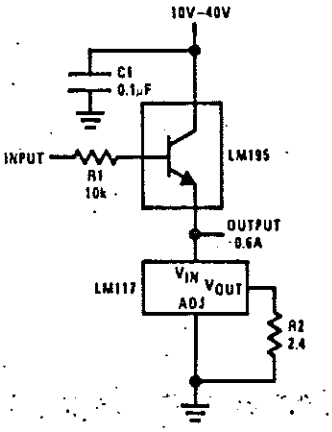
*Minimum load current = 30 mA

‡Optional—improves ripple rejection

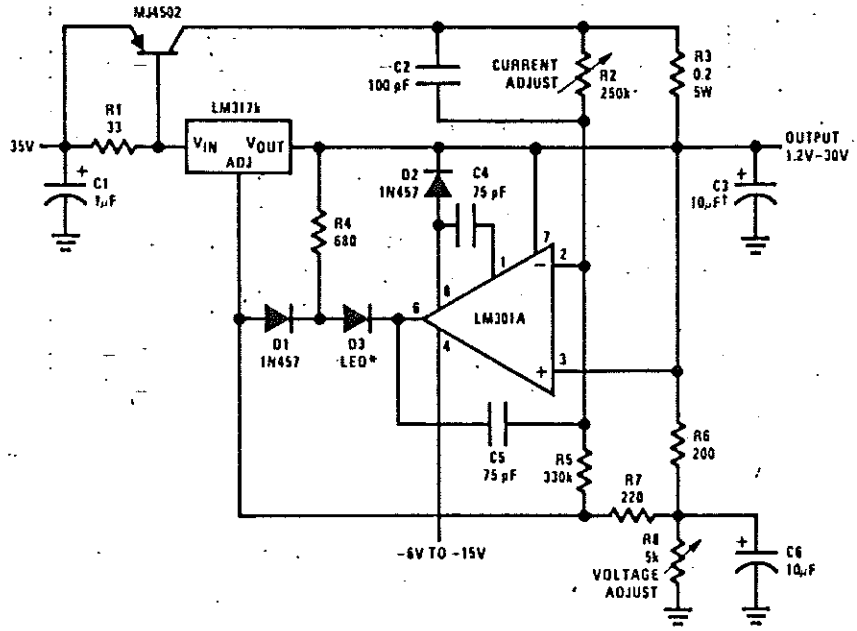
0 to 30V Regulator



Power Follower



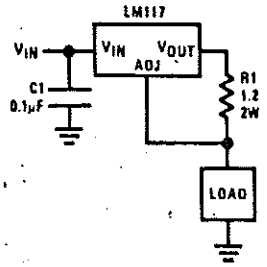
5A Constant Voltage/Constant Current Regulator



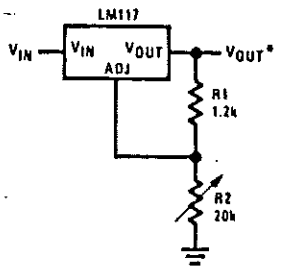
†Solid tantalum

*Lights in constant current mode

1A Current Regulator



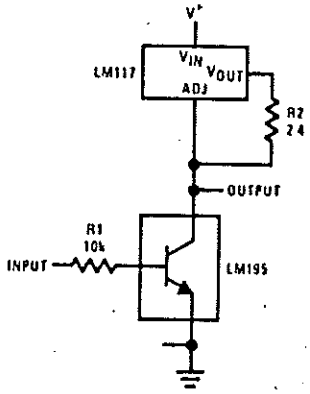
1.2V–20V Regulator with Minimum Program Current



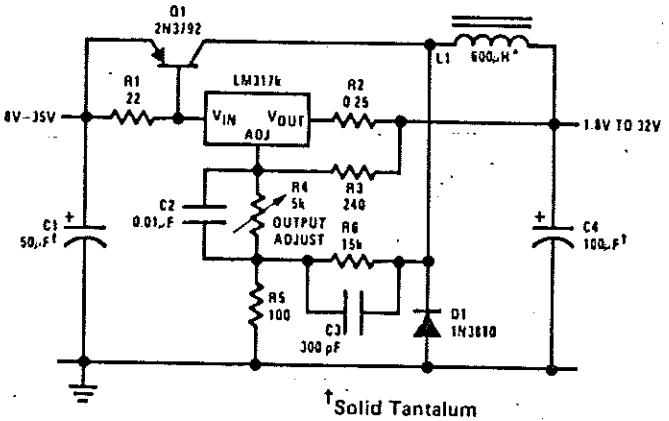
*Minimum load current ≈ 4 mA

Typical Applications (Continued)

