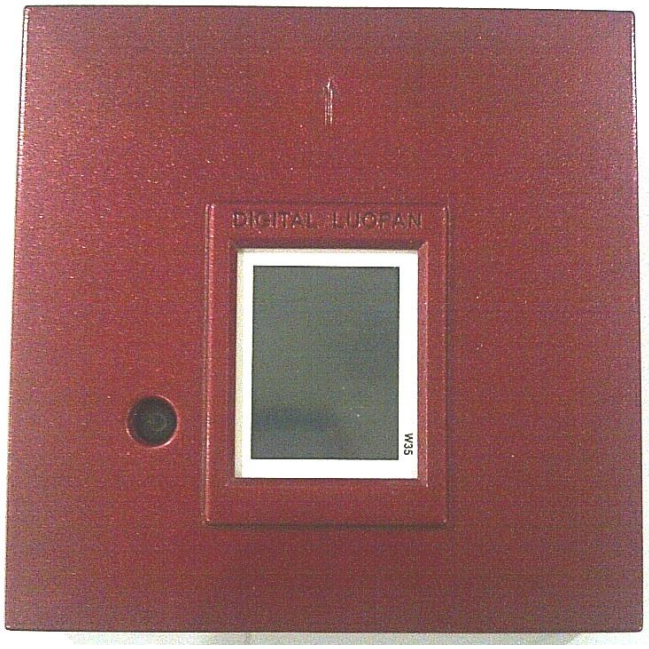
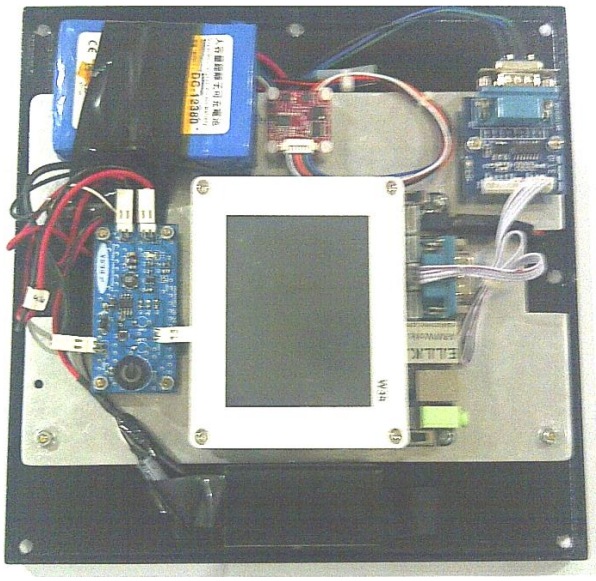
LAMPIRAN A
FOTO ALAT

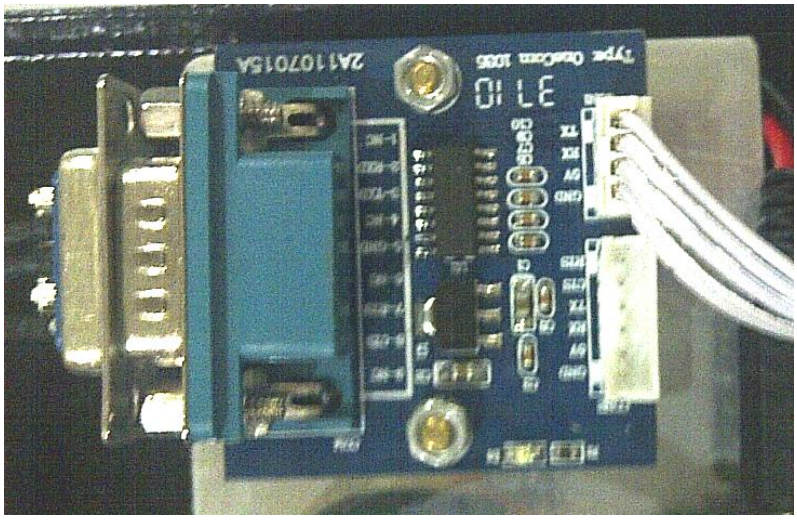


Luopan Digital Dengan Tutup

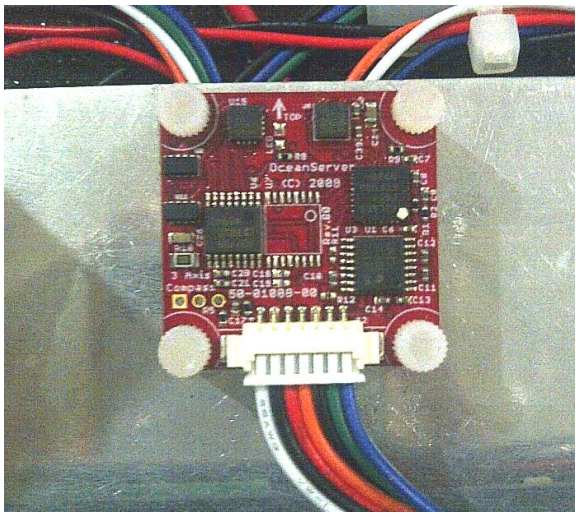


Luopan Digital Tanpa Tutup

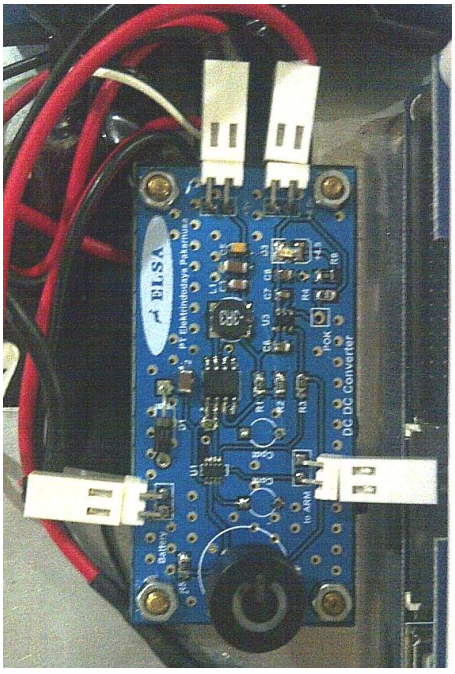
Mini 2440



RS232 *to* TTL *Converter Board*



Kompas OS5000



Dc-Dc *Converter Board*

LAMPIRAN B
LIST PROGRAM DAN DATABASE

```
Public Class Form1
Delegate Sub InvokeDelegate()
Dim derajat01 As String
Dim derajat02() As String
Dim derajat_final As String
Dim derajat_angka() As Byte
Dim arah As Decimal
Dim direction As String
Dim kalibrasi As Decimal
Dim arah_final As Decimal
Private Sub SerialPort1_DataReceived(ByVal sender As Object, ByVal e As
System.IO.Ports.SerialDataReceivedEventArgs) Handles SerialPort1.DataReceived
TextBox1.BeginInvoke(New InvokeDelegate(AddressOf updateTextbox))
End Sub
Private Sub updateTextbox()
derajat01 = SerialPort1.ReadTo(vbCr)
derajat02 = Split(derajat01, ",")
For i As Integer = 0 To UBound(derajat02)
derajat_final = derajat02(1)
Next
derajat_angka = System.Text.Encoding.ASCII.GetBytes(derajat_final)
If (derajat_angka(1) = 46) Then
rumus01()
ElseIf (derajat_angka(2) = 46) Then
rumus02()
ElseIf (derajat_angka(3) = 46) Then
rumus03()
End If
arah_kompas()
End Sub
```

```
Private Sub Timer1_Tick(ByVal sender As Object, ByVal e As System.EventArgs) Handles
Timer1.Tick
arah_final = arah + kalibrasi
If arah_final < 0 Then
arah_final = 360 + arah_final
Else
If arah_final > 360 Then
arah_final = arah_final - 360
Else
If arah_final = 360 Then
arah_final = 0
End If
End If
End If
TextBox1.Text = arah_final
Label3.Text = direction
End Sub
Private Sub rumus01()
arah = (derajat_angka(0) - 48) + ((derajat_angka(2) - 48) * 0.1)
End Sub
Private Sub rumus02()
arah = ((derajat_angka(0) - 48) * 10) + (derajat_angka(1) - 48) + ((derajat_angka(3) - 48) * 0.1)
End Sub
Private Sub rumus03()
arah = ((derajat_angka(0) - 48) * 100) + ((derajat_angka(1) - 48) * 10) + (derajat_angka(2) - 48) +
((derajat_angka(4) - 48) * 0.1)
End Sub
Private Sub arah_kompas()
If (arah_final >= 0 And arah_final < 7.5) Then
direction = "N2"
```

```
Else
If (arah_final >= 7.5 And arah_final < 22.5) Then
direction = "N3"
If (arah_final >= 22.5 And arah_final < 37.5) Then
direction = "NE1"
Else
If (arah_final >= 37.5 And arah_final < 52.5) Then
direction = "NE2"
Else
If (arah_final >= 52.5 And arah_final < 67.5) Then
direction = "NE3"
Else
If (arah_final >= 67.5 And arah_final < 82.5) Then
direction = "E1"
Else
If (arah_final >= 82.5 And arah_final < 97.5) Then
direction = "E2"
Else
If (arah_final >= 97.5 And arah_final < 112.5) Then
direction = "E3"
Else
If (arah_final >= 112.5 And arah_final < 127.5) Then
direction = "SE1"
Else
If (arah_final >= 127.5 And arah_final < 142.5) Then
direction = "SE2"
Else
If (arah_final >= 142.5 And arah_final < 157.5) Then
direction = "SE3"
Else
```

```
If (arah_final >= 157.5 And arah_final < 172.5) Then
direction = "S1"
Else
If (arah_final >= 172.5 And arah_final < 187.5) Then
direction = "S2"
Else
If (arah_final >= 187.5 And arah_final < 202.5) Then
direction = "S3"
Else
If (arah_final >= 202.5 And arah_final < 217.5) Then
direction = "SW1"
 Else
 If (arah_final >= 217.5 And arah_final < 232.5) Then
direction = "SW2"
 Else
If (arah_final >= 232.5 And arah_final < 247.5) Then
direction = "SW3"
 Else
If (arah_final >= 247.5 And arah_final < 262.5) Then
direction = "W1"
Else
If (arah_final >= 262.5 And arah_final < 277.5) Then
direction = "W2"
Else
If (arah_final >= 277.5 And arah_final < 292.5) Then
direction = "W3"
Else
If (arah_final >= 292.5 And arah_final < 307.5) Then
direction = "NW1"
Else
```

```
If (arah_final >= 307.5 And arah_final < 322.5) Then
direction = "NW2"
Else
If (arah_final >= 322.5 And arah_final < 337.5) Then
direction = "NW3"
Else
If (arah_final >= 337.5 And arah_final < 352.5) Then
direction = "N1"
End If
If (arah_final >= 352.5 And arah_final < 360) Then
direction = "N2"
End If
End If
End If
End If
End If
End If
End If
End If
End If
End If
End If
End If
End If
End If
End If
End If
End If
End If
End If
End If
```

```
End If
End If
End If
End If
End Sub
Private Sub Form1_Load(ByVal sender As Object, ByVal e As System.EventArgs) Handles
MyBase.Load
SerialPort1.Open()
Dim OpenFile As New OpenFileDialog
OpenFile.FileName = "calibrasi.txt"
Try
Dim Read As New System.IO.StreamReader(OpenFile.FileName)
kalibrasi = Read.ReadToEnd
Read.Close()
Catch ex As Exception
End Try
End Sub
Private Sub Button1_Click(ByVal sender As Object, ByVal e As System.EventArgs) Handles
Button1.Click
Dim mansion_form As New Form2
mansion_form.ShowDialog()
mansion_form = Nothing
End Sub
Private Sub Button2_Click(ByVal sender As Object, ByVal e As System.EventArgs) Handles
Button2.Click
Dim aspiration_form As New Form3
aspiration_form.ShowDialog()
aspiration_form = Nothing
End Sub
Private Sub Button3_Click(ByVal sender As Object, ByVal e As System.EventArgs) Handles
Button3.Click
```

```
Dim fs_form As New Form4
fs_form.ShowDialog()
fs_form = Nothing
End Sub
Private Sub Button5_Click(ByVal sender As Object, ByVal e As System.EventArgs) Handles
Button5.Click
Dim kalibrasi_windows As New Form7
kalibrasi_windows.ShowDialog()
kalibrasi_windows = Nothing
End Sub
Public Sub kalibrasi_method()
If arah > 0 And arah <= 180 Then
kalibrasi = -arah
Else
If arah > 180 And arah < 360 Then
kalibrasi = 360 - arah
End If
End If
Dim SaveFile As New SaveFileDialog
SaveFile.FileName = "calibrasi.txt"
Try