High Gain Amplifier



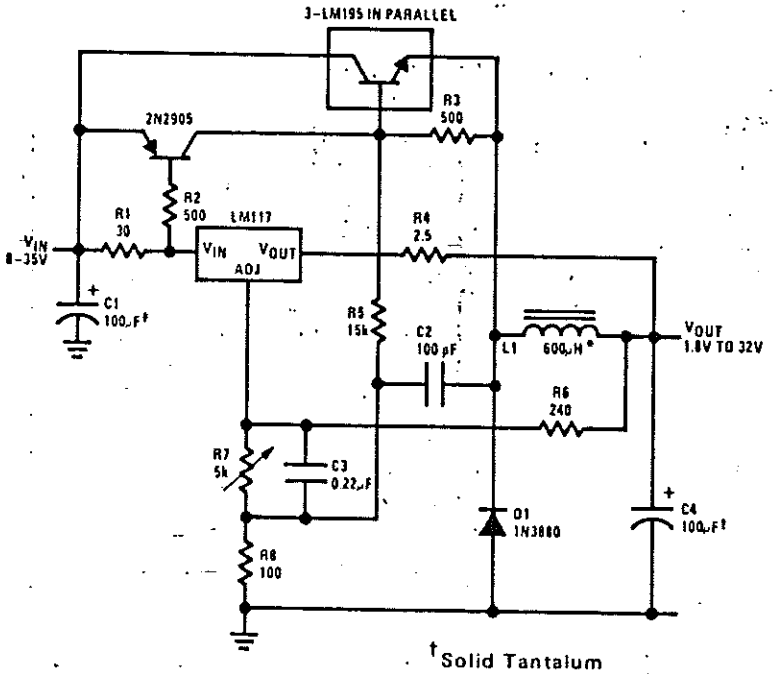
Low Cost 3A Switching Regulator



†Solid Tantalum

*Core–Arnold A-254168-2 60 turns

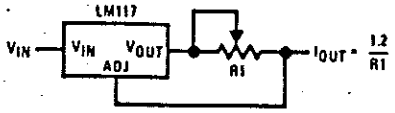
4A Switching Regulator with Overload Protection



†Solid Tantalum

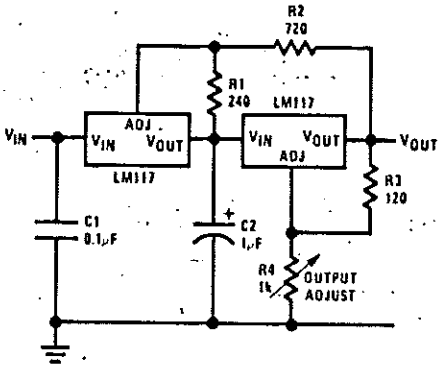
*Core Arnold A-254168-2 60 turns

Precision Current Limiter

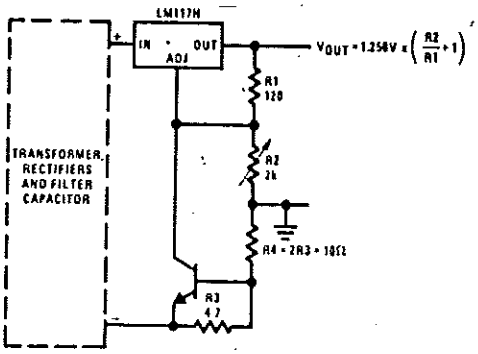


*0.8Ω ≤ R1 ≤ 120Ω

Tracking Preregulator

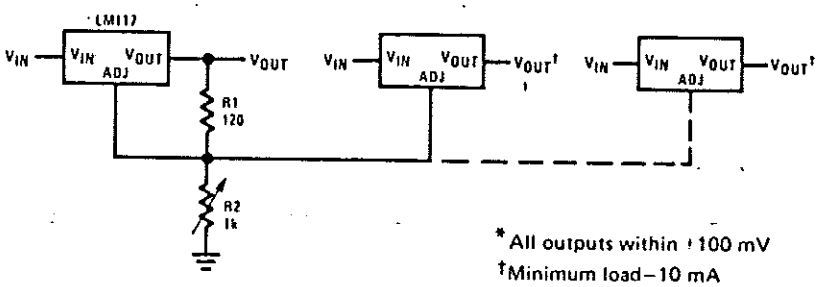


Adjustable Regulator with Current Limiter



Short circuit current is approximately 600 mV/R3, or 120 mA (compared to LM117H's 1 ampere current limit)
At 50 mA output only 3/4V of drop occurs in R3 and R4

Adjusting Multiple On-Card Regulators with Single Control*

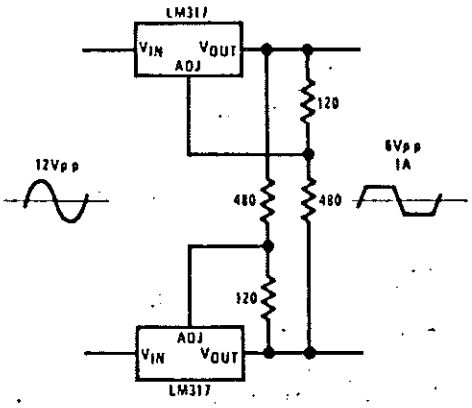


*All outputs within ±100 mV

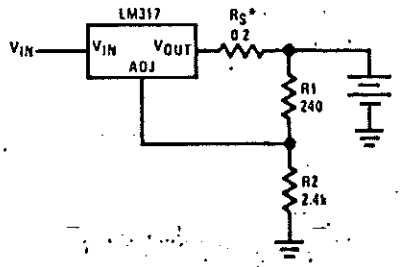
†Minimum load–10 mA

Typical Applications (Continued)

AC Voltage Regulator

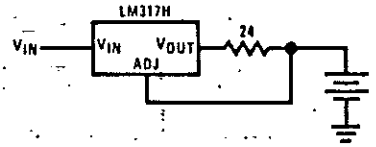


12V Battery Charger

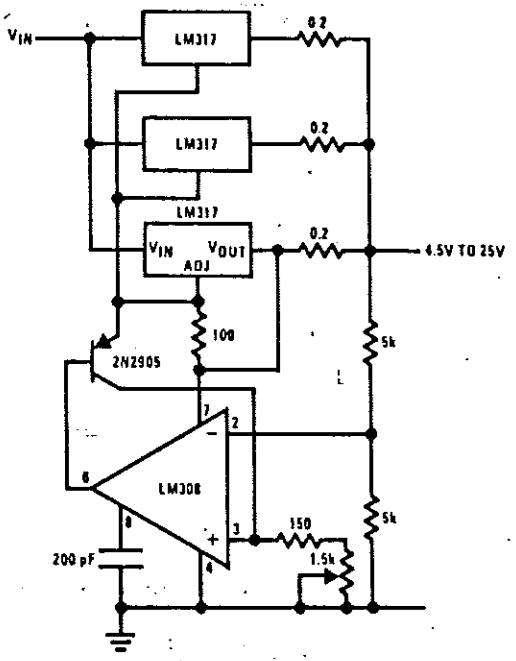


*RS—sets output impedance of charger $Z_{OUT} = R_S\left(1+\frac{R2}{R1}\right)$
Use of RS allows low charging rates with fully charged battery.