Dim Write As New System.IO.StreamWriter(SaveFile.FileName)
Write.Write(kalibrasi)
Write.Close()
Catch ex As Exception
End Try
End Sub
End Class
```

```
Imports System.IO
Public Class Form2
Dim direction As String
Dim input_tanggal As String
Dim jenis_kelamin As Integer
Dim tanggal_lahir_cal() As String
Dim lahir As String
Dim data_lahir() As String
Dim tahun_lahir() As Byte
Dim tahun_lahir_int As Integer
Dim bulan_lahir() As Byte
Dim bulan_lahir_int As Integer
Dim tanggal_lahir() As Byte
Dim tanggal_lahir_int As Integer
Dim data_8mansion As String
Dim data_pertahun() As String
Dim hasil_8mansion() As String
Dim bulan_hasil_8mansion(1) As Byte
Dim bulan_hasil_8mansion_int As Integer
Dim tanggal_hasil_8mansion(2) As Byte
Dim tanggal_hasil_8mansion_int As Integer
Dim arah_gua(23) As String
Dim arah_gua_join As String
Dim i As Integer
Private Sub Form1_Load(ByVal sender As Object, ByVal e As System.EventArgs) Handles
MyBase.Load
RadioButton1.Checked = True
input_tanggal = MonthCalendar1.TodayDate.ToString()
kalkulasi_tanggal()
End Sub
```

```
PrivateSub MonthCalendar1_DateChanged(ByVal sender As Object, ByVal e As
System.Windows.Forms.DateRangeEventArgs)
Handles MonthCalendar1.DateChanged
input_tanggal = MonthCalendar1.SelectionEnd.ToString()
kalkulasi_tanggal()
End Sub
Private Sub kalkulasi_tanggal()
tanggal_lahir_cal = Split(input_tanggal, " ")
lahir = tanggal_lahir_cal(0)
Label5.Text = lahir
End Sub
Private Sub Button1_Click(ByVal sender As Object, ByVal e As System.EventArgs) Handles
Button1.Click
Me.Close()
End Sub
Private Sub Button2_Click(ByVal sender As Object, ByVal e As System.EventArgs) Handles
Button2.Click
MonthCalendar1.Visible = False
data_lahir = Split(lahir, "/")
tahun_lahir = System.Text.Encoding.ASCII.GetBytes(data_lahir(2))
tahun_lahir_int = (((tahun_lahir(0) - 48) * 1000) + ((tahun_lahir(1) - 48) * 100) + ((tahun_lahir(2) -
48) * 10) + (tahun_lahir(3) - 48))
bulan_lahir = System.Text.Encoding.ASCII.GetBytes(data_lahir(0))
If bulan_lahir.Length = 1 Then
bulan_lahir_int = (bulan_lahir(0) - 48)
Else
bulan_lahir_int = ((bulan_lahir(0) - 48) * 10) + (bulan_lahir(1) - 48)
End If
tanggal_lahir = System.Text.Encoding.ASCII.GetBytes(data_lahir(1))
If tanggal_lahir.Length = 1 Then
tanggal_lahir_int = (tanggal_lahir(0) - 48)
```

```
Else
tanggal_lahir_int = ((tanggal_lahir(0) - 48) * 10) + (tanggal_lahir(1) - 48)
End If
If (RadioButton1.Checked = True) Then
jenis_kelamin = 1
Else
If (RadioButton2.Checked = True) Then
jenis_kelamin = 2
End If
End If
Dim OpenFile As New OpenFileDialog
OpenFile.FileName = "8mansion.txt"
Try
Dim Read As New System.IO.StreamReader(OpenFile.FileName)
data_8mansion = Read.ReadToEnd
Read.Close()
Catch ex As Exception
End Try
data_pertahun = Split(data_8mansion, ";")
i = tahun_lahir_int - 1924
hasil_8mansion = Split(data_pertahun(i), ",")
bulan_hasil_8mansion = System.Text.Encoding.ASCII.GetBytes(hasil_8mansion(1))
bulan_hasil_8mansion_int = bulan_hasil_8mansion(0) - 48
If bulan_lahir_int > bulan_hasil_8mansion_int Then
gua_number()
Else
If bulan_lahir_int < bulan_hasil_8mansion_int Then
i = i - 1
hasil_8mansion = Split(data_pertahun(i), ",")
gua_number()
Else
```

```
If bulan_lahir_int = bulan_hasil_8mansion_int Then
tanggal_hasil_8mansion = System.Text.Encoding.ASCII.GetBytes(hasil_8mansion(2))
If tanggal_hasil_8mansion.Length = 1 Then
tanggal_hasil_8mansion_int = tanggal_hasil_8mansion(0) - 48
Else
tanggal_hasil_8mansion_int = ((tanggal_hasil_8mansion(0) - 48) * 10) + (tanggal_hasil_8mansion(1)
- 48)
End If
If tanggal_lahir_int >= tanggal_hasil_8mansion_int Then
gua_number()
Else
If tanggal_lahir_int < tanggal_hasil_8mansion_int Then
i = i - 1
hasil_8mansion = Split(data_pertahun(i), ",")
gua_number()
End If
End If
End If
End If
End If
If Timer1.Enabled = False Then
Timer1.Enabled = True
End If
If Label1.Visible = False Then
Label1.Visible = True
End If
If Label4.Visible = False Then
Label4.Visible = True
End If
End Sub
```

```
Private Sub Timer1_Tick(ByVal sender As Object, ByVal e As System.EventArgs) Handles
Timer1.Tick
Label3.Text = Form1.TextBox1.Text
direction = Form1.Label3.Text
Label6.Text = direction
'If hasil_8mansion(3) > 0 Or hasil_8mansion(4) > 0 Then
penampil_arah()
'End If
End Sub
Private Sub PictureBox1_Click(ByVal sender As System.Object, ByVal e As System.EventArgs)
Handles PictureBox1.Click
MonthCalendar1.Visible = True
End Sub
Private Sub gua_number()
If jenis_kelamin = 1 Then 'laki2
Label31.Text = hasil_8mansion(3)
For k As Integer = 0 To UBound(arah_gua)
arah_gua(k) = hasil_8mansion(k + 5)
Next k
Else
If jenis_kelamin = 2 Then 'perempuan
Label31.Text = hasil_8mansion(4)
For j As Integer = 0 To UBound(arah_gua)
arah_gua(j) = hasil_8mansion(j + 29)
Next j
End If
End If
End Sub
Private Sub penampil_arah()
If direction = "N1" Or direction = "N2" Or direction = "N3" Then
Label7.Text = arah_gua(21)
```

```
Label8.Text = arah_gua(22)
Label9.Text = arah_gua(23)
Label10.Text = arah_gua(0)
Label11.Text = arah_gua(1)
Label12.Text = arah_gua(2)
Label13.Text = arah_gua(3)
Label14.Text = arah_gua(4)
Label15.Text = arah_gua(5)
Label16.Text = arah_gua(6)
Label17.Text = arah_gua(7)
Label18.Text = arah_gua(8)
Label19.Text = arah_gua(9)
Label20.Text = arah_gua(10)
Label21.Text = arah_gua(11)
Label22.Text = arah_gua(12)
Label23.Text = arah_gua(13)
Label24.Text = arah_gua(14)
Label25.Text = arah_gua(15)
Label26.Text = arah_gua(16)
Label27.Text = arah_gua(17)
Label28.Text = arah_gua(18)
Label29.Text = arah_gua(19)
Label30.Text = arah_gua(20)
Else