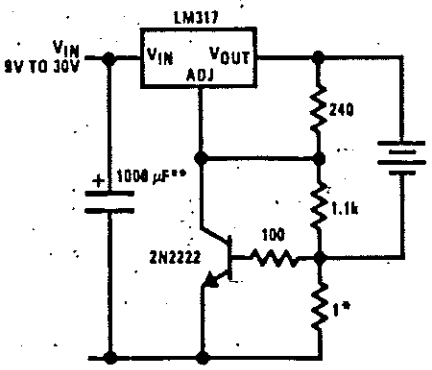
50 mA Constant Current Battery Charger



Adjustable 4A Regulator



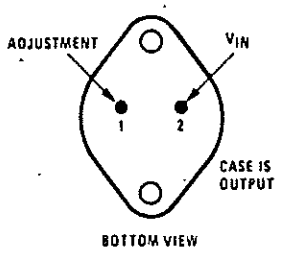
Current Limited 6V Charger



*Sets peak current (0.6A for 1Ω)
**1000 µF is recommended to filter out any input transients.

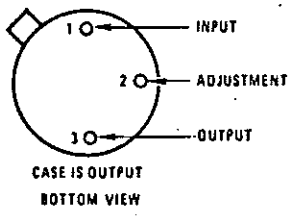
Connection Diagrams

(TO-3 Steel)
Metal Can Package



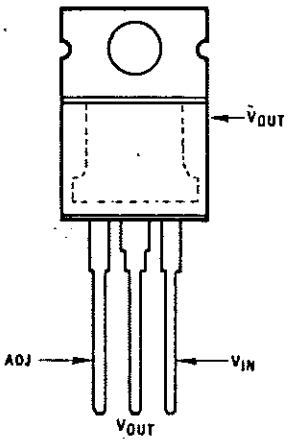
Order Number:
LM117K STEEL
LM217K STEEL
LM317K STEEL
See NS Package K02A

(TO-39)
Metal Can Package



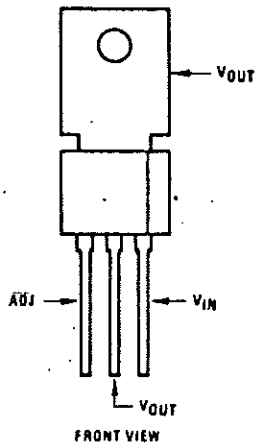
Order Number:
LM117H
LM217H
LM317H
See NS Package H03A

(TO-220)
Plastic Package



Order Number:
LM317T
See NS Package T03B

(TO-202)
Plastic Package



Order Number:
LM317MP
See NS Package P03A

TAB Formed Devices
LM317MP TB
See NS Package P03E

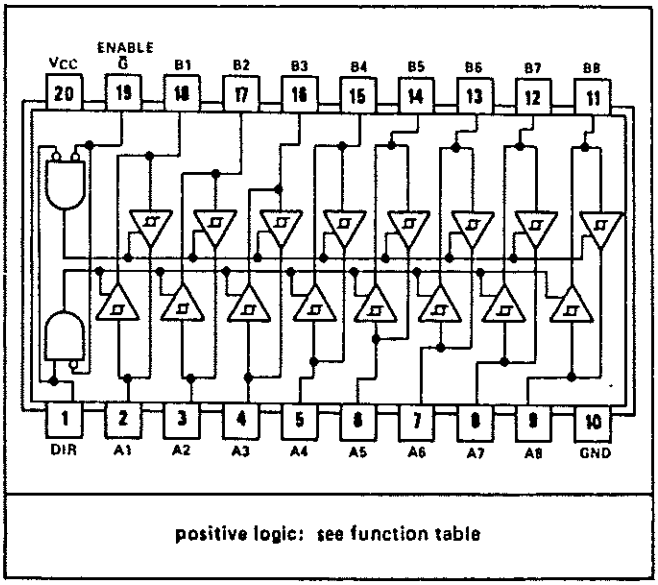
TYPES SN54LS245, SN74LS245
OCTAL BUS TRANSCEIVERS WITH 3-STATE OUTPUTS

BULLETIN NO. DL-S 7612471, OCTOBER 1976

- Bi-directional Bus Transceiver in a High-Density 20-Pin Package
- 3-State Outputs Drive Bus Lines Directly
- P-N-P Inputs Reduce D-C Loading on Bus Lines
- Hysteresis at Bus Inputs Improve Noise Margins
- Typical Propagation Delay Times, Port-to-Port . . . 8 ns
- Typical Enable/Disable Times . . . 17 ns

TYPE	I_{OL} (SINK CURRENT)	I_{OH} (SOURCE CURRENT)
SN54LS245	12 mA	−12 mA
SN74LS245	24 mA	−15 mA

SN54LS245 . . . J PACKAGE
SN74LS245 . . . J OR N PACKAGE
(TOP VIEW)



positive logic: see function table

description

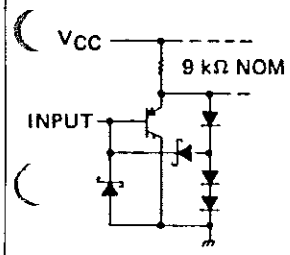
These octal bus transceivers are designed for asynchronous two-way communication between data buses. The control function implementation minimizes external timing requirements.

The device allows data transmission from the A bus to the B bus or from the B bus to the A bus depending upon the logic level at the direction control (DIR) input. The enable input ($\overline{G}$) can be used to disable the device so that the buses are effectively isolated.