If direction = "NE1" Or direction = "NE2" Or direction = "NE3" Then
Label7.Text = arah_gua(0)
Label8.Text = arah_gua(1)
Label9.Text = arah_gua(2)
Label10.Text = arah_gua(3)
Label11.Text = arah_gua(4)
Label12.Text = arah_gua(5)
```

```
Label13.Text = arah_gua(6)
Label14.Text = arah_gua(7)
Label15.Text = arah_gua(8)
Label16.Text = arah_gua(9)
Label17.Text = arah_gua(10)
Label18.Text = arah_gua(11)
Label19.Text = arah_gua(12)
Label20.Text = arah_gua(13)
Label21.Text = arah_gua(14)
Label22.Text = arah_gua(15)
Label23.Text = arah_gua(16)
Label24.Text = arah_gua(17)
Label25.Text = arah_gua(18)
Label26.Text = arah_gua(19)
Label27.Text = arah_gua(20)
Label28.Text = arah_gua(21)
Label29.Text = arah_gua(22)
Label30.Text = arah_gua(23)
Else
If direction = "E1" Or direction = "E2" Or direction = "E3" Then
Label7.Text = arah_gua(3)
Label8.Text = arah_gua(4)
Label9.Text = arah_gua(5)
Label10.Text = arah_gua(6)
Label11.Text = arah_gua(7)
Label12.Text = arah_gua(8)
Label13.Text = arah_gua(9)
Label14.Text = arah_gua(10)
Label15.Text = arah_gua(11)
Label16.Text = arah_gua(12)
Label17.Text = arah_gua(13)
```

```
Label18.Text = arah_gua(14)
Label19.Text = arah_gua(15)
Label20.Text = arah_gua(16)
Label21.Text = arah_gua(17)
Label22.Text = arah_gua(18)
Label23.Text = arah_gua(19)
Label24.Text = arah_gua(20)
Label25.Text = arah_gua(21)
Label26.Text = arah_gua(22)
Label27.Text = arah_gua(23)
Label28.Text = arah_gua(0)
Label29.Text = arah_gua(1)
Label30.Text = arah_gua(2)
Else
If direction = "SE1" Or direction = "SE2" Or direction = "SE3" Then
Label7.Text = arah_gua(6)
Label8.Text = arah_gua(7)
Label9.Text = arah_gua(8)
Label10.Text = arah_gua(9)
Label11.Text = arah_gua(10)
Label12.Text = arah_gua(11)
Label13.Text = arah_gua(12)
Label14.Text = arah_gua(13)
Label15.Text = arah_gua(14)
Label16.Text = arah_gua(15)
Label17.Text = arah_gua(16)
Label18.Text = arah_gua(17)
Label19.Text = arah_gua(18)
Label20.Text = arah_gua(19)
Label21.Text = arah_gua(20)
Label22.Text = arah_gua(21)
```

```
Label23.Text = arah_gua(22)
Label24.Text = arah_gua(23)
Label25.Text = arah_gua(0)
Label26.Text = arah_gua(1)
Label27.Text = arah_gua(2)
Label28.Text = arah_gua(3)
Label29.Text = arah_gua(4)
Label30.Text = arah_gua(5)
Else
If direction = "S1" Or direction = "S2" Or direction = "S3" Then
Label7.Text = arah_gua(9)
Label8.Text = arah_gua(10)
Label9.Text = arah_gua(11)
Label10.Text = arah_gua(12)
Label11.Text = arah_gua(13)
Label12.Text = arah_gua(14)
Label13.Text = arah_gua(15)
Label14.Text = arah_gua(16)
Label15.Text = arah_gua(17)
Label16.Text = arah_gua(18)
Label17.Text = arah_gua(19)
Label18.Text = arah_gua(20)
Label19.Text = arah_gua(21)
Label20.Text = arah_gua(22)
Label21.Text = arah_gua(23)
Label22.Text = arah_gua(0)
Label23.Text = arah_gua(1)
Label24.Text = arah_gua(2)
Label25.Text = arah_gua(3)
Label26.Text = arah_gua(4)
Label27.Text = arah_gua(5)
```

```
Label28.Text = arah_gua(6)
Label29.Text = arah_gua(7)
Label30.Text = arah_gua(8)
Else
If direction = "SW1" Or direction = "SW2" Or direction = "SW3" Then
Label7.Text = arah_gua(12)
Label8.Text = arah_gua(13)
Label9.Text = arah_gua(14)
Label10.Text = arah_gua(15)
Label11.Text = arah_gua(16)
Label12.Text = arah_gua(17)
Label13.Text = arah_gua(18)
Label14.Text = arah_gua(19)
Label15.Text = arah_gua(20)
Label16.Text = arah_gua(21)
Label17.Text = arah_gua(22)
Label18.Text = arah_gua(23)
Label19.Text = arah_gua(0)
Label20.Text = arah_gua(1)
Label21.Text = arah_gua(2)
Label22.Text = arah_gua(3)
Label23.Text = arah_gua(4)
Label24.Text = arah_gua(5)
Label25.Text = arah_gua(6)
Label26.Text = arah_gua(7)
Label27.Text = arah_gua(8)
Label28.Text = arah_gua(9)
Label29.Text = arah_gua(10)
Label30.Text = arah_gua(11)
Else
If direction = "W1" Or direction = "W2" Or direction = "W3" Then
```

```
Label7.Text = arah_gua(15)
Label8.Text = arah_gua(16)
Label9.Text = arah_gua(17)
Label10.Text = arah_gua(18)
Label11.Text = arah_gua(19)
Label12.Text = arah_gua(20)
Label13.Text = arah_gua(21)
Label14.Text = arah_gua(22)
Label15.Text = arah_gua(23)
Label16.Text = arah_gua(0)
Label17.Text = arah_gua(1)
Label18.Text = arah_gua(2)
Label19.Text = arah_gua(3)
Label20.Text = arah_gua(4)
Label21.Text = arah_gua(5)
Label22.Text = arah_gua(6)
Label23.Text = arah_gua(7)
Label24.Text = arah_gua(8)
Label25.Text = arah_gua(9)
Label26.Text = arah_gua(10)
Label27.Text = arah_gua(11)
Label28.Text = arah_gua(12)
Label29.Text = arah_gua(13)
Label30.Text = arah_gua(14)
Else
If direction = "NW1" Or direction = "NW2" Or direction = "NW3" Then
Label7.Text = arah_gua(18)
Label8.Text = arah_gua(19)
Label9.Text = arah_gua(20)
Label10.Text = arah_gua(21)
Label11.Text = arah_gua(22)
```

```
Label12.Text = arah_gua(23)
Label13.Text = arah_gua(0)
Label14.Text = arah_gua(1)
Label15.Text = arah_gua(2)
Label16.Text = arah_gua(3)
Label17.Text = arah_gua(4)
Label18.Text = arah_gua(5)
Label19.Text = arah_gua(6)
Label20.Text = arah_gua(7)
Label21.Text = arah_gua(8)
Label22.Text = arah_gua(9)
Label23.Text = arah_gua(10)
Label24.Text = arah_gua(11)
Label25.Text = arah_gua(12)
Label26.Text = arah_gua(13)
Label27.Text = arah_gua(14)
Label28.Text = arah_gua(15)
Label29.Text = arah_gua(16)
Label30.Text = arah_gua(17)
End If
End If
End If
End If
End If
End If
End If
End If
End Sub
End Class
```

```
Public Class Form3
    Dim direction As String
    Private Sub Button1_Click(ByVal sender As Object, ByVal e As System.EventArgs) Handles
Button1.Click
        Me.Close()
    End Sub
    Private Sub Timer1_Tick(ByVal sender As Object, ByVal e As System.EventArgs) Handles
Timer1.Tick
        Label3.Text = Form1.TextBox1.Text
        direction = Form1.Label3.Text
        Label6.Text = direction
        penentu_arah()
    End Sub
    Private Sub penentu_arah()
If (direction = "N1" Or direction = "N2" Or direction = "N3") Then
arah_N()
Else
If (direction = "NE1" Or direction = "NE2" Or direction = "NE3") Then
arah_NE()
Else
If (direction = "E1" Or direction = "E2" Or direction = "E3") Then
arah_E()
Else
If (direction = "SE1" Or direction = "SE2" Or direction = "SE3") Then
arah_SE()
Else
If (direction = "S1" Or direction = "S2" Or direction = "S3") Then
arah_S()
Else
If (direction = "SW1" Or direction = "SW2" Or direction = "SW3") Then
arah_SW()
```

```
Else
If (direction = "W1" Or direction = "W2" Or direction = "W3") Then
arah_W()
Else
If (direction = "NW1" Or direction = "NW2" Or direction = "NW3") Then arah_NW()
        End If
        End If
        End If
        End If
        End If
        End If
        End If
        End If
    End Sub
    Private Sub arah_N()
        Label7.Text = "NW(6)"
        Label8.Text = "B.Metal"
        Label8.ForeColor = Color.DarkGray
        Label9.Text = "Mentor"
        Label10.Text = "N(1)"
        Label11.Text = "Water"
        Label11.ForeColor = Color.Blue
        Label12.Text = "Carrier"
        Label13.Text = "NE(8)"
        Label14.Text = "S.Earth"
        Label14.ForeColor = Color.Gold
        Label15.Text = "Education"
        Label16.Text = "E(3)"
        Label17.Text = "B.Wood"
        Label17.ForeColor = Color.Green
        Label18.Text = "Health"
```

```
    Label19.Text = "SE-4"
    Label20.Text = "S.Wood"
    Label20.ForeColor = Color.Green
    Label21.Text = "Wealth"
    Label22.Text = "S-9"
    Label23.Text = "Fire"
    Label23.ForeColor = Color.Red
    Label24.Text = "Fame"
    Label25.Text = "SW-2"
    Label26.Text = "B.Earth"
    Label26.ForeColor = Color.Gold
    Label27.Text = "Love"
    Label28.Text = "W-7"
    Label29.Text = "S.Metal"
    Label29.ForeColor = Color.DarkGray
    Label30.Text = "Descendant"
End Sub
Private Sub arah_NE()
    Label7.Text = "N-1"
    Label8.Text = "Water"
    Label8.ForeColor = Color.Blue
    Label9.Text = "Carrier"
    Label10.Text = "NE-8"
    Label11.Text = "S.Earth"
    Label11.ForeColor = Color.Gold
    Label12.Text = "Education"
    Label13.Text = "E-3"
    Label14.Text = "B.Wood"
    Label14.ForeColor = Color.Green
    Label15.Text = "Health"
    Label16.Text = "SE-4"
```

```
    Label17.Text = "S.Wood"
    Label17.ForeColor = Color.Green
    Label18.Text = "Wealth"
    Label19.Text = "S-9"
    Label20.Text = "Fire"
    Label20.ForeColor = Color.Red
    Label21.Text = "Fame"
    Label22.Text = "SW-2"
    Label23.Text = "B.Earth"
    Label23.ForeColor = Color.Gold
    Label24.Text = "Love"
    Label25.Text = "W-7"
    Label26.Text = "S.Metal"
    Label26.ForeColor = Color.DarkGray
    Label27.Text = "Descendant"
    Label28.Text = "NW-6"
    Label29.Text = "B.Metal"
    Label29.ForeColor = Color.DarkGray
    Label30.Text = "Mentor"
End Sub
Private Sub arah_E()
    Label7.Text = "NE-8"
    Label8.Text = "S.Earth"
    Label8.ForeColor = Color.Gold
    Label9.Text = "Education"
    Label10.Text = "E-3"
    Label11.Text = "B.Wood"
    Label11.ForeColor = Color.Green
    Label12.Text = "Health"
    Label13.Text = "SE-4"
    Label14.Text = "S.Wood"
```

```
    Label14.ForeColor = Color.Green
    Label15.Text = "Wealth"
    Label16.Text = "S-9"
    Label17.Text = "Fire"
    Label17.ForeColor = Color.Red
    Label18.Text = "Fame"
    Label19.Text = "SW-2"
    Label20.Text = "B.Earth"
    Label20.ForeColor = Color.Gold
    Label21.Text = "Love"
    Label22.Text = "W-7"
    Label23.Text = "S.Metal"
    Label23.ForeColor = Color.DarkGray
    Label24.Text = "Descendant"
    Label25.Text = "NW-6"
    Label26.Text = "B.Metal"
    Label26.ForeColor = Color.DarkGray
    Label27.Text = "Mentor"
    Label28.Text = "N-1"
    Label29.Text = "Water"
    Label29.ForeColor = Color.Blue
    Label30.Text = "Carrier"
End Sub
Private Sub arah_SE()
    Label7.Text = "E-3"
    Label8.Text = "B.Wood"
    Label8.ForeColor = Color.Green
    Label9.Text = "Health"
    Label10.Text = "SE-4"
    Label11.Text = "S.Wood"
    Label11.ForeColor = Color.Green
```

```
    Label12.Text = "Wealth"
    Label13.Text = "S-9"
    Label14.Text = "Fire"
    Label14.ForeColor = Color.Red
    Label15.Text = "Fame"
    Label16.Text = "SW-2"
    Label17.Text = "B.Earth"
    Label17.ForeColor = Color.Gold
    Label18.Text = "Love"
    Label19.Text = "W-7"
    Label20.Text = "S.Metal"
    Label20.ForeColor = Color.DarkGray
    Label21.Text = "Descendant"
    Label22.Text = "NW-6"
    Label23.Text = "B.Metal"
    Label23.ForeColor = Color.DarkGray
    Label24.Text = "Mentor"
    Label25.Text = "N-1"
    Label26.Text = "Water"
    Label26.ForeColor = Color.Blue
    Label27.Text = "Carrier"
    Label28.Text = "NE-8"
    Label29.Text = "S.Earth"
    Label29.ForeColor = Color.Gold
    Label30.Text = "Education"
End Sub
Private Sub arah_S()
    Label7.Text = "SE-4"
    Label8.Text = "S.Wood"
    Label8.ForeColor = Color.Green
    Label9.Text = "Wealth"
```

```
    Label10.Text = "S-9"
    Label11.Text = "Fire"
    Label11.ForeColor = Color.Red
    Label12.Text = "Fame"
    Label13.Text = "SW-2"
    Label14.Text = "B.Earth"
    Label14.ForeColor = Color.Gold
    Label15.Text = "Love"
    Label16.Text = "W-7"
    Label17.Text = "S.Metal"
    Label17.ForeColor = Color.DarkGray
    Label18.Text = "Descendant"
    Label19.Text = "NW-6"