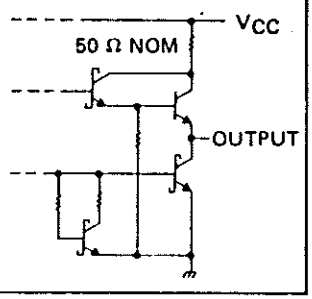
The SN54LS245 is characterized for operation over the full military temperature range of −55°C to 125°C. The SN74LS245 is characterized for operation from 0°C to 70°C.

schematics of inputs and outputs

EQUIVALENT OF EACH INPUT



TYPICAL OF ALL OUTPUTS



FUNCTION TABLE

ENABLE $\overline{G}$	DIRECTION CONTROL DIR	OPERATION
L	L	B data to A bus
L	H	A data to B bus
H	X	Isolation

H = high level, L = low level, X = irrelevant

absolute maximum ratings over operating free-air temperature range (unless otherwise noted)

Supply voltage, V_{CC} (see Note 1) . . . . . 7 V
Input voltage . . . . . 7 V
Operating free-air temperature range: SN54LS245 . . . . . −55°C to 125°C
SN74LS245 . . . . . 0°C to 70°C
Storage temperature range . . . . . −65°C to 150°C

NOTE 1: Voltage values are with respect to network ground terminal.

DESIGN GOAL
This page provides tentative information on a product in the developmental stage. Texas Instruments reserves the right to change or discontinue this product without notice.

TEXAS INSTRUMENTS

recommended operating conditions

PARAMETER	SN54LS245			SN74LS245			UNIT
	MIN	NOM	MAX	MIN	NOM	MAX	
Supply voltage, V_{CC}	4.5	5	5.5	4.75	5	5.25	V
High-level output current, I_{OH}			−12			−15	mA
Low-level output current, I_{OL}			12			24	mA
Operating free-air temperature, T_A	−55		125	0		70	°C

electrical characteristics over recommended operating free-air temperature range (unless otherwise noted)

PARAMETER		TEST CONDITIONS†		SN54LS245			SN74LS245			UNIT
				MIN	TYP‡	MAX	MIN	TYP‡	MAX	
V_{IH}	High-level input voltage			2			2			V
V_{IL}	Low-level input voltage					0.7			0.8	V
V_{IK}	Input clamp voltage	V_{CC} = MIN,	I_I = −18 mA			−1.5			−1.5	V
	Hysteresis ($V_{T+} - V_{T-}$) A or B input	V_{CC} = MIN		0.2	0.4		0.2	0.4		V
V_{OH}	High-level output voltage	V_{CC} = MIN, V_{IH} = 2 V, V_{IL} = V_{IL} max	I_{OH} = −3 mA	2.4	3.4		2.4	3.4		V
			I_{OH} = MAX	2			2			
V_{OL}	Low-level output voltage	V_{CC} = MIN, V_{IH} = 2 V, V_{IL} = V_{IL} max	I_{OL} = 12 mA			0.4			0.4	V
			I_{OL} = 24 mA						0.5	
I_{OZH}	Off-state output current, high-level voltage applied	V_{CC} = MAX, $\overline{G}$ at 2 V	V_O = 2.7 V			10			10	µA
I_{OZL}	Off-state output current, low-level voltage applied		V_O = 0.4 V			−200			−200	
I_I	Input current at maximum input voltage	A or B; V_{CC} = MAX	V_I = 5.5 V			0.1			0.1	mA
		Dir or $\overline{G}$; V_{CC} = MAX	V_I = 7 V			0.1			0.1	
I_{IH}	High-level input current	V_{CC} = MAX,	V_{IH} = 2.7 V			20			20	µA
I_{IL}	Low-level input current	V_{CC} = MAX,	V_{IL} = 0.4 V			−0.2			−0.2	mA
I_{OS}	Short-circuit output current¶	V_{CC} = MAX		−40		−225	−40		−225	mA
I_{CC}	Supply current, Total, outputs high	V_{CC} = MAX,	Outputs open		48	70		48	70	mA
	Supply current, Total, outputs low				62	90		62	90	
	Supply current, Outputs at Hi-Z				64	95		64	95	

†For conditions shown as MIN or MAX, use the appropriate value specified under recommended operating conditions.
‡All typical values are at V_{CC} = 5 V, T_A = 25°C.
¶Not more than one output should be shorted at a time, and duration of the short-circuit should not exceed one second.

switching characteristics, V_{CC} = 5 V, T_A = 25°C

PARAMETER		TEST CONDITIONS	MIN	TYP	MAX	UNIT
t_{PLH}	Propagation delay time, low-to-high-level output	C_L = 45 pF, R_L = 667 Ω, See Note 2		8	12	ns
t_{PHL}	Propagation delay time, high-to-low-level output			8	12	ns
t_{PZL}	Output enable time to low level			27	40	ns
t_{PZH}	Output enable time to high level			25	40	ns
t_{PLZ}	Output disable time from low level	C_L = 5 pF, R_L = 667 Ω, See Note 2		15	25	ns
t_{PHZ}	Output disable time from high level			15	25	ns

NOTE 2: Load circuit and waveforms are shown on page 3-11.

DESIGN GOAL

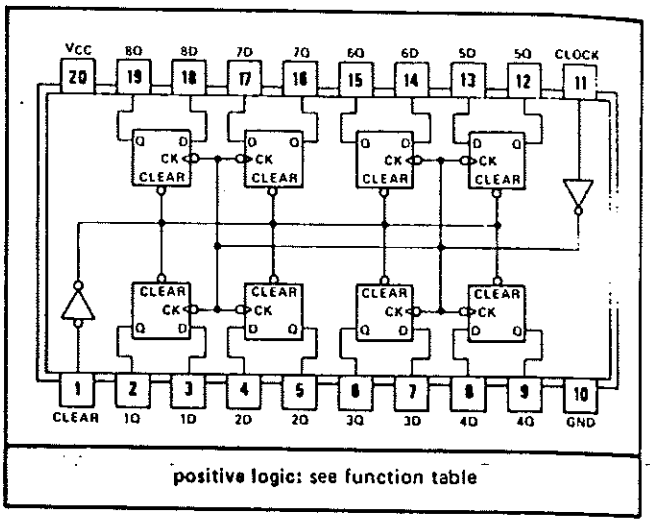
This page provides tentative information on a product in the developmental stage. Texas Instruments reserves the right to change or discontinue this product without notice.

TYPES SN54273, SN54LS273, SN74273, SN74LS273
OCTAL D-TYPE FLIP-FLOP WITH CLE

BULLETIN NO. DL-S 7612091, OCTOBER

- Contains Eight Flip-Flops with Single-Rail Outputs
- Buffered Clock and Direct Clear Inputs
- Individual Data Input to Each Flip-Flop
- Applications Include:
  - Buffer/Storage Registers
  - Shift Registers
  - Pattern Generators

SN54273, SN54LS273 . . . J PACKAGE
SN74273, SN74LS273 . . . J OR N PACKAGE



positive logic: see function table

description

These monolithic, positive-edge-triggered flip-flops utilize TTL circuitry to implement D-type flip-flop logic with a direct clear input.

Information at the D inputs meeting the setup time requirements is transferred to the Q outputs on the positive-going edge of the clock pulse. Clock triggering occurs at a particular voltage level and is not directly related to the transition time of the positive-going pulse. When the clock input is at either the high or low level, the D input signal has no effect at the output.

These flip-flops are guaranteed to respond to clock frequencies ranging from 0 to 30 megahertz while maximum clock frequency is typically 40 megahertz. Typical power dissipation is 39 milliwatts per flip-flop for the '273 and 10 milliwatts for the 'LS273.

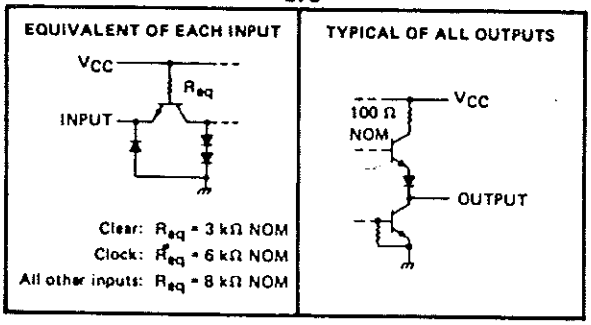
FUNCTION TABLE
(EACH FLIP-FLOP)

INPUTS			OUTPUT
CLEAR	CLOCK	D	Q
L	X	X	L
H	↑	H	H
H	↑	L	L
H	L	X	Q_0

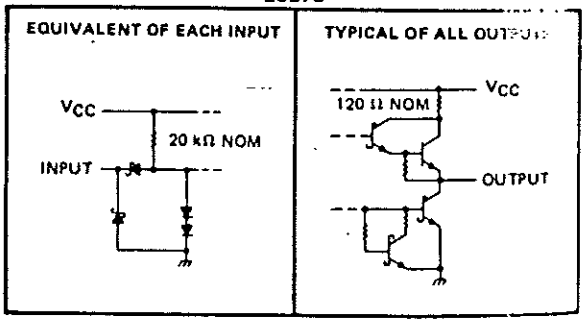
See explanation of function tables on page 3-8.

schematics of inputs and output

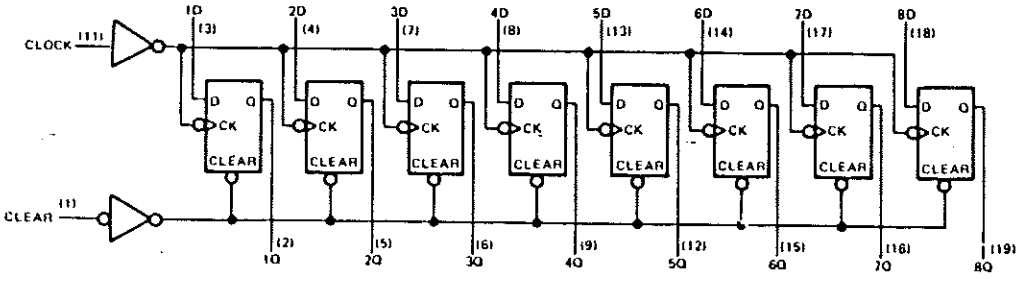
'273



'LS273



functional block diagram



TYPES SN54273, SN74273
OCTAL D-TYPE FLIP-FLOP WITH CLEAR

absolute maximum ratings over operating free-air temperature range (unless otherwise noted)

Supply voltage, V_{CC} (see Note 1) . . . . . 7 V
Input voltage . . . . . 5.5 V
Operating free-air temperature range: SN54273 . . . . . −55°C to 125°C
SN74273 . . . . . 0°C to 70°C
Storage temperature range . . . . . −65°C to 150°C

NOTE 1: Voltage values are with respect to network ground terminal.

ommended operating conditions

		SN54273			SN74273			UNIT
		MIN	NOM	MAX	MIN	NOM	MAX	
Supply voltage, V_{CC}		4.5	5	5.5	4.75	5	5.25	V
High-level output current, I_{OH}				−800			−800	μA
Low-level output current, I_{OL}				16			16	mA
Clock frequency, f_{clock}		0		30	0		30	MHz
Width of clock or clear pulse, t_w		16.5			16.5			ns
Set-up time, t_{su}	Data input	20↑			20↑			ns
	Clear inactive state	25↑			25↑			
Data hold time, t_h		5↑			5↑			ns
Operating free-air temperature, T_A		−55		125	0		70	°C