    Label20.Text = "B.Metal"
    Label20.ForeColor = Color.DarkGray
    Label21.Text = "Mentor"
    Label22.Text = "N-1"
    Label23.Text = "Water"
    Label23.ForeColor = Color.Blue
    Label24.Text = "Carrier"
    Label25.Text = "NE-8"
    Label26.Text = "S.Earth"
    Label26.ForeColor = Color.Gold
    Label27.Text = "Education"
    Label28.Text = "E-3"
    Label29.Text = "B.Wood"
    Label29.ForeColor = Color.Green
    Label30.Text = "Health"
End Sub
Private Sub arah_SW()
    Label7.Text = "S(9)"
```

```
Label8.Text = "Fire"
Label8.ForeColor = Color.Red
Label9.Text = "Fame"
Label10.Text = "SW(2)"
Label11.Text = "B.Earth"
Label11.ForeColor = Color.Gold
Label12.Text = "Love"
Label13.Text = "W(7)"
Label14.Text = "S.Metal"
Label14.ForeColor = Color.DarkGray
Label15.Text = "Descendant"
Label16.Text = "NW(6)"
Label17.Text = "B.Metal"
Label17.ForeColor = Color.DarkGray
Label18.Text = "Mentor"
Label19.Text = "N(1)"
Label20.Text = "Water"
Label20.ForeColor = Color.Blue
Label21.Text = "Carrier"
Label22.Text = "NE(8)"
Label23.Text = "S.Earth"
Label23.ForeColor = Color.Gold
Label24.Text = "Education"
Label25.Text = "E(3)"
Label26.Text = "B.Wood"
Label26.ForeColor = Color.Green
Label27.Text = "Health"
Label28.Text = "SE(4)"
Label29.Text = "S.Wood"
Label29.ForeColor = Color.Green
Label30.Text = "Wealth"
```

```
End Sub
Private Sub arah_W()
   Label7.Text = "SW(2)"
    Label8.Text = "B.Earth"
    Label8.ForeColor = Color.Gold
    Label9.Text = "Love"
    Label10.Text = "W(7)"
    Label11.Text = "S.Metal"
    Label11.ForeColor = Color.DarkGray
    Label12.Text = "Descendant"
    Label13.Text = "NW(6)"
    Label14.Text = "B.Metal"
    Label14.ForeColor = Color.DarkGray
    Label15.Text = "Mentor"
    Label16.Text = "N(1)"
    Label17.Text = "Water"
    Label17.ForeColor = Color.Blue
    Label18.Text = "Carrier"
    Label19.Text = "NE(8)"
    Label20.Text = "S.Earth"
    Label20.ForeColor = Color.Gold
    Label21.Text = "Education"
    Label22.Text = "E(3)"
    Label23.Text = "B.Wood"
    Label23.ForeColor = Color.Green
    Label24.Text = "Health"
    Label25.Text = "SE(4)"
    Label26.Text = "S.Wood"
    Label26.ForeColor = Color.Green
    Label27.Text = "Wealth"
    Label28.Text = "S(9)"
```

```
        Label29.Text = "Fire"
        Label29.ForeColor = Color.Red
        Label30.Text = "Fame"
    End Sub
    Private Sub arah_NW()
        Label7.Text = "W(7)"
        Label8.Text = "S.Metal"
        Label8.ForeColor = Color.DarkGray
        Label9.Text = "Descendant"
        Label10.Text = "NW(6)"
        Label11.Text = "B.Metal"
        Label11.ForeColor = Color.DarkGray
        Label12.Text = "Mentor"
        Label13.Text = "N(1)"
        Label14.Text = "Water"
        Label14.ForeColor = Color.Blue
        Label15.Text = "Carrier"
        Label16.Text = "NE(8)"
        Label17.Text = "S.Earth"
        Label17.ForeColor = Color.Gold
        Label18.Text = "Education"
        Label19.Text = "E(3)"
        Label20.Text = "B.Wood"
        Label20.ForeColor = Color.Green
        Label21.Text = "Health"
        Label22.Text = "SE(4)"
        Label23.Text = "S.Wood"
        Label23.ForeColor = Color.Green
        Label24.Text = "Wealth"
        Label25.Text = "S(9)"
        Label26.Text = "Fire"
```

```
        Label26.ForeColor = Color.Red
        Label27.Text = "Fame"
        Label28.Text = "SW(2)"
        Label29.Text = "B.Earth"
        Label29.ForeColor = Color.Gold
        Label30.Text = "Love"
    End Sub
End Class

Public Class Form4
    Private Sub Button1_Click(ByVal sender As Object, ByVal e As System.EventArgs) Handles
Button1.Click
        Me.Close()
    End Sub
    Private Sub Button2_Click(ByVal sender As Object, ByVal e As System.EventArgs) Handles
Button2.Click
        Dim Fs_7 As New Form5
        Fs_7.ShowDialog()
        Fs_7 = Nothing
    End Sub
    Private Sub Button3_Click(ByVal sender As Object, ByVal e As System.EventArgs) Handles
Button3.Click
        Dim Fs_8 As New Form6
        Fs_8.ShowDialog()
        Fs_8 = Nothing
    End Sub
End Class
```

```
Imports System.IO
Public Class Form5
    Dim direction As String
    Dim p_7 As String
    Dim p_7_baris() As String
    Dim p_7_kolom() As String
    Dim final As String

    Private Sub Form5_Load(ByVal sender As Object, ByVal e As System.EventArgs) Handles
MyBase.Load
        Dim OpenFile As New OpenFileDialog
        OpenFile.FileName = "periode_7.txt"
        Try
            Dim Read As New System.IO.StreamReader(OpenFile.FileName)
            p_7 = Read.ReadToEnd()
            Read.Close()
        Catch ex As Exception
        End Try
        p_7_baris = Split(p_7, ";")
    End Sub
    Private Sub Button1_Click(ByVal sender As Object, ByVal e As System.EventArgs) Handles
Button1.Click
        Me.Close()
    End Sub
    Private Sub Timer1_Tick(ByVal sender As Object, ByVal e As System.EventArgs) Handles
Timer1.Tick
        Label3.Text = Form1.TextBox1.Text
        direction = Form1.Label3.Text
        Label6.Text = direction
        penentu_arah()
```

```
    End Sub
    Private Sub penentu_arah()
If direction = "N1" Then
p_7_kolom = Split(p_7_baris(0), ",")
Else
If direction = "N2" Or direction = "N3" Then
p_7_kolom = Split(p_7_baris(1), ",")
Else
If direction = "NE1" Then
p_7_kolom = Split(p_7_baris(2), ",")
Else
If direction = "NE2" Or direction = "NE3" Then
p_7_kolom = Split(p_7_baris(3), ",")
Else
If direction = "E1" Then
p_7_kolom = Split(p_7_baris(4), ",")
Else
If direction = "E2" Or direction = "E3" Then
p_7_kolom = Split(p_7_baris(5), ",")