The arrow indicates that the rising edge of the clock pulse is used for reference.

electrical characteristics over recommended operating free-air temperature range (unless otherwise noted)

PARAMETER		TEST CONDITIONS†	MIN	TYP‡	MAX	UNIT
V_{IH} High-level input voltage			2			V
V_{IL} Low-level input voltage					0.8	V
V_{IK} Input clamp voltage		V_{CC} = MIN, I_I = −12 mA			−1.5	V
V_{OH} High-level output voltage		V_{CC} = MIN, V_{IH} = 2 V, V_{IL} = 0.8 V, I_{OH} = −800 μA	2.4	3.4		V
V_{OL} Low-level output voltage		V_{CC} = MIN, V_{IH} = 2 V, V_{IL} = 0.8 V, I_{OL} = 16 mA			0.4	V
I_I Input current at maximum input voltage		V_{CC} = MAX, V_I = 5.5 V			1	mA
I_{IH} High-level input current	Clear	V_{CC} = MAX, V_I = 2.4 V			80	μA
	Clock or D				40	
I_{IL} Low-level input current	Clear	V_{CC} = MAX, V_I = 0.4 V			−3.2	mA
	Clock or D				−1.6	
I_{OS} Short-circuit output current§		V_{CC} = MAX	−18		−57	mA
I_{CC} Supply current		V_{CC} = MAX, See Note 2		62	94	mA

†For conditions shown as MIN or MAX, use the appropriate value specified under recommended operating conditions.
‡All typical values are at V_{CC} = 5 V, T_A = 25°C.
§Not more than one output should be shorted at a time.
NOTE 2: With all outputs open and 4.5 V applied to all data and clear inputs, I_{CC} is measured after a momentary ground, then 4.5 V, is applied to clock.

itching characteristics, V_{CC} = 5 V, T_A = 25°C

PARAMETER	TEST CONDITIONS	MIN	TYP	MAX	UNIT
f_{max} Maximum clock frequency	C_L = 15 pF, R_L = 400 Ω, See Note 3	30	40		MHz
t_{PHL} Propagation delay time, high-to-low-level output from clear			18	27	ns
t_{PLH} Propagation delay time, low-to-high-level output from clock			17	27	ns
t_{PHL} Propagation delay time, high-to-low-level output from clock			18	27	ns

NOTE 3: Load circuit and voltage waveforms are shown on page 3-10.

TYPES SN54LS273, SN74LS273
OCTAL D-TYPE FLIP-FLOP WITH CLEAR

absolute maximum ratings over operating free-air temperature range (unless otherwise noted)

Supply voltage, V_{CC} (see Note 1) . . . . . 7 V
Input voltage . . . . . 7 V
Operating free-air temperature range: SN54LS273 . . . . . −55°C to 125°C
SN74LS273 . . . . . 0°C to 70°C
Storage temperature range . . . . . 65°C to 150°C

NOTE 1: Voltage values are with respect to network ground terminal

recommended operating conditions

		SN54LS273			SN74LS273			UNIT
		MIN	NOM	MAX	MIN	NOM	MAX	
Supply voltage, V_{CC}		4.5	5	5.5	4.75	5	5.25	V
High-level output current, I_{OH}				−400			−400	μA
Low-level output current, I_{OL}				4			8	mA
Clock frequency, f_{clock}		0		30	0		30	MHz
Width of clock or clear pulse, t_w		20			20			ns
Set-up time, t_{su}	Data input	20↑			20↑			ns
	Clear inactive state	25↑			25↑			
Data hold time, t_h		5↑			5↑			ns
Operating free-air temperature, T_A		−55		125	0		70	°C

↑The arrow indicates that the rising edge of the clock pulse is used for reference.

electrical characteristics over recommended operating free-air temperature range (unless otherwise noted)

PARAMETER		TEST CONDITIONS†		SN54LS273			SN74LS273			UNIT
				MIN	TYP‡	MAX	MIN	TYP‡	MAX	
V_{IH}	High-level input voltage			2			2			V
V_{IL}	Low-level input voltage					0.7			0.8	V
V_{IK}	Input clamp voltage	V_{CC} = MIN, I_I = −18 mA				−1.5			−1.5	V
V_{OH}	High-level output voltage	V_{CC} = MIN, V_{IH} = 2 V, V_{IL} = V_{IL}max, I_{OH} = −400 μA		2.5	3.4		2.7	3.4		V
V_{OL}	Low-level output voltage	V_{CC} = MIN, V_{IH} = 2 V, V_{IL} = V_{IL}max	I_{OL} = 4 mA		0.25	0.4		0.25	0.4	V
			I_{OL} = 8 mA					0.35	0.5	
I_I	Input current at maximum input voltage	V_{CC} = MAX, V_I = 7 V				0.1			0.1	mA
I_{IH}	High-level input current	V_{CC} = MAX, V_I = 2.7 V				20			20	μA
I_{IL}	Low-level input current	V_{CC} = MAX, V_I = −0.4 V				−0.4			−0.4	mA
I_{OS}	Short-circuit output current§	V_{CC} = MAX		−20		−100	−20		−100	mA
I_{CC}	Supply current	V_{CC} = MAX, See Note 2			17	27		17	27	mA

†For conditions shown as MIN or MAX, use the appropriate value specified under recommended operating conditions.
‡All typical values are at V_{CC} = 5 V, T_A = 25°C.
§Not more than one output should be shorted at a time and duration of short circuit should not exceed one second.
NOTE 2: With all outputs open and 4.5 V applied to all data and clear inputs, I_{CC} is measured after a momentary ground, then 4.5 V applied to clock.

switching characteristics, V_{CC} = 5 V, T_A = 25°C

PARAMETER		TEST CONDITIONS	MIN	TYP	MAX	UNIT
f_{max}	Maximum clock frequency	C_L = 15 pF, R_L = 2 kΩ, See Note 4	30	40		MHz
t_{PHL}	Propagation delay time, high-to-low-level output from clear			18	27	ns
t_{PLH}	Propagation delay time, low-to-high-level output from clock			17	27	ns
t_{PHL}	Propagation delay time, high-to-low-level output from clock			18	27	ns

NOTE 4: Load circuit and voltage waveforms are shown on page 3-11.

54/74 FAMILIES OF COMPATIBLE TTL CIRCUITS

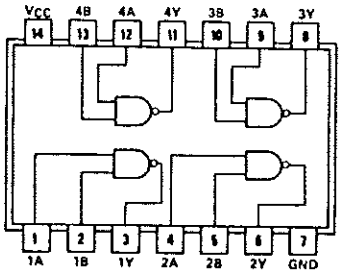
PIN ASSIGNMENTS (TOP VIEWS)

QUADRUPLE 2-INPUT
POSITIVE-NAND GATES
WITH OPEN-COLLECTOR OUTPUTS

03

positive logic:
$Y = \overline{AB}$

See page 6-4



SN5403 (J)
SN54L03 (J)
SN54LS03 (J, W)
SN54S03 (J, W)

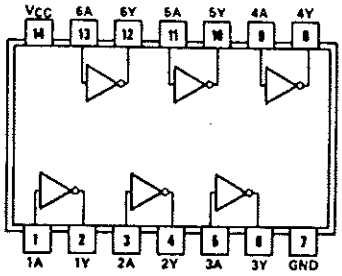
SN7403 (J, N)
SN74L03 (J, N)
SN74LS03 (J, N)
SN74S03 (J, N)

HEX INVERTERS

04

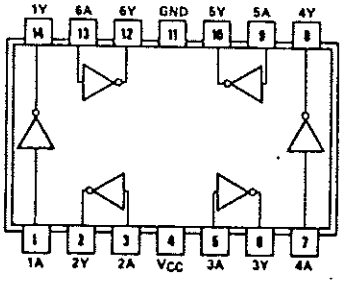
positive logic:
$Y = \overline{A}$

See page 6-2



SN5404 (J)
SN54H04 (J)
SN54L04 (J)
SN54LS04 (J, W)
SN54S04 (J, W)

SN7404 (J, N)
SN74H04 (J, N)
SN74L04 (J, N)
SN74LS04 (J, N)
SN74S04 (J, N)



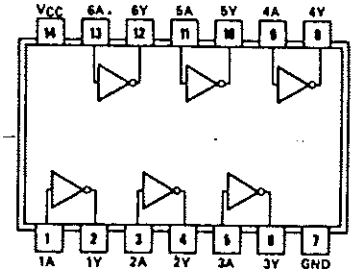
SN5404 (W)
SN54H04 (W)
SN54L04 (T)

HEX INVERTERS
WITH OPEN-COLLECTOR OUTPUTS

05

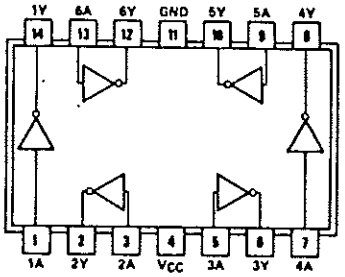
positive logic:
$Y = \overline{A}$

See page 6-4



SN5405 (J)
SN54H05 (J)
SN54LS05 (J, W)
SN54S05 (J, W)

SN7405 (J, N)
SN74H05 (J, N)
SN74LS05 (J, N)
SN74S05 (J, N)



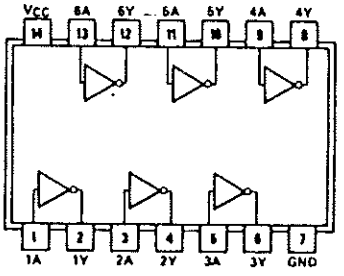
SN5405 (W)
SN54H05 (W)

HEX INVERTER BUFFERS/DRIVERS
WITH OPEN-COLLECTOR
HIGH-VOLTAGE OUTPUTS

06

positive logic:
$Y = \overline{A}$

See page 6-24



SN5406 (J, W)

SN7406 (J, N)

recommended operating conditions

	54 FAMILY / 74 FAMILY	SERIES 54' / SERIES 74'												UNIT
		'06, '07			'16, '17			'26			'33, '38			
		MIN	NOM	MAX	MIN	NOM	MAX	MIN	NOM	MAX	MIN	NOM	MAX	
Supply voltage, V_{CC}	54 Family	4.5	5	5.5	4.5	5	5.5	4.5	5	5.5	4.5	5	5.5	V
	74 Family	4.75	5	5.25	4.75	5	5.25	4.75	5	5.25	4.75	5	5.25	
High-level output voltage, V_{OH}				30			15			15			5.5	V
Low-level output current, I_{OL}	54 Family			30			30			16			48	mA
	74 Family			40			40			16			48	
Operating free-air temperature, T_A	54 Family	−55		125	−55		125	−55		125	−55		125	°C
	74 Family	0		70	0		70	0		70	0		70	

electrical characteristics over recommended operating free-air temperature range (unless otherwise noted)