Else
If direction = "SE1" Then
p_7_kolom = Split(p_7_baris(6), ",")
Else
If direction = "SE2" Or direction = "SE3" Then
p_7_kolom = Split(p_7_baris(7), ",")
Else
If direction = "S1" Then
p_7_kolom = Split(p_7_baris(8), ",")
Else
If direction = "S2" Or direction = "S3" Then
p_7_kolom = Split(p_7_baris(9), ",")
```

```
Else
If direction = "SW1" Then
p_7_kolom = Split(p_7_baris(10), ",")
Else
If direction = "SW2" Or direction = "SW3" Then
p_7_kolom = Split(p_7_baris(11), ",")
Else
If direction = "W1" Then
p_7_kolom = Split(p_7_baris(12), ",")
Else
If direction = "W2" Or direction = "W3" Then
p_7_kolom = Split(p_7_baris(13), ",")
Else
If direction = "NW1" Then
p_7_kolom = Split(p_7_baris(14), ",")
Else
If direction = "NW2" Or direction = "NW3" Then
p_7_kolom = Split(p_7_baris(15), ",")
End If
End If
End If
End If
End If
End If
End If
End If
End If
End If
End If
End If
End If
End If
End If
End If
```

```
End If
End If
End If
        penampil_arah()
    End Sub
    Private Sub penampil_arah()
        Label7.Text = p_7_kolom(15)
        Label8.Text = p_7_kolom(16)
        Label9.Text = p_7_kolom(1)
        Label10.Text = p_7_kolom(2)
        Label11.Text = p_7_kolom(3)
        Label12.Text = p_7_kolom(4)
        Label13.Text = p_7_kolom(5)
        Label14.Text = p_7_kolom(6)
        Label15.Text = p_7_kolom(7)
        Label16.Text = p_7_kolom(8)
        Label17.Text = p_7_kolom(9)
        Label18.Text = p_7_kolom(10)
        Label19.Text = p_7_kolom(11)
        Label20.Text = p_7_kolom(12)
        Label21.Text = p_7_kolom(13)
        Label22.Text = p_7_kolom(14)
        Label5.Text = p_7_kolom(17)
    End Sub
    Private Sub Button2_Click(ByVal sender As Object, ByVal e As System.EventArgs) Handles
Button2.Click
        Dim help_fs As New Form8
        help_fs.ShowDialog()
        help_fs = Nothing
    End Sub
End Class
```

```
Imports System.IO
Public Class Form6
    Dim direction As String
    Dim p_8 As String
    Dim p_8_baris() As String
    Dim p_8_kolom() As String
    Dim final As String
    Private Sub Button1_Click(ByVal sender As Object, ByVal e As System.EventArgs) Handles
Button1.Click
        Me.Close()
    End Sub
    Private Sub Timer1_Tick(ByVal sender As Object, ByVal e As System.EventArgs) Handles
Timer1.Tick
        Label3.Text = Form1.TextBox1.Text
        direction = Form1.Label3.Text
        Label6.Text = direction
        penentu_arah()
    End Sub
    Private Sub Form6_Load(ByVal sender As Object, ByVal e As System.EventArgs) Handles
MyBase.Load
        Dim OpenFile As New OpenFileDialog
        OpenFile.FileName = "periode_8.txt"
        Try
            Dim Read As New System.IO.StreamReader(OpenFile.FileName)
            p_8 = Read.ReadToEnd()
            Read.Close()
        Catch ex As Exception
        End Try
        p_8_baris = Split(p_8, ";")
    End Sub
    Private Sub penentu_arah()
```

```
If direction = "N1" Then
p_8_kolom = Split(p_8_baris(0), ",")
Else
If direction = "N2" Or direction = "N3" Then
p_8_kolom = Split(p_8_baris(1), ",")
Else
If direction = "NE1" Then
p_8_kolom = Split(p_8_baris(2), ",")
Else
If direction = "NE2" Or direction = "NE3" Then
p_8_kolom = Split(p_8_baris(3), ",")
Else
If direction = "E1" Then
p_8_kolom = Split(p_8_baris(4), ",")
Else
If direction = "E2" Or direction = "E3" Then
p_8_kolom = Split(p_8_baris(5), ",")
Else
If direction = "SE1" Then
p_8_kolom = Split(p_8_baris(6), ",")
Else
If direction = "SE2" Or direction = "SE3" Then
p_8_kolom = Split(p_8_baris(7), ",")
Else
If direction = "S1" Then
p_8_kolom = Split(p_8_baris(8), ",")
Else
If direction = "S2" Or direction = "S3" Then
p_8_kolom = Split(p_8_baris(9), ",")
Else
If direction = "SW1" Then
```

```
p_8_kolom = Split(p_8_baris(10), ",")
Else
If direction = "SW2" Or direction = "SW3" Then
p_8_kolom = Split(p_8_baris(11), ",")
Else
If direction = "W1" Then
p_8_kolom = Split(p_8_baris(12), ",")
Else
If direction = "W2" Or direction = "W3" Then
p_8_kolom = Split(p_8_baris(13), ",")
Else
If direction = "NW1" Then
p_8_kolom = Split(p_8_baris(14), ",")
Else
If direction = "NW2" Or direction = "NW3" Then
p_8_kolom = Split(p_8_baris(15), ",")
End If
End If
End If
End If
End If
End If
End If
End If
End If
End If
End If
End If
End If
End If
End If
End If
End If
End If
```

```
End If
        penampil_arah()
    End Sub
Private Sub penampil_arah()
        Label7.Text = p_8_kolom(15)
        Label8.Text = p_8_kolom(16)
        Label9.Text = p_8_kolom(1)
        Label10.Text = p_8_kolom(2)
        Label11.Text = p_8_kolom(3)
        Label12.Text = p_8_kolom(4)
        Label13.Text = p_8_kolom(5)
        Label14.Text = p_8_kolom(6)
        Label15.Text = p_8_kolom(7)
        Label16.Text = p_8_kolom(8)
        Label17.Text = p_8_kolom(9)
        Label18.Text = p_8_kolom(10)
        Label19.Text = p_8_kolom(11)
        Label20.Text = p_8_kolom(12)
        Label21.Text = p_8_kolom(13)
        Label22.Text = p_8_kolom(14)
        Label5.Text = p_8_kolom(17)
    End Sub
    Private Sub Button2_Click(ByVal sender As Object, ByVal e As System.EventArgs) Handles
Button2.Click
        Dim help_fs_form As New Form8
        help_fs_form.ShowDialog()
        help_fs_form = Nothing
    End Sub
End Class
```

```
Public Class Form7
    Private Sub Button2_Click(ByVal sender As System.Object, ByVal e As System.EventArgs)
Handles Button2.Click
        Me.Close()
    End Sub
    Private Sub Button1_Click(ByVal sender As Object, ByVal e As System.EventArgs) Handles
Button1.Click
        Form1.kalibrasi_method()
        Me.Close()
    End Sub
    Private Sub Timer1_Tick(ByVal sender As Object, ByVal e As System.EventArgs) Handles
Timer1.Tick
        TextBox1.Text = Form1.TextBox1.Text
    End Sub
End Class


Public Class Form8
    Private Sub Button1_Click(ByVal sender As Object, ByVal e As System.EventArgs) Handles
Button1.Click
        Me.Close()
    End Sub
End Class
```

Database 8Mansion

1924	2	5	4	2	N	SC	wealth	NE	cm	total loss	E	YN	relation	SE	FW	creativity	S	TY	health
1925	1	24	3	3	N	TY	health	NE	ls	bodily harm	E	FW	creativity	SE	YN	relation	S	SC	wealth
1926	2	13	2	4	N	cm	total loss	NE	SC	wealth	E	hh	misfortunes	SE	wk	loss	S	ls	bodily harm
1927	2	2	1	8	N	FW	creativity	NE	wk	loss	E	TY	relation	SE	SC	wealth	S	YN	relation
1928	1	23	9	6	N	YN	relation	NE	hh	misfortunes	E	SC	wealth	SE	TY	health	S	FW	creativity
1929	2	10	8	7	N	wk	loss	NE	FW	creativity	E	ls	bodily harm	SE	cm	total loss	S	hh	misfortunes
1930	1	30	7	8	N	hh	misfortunes	NE	YN	relation	E	cm	total loss	SE	ls	bodily harm	S	wk	loss
1931	2	17	6	9	N	ls	bodily harm	NE	TY	health	E	wk	loss	SE	hh	misfortunes	S	cm	total loss
1932	2	6	2	1	N	cm	total loss	NE	SC	wealth	E	hh	misfortunes	SE	wk	loss	S	ls	bodily harm
1933	1	26	4	2	N	SC	wealth	NE	cm	total loss	E	YN	relation	SE	FW	creativity	S	TY	health
1934	2	14	3	3	N	TY	health	NE	ls	bodily harm	E	FW	creativity	SE	YN	relation	S	SC	wealth
1935	2	4	2	4	N	cm	total loss	NE	SC	wealth	E	hh	misfortunes	SE	wk	loss	S	ls	bodily harm
1936	1	24	1	8	N	FW	creativity	NE	wk	loss	E	TY	relation	SE	SC	wealth	S	YN	relation
1937	2	11	9	6	N	YN	relation	NE	hh	misfortunes	E	SC	wealth	SE	TY	health	S	FW	creativity
1938	1	31	8	7	N	wk	loss	NE	FW	creativity	E	ls	bodily harm	SE	cm	total loss	S	hh	misfortunes
1939	2	19	7	8	N	hh	misfortunes	NE	YN	relation	E	cm	total loss	SE	ls	bodily harm	S	wk	loss
1940	2	8	6	9	N	ls	bodily harm	NE	TY	health	E	wk	loss	SE	hh	misfortunes	S	cm	total loss
1941	1	27	2	1	N	cm	total loss	NE	SC	wealth	E	hh	misfortunes	SE	wk	loss	S	ls	bodily harm
1942	2	15	4	2	N	SC	wealth	NE	cm	total loss	E	YN	relation	SE	FW	creativity	S	TY	health
1943	2	5	3	3	N	TY	health	NE	ls	bodily harm	E	FW	creativity	SE	YN	relation	S	SC	wealth
1944	1	25	2	4	N	cm	total loss	NE	SC	wealth	E	hh	misfortunes	SE	wk	loss	S	ls	bodily harm
1945	2	13	1	8	N	FW	creativity	NE	wk	loss	E	TY	relation	SE	SC	wealth	S	YN	relation
1946	2	2	9	6	N	YN	relation	NE	hh	misfortunes	E	SC	wealth	SE	TY	health	S	FW	creativity
1947	1	22	8	7	N	wk	loss	NE	FW	creativity	E	ls	bodily harm	SE	cm	total loss	S	hh	misfortunes
1948	2	10	7	8	N	hh	misfortunes	NE	YN	relation	E	cm	total loss	SE	ls	bodily harm	S	wk	loss
1949	1	29	6	9	N	ls	bodily harm	NE	TY	health	E	wk	loss	SE	hh	misfortunes	S	cm	total loss
1950	2	17	2	1	N	cm	total loss	NE	SC	wealth	E	hh	misfortunes	SE	wk	loss	S	ls	bodily harm
1951	2	6	4	2	N	SC	wealth	NE	cm	total loss	E	YN	relation	SE	FW	creativity	S	TY	health
1952	1	27	3	3	N	TY	health	NE	ls	bodily harm	E	FW	creativity	SE	YN	relation	S	SC	wealth
1953	2	14	2	4	N	cm	total loss	NE	SC	wealth	E	hh	misfortunes	SE	wk	loss	S	ls	bodily harm
1954	2	3	1	8	N	FW	creativity	NE	wk	loss	E	TY	relation	SE	SC	wealth	S	YN	relation
1955	1	24	9	6	N	YN	relation	NE	hh	misfortunes	E	SC	wealth	SE	TY	health	S	FW	creativity
1956	2	12	8	7	N	wk	loss	NE	FW	creativity	E	ls	bodily harm	SE	cm	total loss	S	hh	misfortunes
1957	1	31	7	8	N	hh	misfortunes	NE	YN	relation	E	cm	total loss	SE	ls	bodily harm	S	wk	loss
1958	2	18	6	9	N	ls	bodily harm	NE	TY	health	E	wk	loss	SE	hh	misfortunes	S	cm	total loss
1959	2	8	2	1	N	cm	total loss	NE	SC	wealth	E	hh	misfortunes	SE	wk	loss	S	ls	bodily harm
1960	1	28	4	2	N	SC	wealth	NE	cm	total loss	E	YN	relation	SE	FW	creativity	S	TY	health
1961	2	15	3	3	N	TY	health	NE	ls	bodily harm	E	FW	creativity	SE	YN	relation	S	SC	wealth
1962	2	5	2	4	N	cm	total loss	NE	SC	wealth	E	hh	misfortunes	SE	wk	loss	S	ls	bodily harm
1963	1	25	1	8	N	FW	creativity	NE	wk	loss	E	TY	relation	SE	SC	wealth	S	YN	relation
1964	2	13	9	6	N	YN	relation	NE	hh	misfortunes	E	SC	wealth	SE	TY	health	S	FW	creativity
1965	2	2	8	7	N	wk	loss	NE	FW	creativity	E	ls	bodily harm	SE	cm	total loss	S	hh	misfortunes
1966	1	21	7	8	N	hh	misfortunes	NE	YN	relation	E	cm	total loss	SE	ls	bodily harm	S	wk	loss
1967	2	9	6	9	N	ls	bodily harm	NE	TY	health	E	wk	loss	SE	hh	misfortunes	S	cm	total loss
1968	1	30	2	1	N	cm	total loss	NE	SC	wealth	E	hh	misfortunes	SE	wk	loss	S	ls	bodily harm
1969	2	17	4	2	N	SC	wealth	NE	cm	total loss	E	YN	relation	SE	FW	creativity	S	TY	health
1970	2	6	3	3	N	TY	health	NE	ls	bodily harm	E	FW	creativity	SE	YN	relation	S	SC	wealth
1971	1	27	2	4	N	cm	total loss	NE	SC	wealth	E	hh	misfortunes	SE	wk	loss	S	ls	bodily harm
1972	2	15	1	8	N	FW	creativity	NE	wk	loss	E	TY	relation	SE	SC	wealth	S	YN	relation
1973	2	3	9	6	N	YN	relation	NE	hh	misfortunes	E	SC	wealth	SE	TY	health	S	FW	creativity

SW	wk	loss	W	ls	bodily harm	NW	hh	misfortunes	N	cm	total loss	NE	SC	wealth	E	hh	misfortunes
SW	hh	misfortunes	W	cm	total loss	NW	wk	loss	N	TY	health	NE	ls	bodily harm	E	FW	creativity
SW	FW	creativity	W	TY	health	NW	YN	relation	N	SC	wealth	NE	cm	total loss	E	YN	relation
SW	cm	total loss	W	hh	misfortunes	NW	ls	bodily harm	N	wk	loss	NE	FW	creativity	E	ls	bodily harm
SW	ls	bodily harm	W	wk	loss	NW	cm	total loss	N	ls	bodily harm	NE	TY	health	E	wk	loss
SW	SC	wealth	W	YN	relation	NW	TY	health	N	hh	misfortunes	NE	YN	relation	E	cm	total loss
SW	TY	health	W	FW	creativity	NW	SC	wealth	N	wk	loss	NE	FW	creativity	E	ls	bodily harm
SW	YN	relation	W	SC	wealth	NW	FW	creativity	N	YN	relation	NE	hh	misfortunes	E	SC	wealth