PARAMETER		TEST FIGURE	TEST CONDITIONS†		SERIES 54' / SERIES 74'												UNIT
					'06, '07			'16, '17			'26			'33, '38			
					MIN	TYP	MAX	MIN	TYP	MAX	MIN	TYP	MAX	MIN	TYP	MAX	
V_{IH}	High-level input voltage	1, 2			2			2			2			2			V
V_{IL}	Low-level input voltage	1, 2					0.8			0.8			0.8			0.8	V
V_{IK}	Input clamp voltage	3	V_{CC} = MIN, I_I = −12 mA				−1.5			−1.5			−1.5			−1.5	V
I_{OH}	High-level output current	1	V_{CC} = MIN, V_I = ▲	V_{OH} = 12 V									50				μA
				V_{OH} = MAX			250			250			1000			250	
V_{OL}	Low-level output voltage	2	V_{CC} = MIN, V_I = ▲	I_{OL} = 16 mA			0.4			0.4			0.4				V
				I_{OL} = MAX			0.7			0.7			0.4			0.4	
I_I	Input current at maximum input voltage	4	V_{CC} = MAX, V_I = 5.5 V				1			1			1			1	mA
I_{IH}	High-level input current	4	V_{CC} = MAX, V_{IH} = 2.4 V				40			40			40			40	μA
I_{IL}	Low-level input current	5	V_{CC} = MAX, V_{IL} = 0.4 V				−1.6			−1.6			−1.6			−1.6	mA
I_{CC}	Supply current	7	V_{CC} = MAX		See table on next page												mA

†For conditions shown as MIN or MAX, use the appropriate value specified under recommended operating conditions.

▲The input voltage is V_{IH} = 2 V or V_{IL} = V_{IL} max, as appropriate. See tables with test figures 1 and 2.

supply current¶

TYPE	I_{CCH} (mA) Total with outputs high		I_{CCL} (mA) Total with outputs low		I_{CC} (mA) Average per gate (50% duty cycle)
	TYP	MAX	TYP	MAX	TYP
'06, '16	30	48	32	51	5.17
'07, '17	29	41	21	30	4.17
'26	4	8	12	22	2.00
'33	12	21	33	57	5.63
'38	5	8.5	34	54	4.88

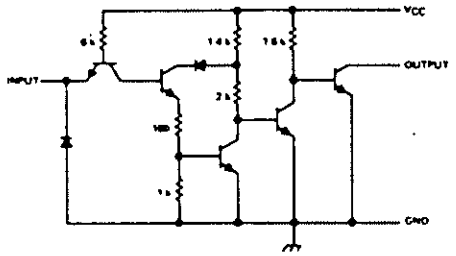
¶Maximum values of I_{CC} shown are over the recommended operating ranges of V_{CC} and T_A; typical values are at V_{CC} = 5 V, T_A = 25°C.

switching characteristics, V_{CC} = 5 V, T_A = 25°C

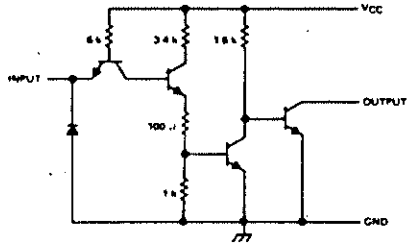
TYPE	TEST CONDITIONS#	t_{PLH} (ns) Propagation delay time, low-to-high-level output		t_{PHL} (ns) Propagation delay time, high-to-low-level output	
		TYP	MAX	TYP	MAX
'06, '16	C_L = 15 pF, R_L = 110 Ω	10	15	15	23
'07, '17		6	10	20	30
'26	C_L = 15 pF, R_L = 1 kΩ	16	24	11	17
'33	C_L = 50 pF, R_L = 133 Ω	10	15	12	18
	C_L = 150 pF, R_L = 133 Ω	15	22	16	24
'38	C_L = 45 pF, R_L = 133 Ω	14	22	11	18

#Load circuit and voltage waveforms are shown on page 3-10.

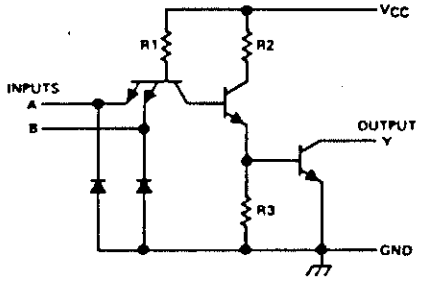
schematics (each gate)



'06, '16 CIRCUITS

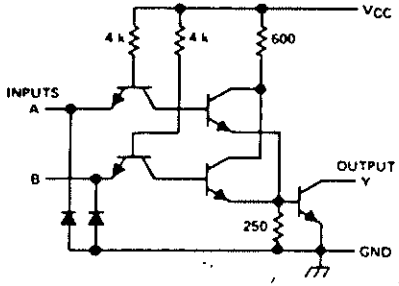


'07, '17 CIRCUITS



CIRCUITS	R1	R2	R3
'26	4 kΩ	1.6 kΩ	1 kΩ
'38	4 kΩ	600 Ω	400 Ω

'26, '38 CIRCUITS



'33 CIRCUITS

Defaultvärden

Defaulttabellen för tangenterna är följande:

	A	B	C	D	E	F	G	H
1	0	8	é	H	P	X	é	h
2	1	9	A	I	Q	Y	a	i
3	2	:	B	J	R	Z	b	j
4	3	;	C	K	S	Ä	c	k
5	4	<	D	L	T	ö	d	l
6	5	=	E	M	U	A	e	m
7	6	>	F	N	V	Ü	f	n
8	7	?	G	O	W	_	g	o

samtliga repetitionstider är satta till ca 0,1 sek.

Start till autorepetitions början ca 0.6 sek
Kontaktsudseliminationca 0.02

För att ändra dessa värden, får man gå in i modulen rejinit. (se appendix C)

För den seriella kommunikationen finns som default överföringen 9600 Baud, 1 stopbit, ingen paritet. Värdena för detta samt värdet för klockan (default ca 100 anrop per sek) finns i modulen initsio. För närmare information refereras till de mer utförliga kommentarerna i programlistan. (appendix C, modul initsio.)