SW	FW	creativity	W	TY	health	NW	YN	relation	N	FW	creativity	NE	wk	loss	E	TY	health
SW	wk	loss	W	ls	bodily harm	NW	hh	misfortunes	N	cm	total loss	NE	SC	wealth	E	hh	misfortunes
SW	hh	misfortunes	W	cm	total loss	NW	wk	loss	N	TY	health	NE	ls	bodily harm	E	FW	creativity
SW	FW	creativity	W	TY	health	NW	YN	relation	N	SC	wealth	NE	cm	total loss	E	YN	relation
SW	cm	total loss	W	hh	misfortunes	NW	ls	bodily harm	N	wk	loss	NE	FW	creativity	E	ls	bodily harm
SW	ls	bodily harm	W	wk	loss	NW	cm	total loss	N	ls	bodily harm	NE	TY	health	E	wk	loss
SW	SC	wealth	W	YN	relation	NW	TY	health	N	hh	misfortunes	NE	YN	relation	E	cm	total loss
SW	TY	health	W	FW	creativity	NW	SC	wealth	N	wk	loss	NE	FW	creativity	E	ls	bodily harm
SW	YN	relation	W	SC	wealth	NW	FW	creativity	N	YN	relation	NE	hh	misfortunes	E	SC	wealth
SW	FW	creativity	W	TY	health	NW	YN	relation	N	FW	creativity	NE	wk	loss	E	TY	health
SW	wk	loss	W	ls	bodily harm	NW	hh	misfortunes	N	cm	total loss	NE	SC	wealth	E	hh	misfortunes
SW	hh	misfortunes	W	cm	total loss	NW	wk	loss	N	TY	health	NE	ls	bodily harm	E	FW	creativity
SW	FW	creativity	W	TY	health	NW	YN	relation	N	SC	wealth	NE	cm	total loss	E	YN	relation
SW	cm	total loss	W	hh	misfortunes	NW	ls	bodily harm	N	wk	loss	NE	FW	creativity	E	ls	bodily harm
SW	ls	bodily harm	W	wk	loss	NW	cm	total loss	N	ls	bodily harm	NE	TY	health	E	wk	loss
SW	SC	wealth	W	YN	relation	NW	TY	health	N	hh	misfortunes	NE	YN	relation	E	cm	total loss
SW	TY	health	W	FW	creativity	NW	SC	wealth	N	wk	loss	NE	FW	creativity	E	ls	bodily harm
SW	YN	relation	W	SC	wealth	NW	FW	creativity	N	YN	relation	NE	hh	misfortunes	E	SC	wealth
SW	FW	creativity	W	TY	health	NW	YN	relation	N	FW	creativity	NE	wk	loss	E	TY	health
SW	wk	loss	W	ls	bodily harm	NW	hh	misfortunes	N	cm	total loss	NE	SC	wealth	E	hh	misfortunes
SW	hh	misfortunes	W	cm	total loss	NW	wk	loss	N	TY	health	NE	ls	bodily harm	E	FW	creativity
SW	FW	creativity	W	TY	health	NW	YN	relation	N	SC	wealth	NE	cm	total loss	E	YN	relation
SW	cm	total loss	W	hh	misfortunes	NW	ls	bodily harm	N	wk	loss	NE	FW	creativity	E	ls	bodily harm
SW	ls	bodily harm	W	wk	loss	NW	cm	total loss	N	ls	bodily harm	NE	TY	health	E	wk	loss
SW	SC	wealth	W	YN	relation	NW	TY	health	N	hh	misfortunes	NE	YN	relation	E	cm	total loss
SW	TY	health	W	FW	creativity	NW	SC	wealth	N	wk	loss	NE	FW	creativity	E	ls	bodily harm
SW	YN	relation	W	SC	wealth	NW	FW	creativity	N	YN	relation	NE	hh	misfortunes	E	SC	wealth
SW	FW	creativity	W	TY	health	NW	YN	relation	N	FW	creativity	NE	wk	loss	E	TY	health
SW	wk	loss	W	ls	bodily harm	NW	hh	misfortunes	N	cm	total loss	NE	SC	wealth	E	hh	misfortunes
SW	hh	misfortunes	W	cm	total loss	NW	wk	loss	N	TY	health	NE	ls	bodily harm	E	FW	creativity
SW	FW	creativity	W	TY	health	NW	YN	relation	N	SC	wealth	NE	cm	total loss	E	YN	relation
SW	cm	total loss	W	hh	misfortunes	NW	ls	bodily harm	N	wk	loss	NE	FW	creativity	E	ls	bodily harm
SW	ls	bodily harm	W	wk	loss	NW	cm	total loss	N	ls	bodily harm	NE	TY	health	E	wk	loss
SW	SC	wealth	W	YN	relation	NW	TY	health	N	hh	misfortunes	NE	YN	relation	E	cm	total loss
SW	TY	health	W	FW	creativity	NW	SC	wealth	N	wk	loss	NE	FW	creativity	E	ls	bodily harm
SW	YN	relation	W	SC	wealth	NW	FW	creativity	N	YN	relation	NE	hh	misfortunes	E	SC	wealth
SW	FW	creativity	W	TY	health	NW	YN	relation	N	FW	creativity	NE	wk	loss	E	TY	health
SW	wk	loss	W	ls	bodily harm	NW	hh	misfortunes	N	cm	total loss	NE	SC	wealth	E	hh	misfortunes
SW	hh	misfortunes	W	cm	total loss	NW	wk	loss	N	TY	health	NE	ls	bodily harm	E	FW	creativity
SW	FW	creativity	W	TY	health	NW	YN	relation	N	SC	wealth	NE	cm	total loss	E	YN	relation
SW	cm	total loss	W	hh	misfortunes	NW	ls	bodily harm	N	wk	loss	NE	FW	creativity	E	ls	bodily harm
SW	ls	bodily harm	W	wk	loss	NW	cm	total loss	N	ls	bodily harm	NE	TY	health	E	wk	loss

SE	wk	loss	S	ls	bodily harm	SW	FW	creativity	W	TY	health	NW	YN	relation	;
SE	YN	relation	S	SC	wealth	SW	hh	misfortunes	W	cm	total loss	NW	wk	loss	;
SE	FW	creativity	S	TY	health	SW	wk	loss	W	ls	bodily harm	NW	hh	misfortunes	;
SE	cm	total loss	S	hh	misfortunes	SW	SC	wealth	W	YN	relation	NW	TY	health	;
SE	hh	misfortunes	S	cm	total loss	SW	YN	relation	W	SC	wealth	NW	FW	creativity	;
SE	ls	bodily harm	S	wk	loss	SW	TY	health	W	FW	creativity	NW	SC	wealth	;
SE	cm	total loss	S	hh	misfortunes	SW	SC	wealth	W	YN	relation	NW	TY	health	;
SE	TY	health	S	FW	creativity	SW	ls	bodily harm	W	wk	loss	NW	cm	total loss	;
SE	SC	wealth	S	YN	relation	SW	cm	total loss	W	hh	misfortunes	NW	ls	bodily harm	;
SE	wk	loss	S	ls	bodily harm	SW	FW	creativity	W	TY	health	NW	YN	relation	;
SE	YN	relation	S	SC	wealth	SW	hh	misfortunes	W	cm	total loss	NW	wk	loss	;
SE	FW	creativity	S	TY	health	SW	wk	loss	W	ls	bodily harm	NW	hh	misfortunes	;
SE	cm	total loss	S	hh	misfortunes	SW	SC	wealth	W	YN	relation	NW	TY	health	;
SE	hh	misfortunes	S	cm	total loss	SW	YN	relation	W	SC	wealth	NW	FW	creativity	;
SE	ls	bodily harm	S	wk	loss	SW	TY	health	W	FW	creativity	NW	SC	wealth	;
SE	cm	total loss	S	hh	misfortunes	SW	SC	wealth	W	YN	relation	NW	TY	health	;
SE	TY	health	S	FW	creativity	SW	ls	bodily harm	W	wk	loss	NW	cm	total loss	;
SE	SC	wealth	S	YN	relation	SW	cm	total loss	W	hh	misfortunes	NW	ls	bodily harm	;
SE	wk	loss	S	ls	bodily harm	SW	FW	creativity	W	TY	health	NW	YN	relation	;
SE	YN	relation	S	SC	wealth	SW	hh	misfortunes	W	cm	total loss	NW	wk	loss	;
SE	FW	creativity	S	TY	health	SW	wk	loss	W	ls	bodily harm	NW	hh	misfortunes	;
SE	cm	total loss	S	hh	misfortunes	SW	SC	wealth	W	YN	relation	NW	TY	health	;
SE	hh	misfortunes	S	cm	total loss	SW	YN	relation	W	SC	wealth	NW	FW	creativity	;
SE	ls	bodily harm	S	wk	loss	SW	TY	health	W	FW	creativity	NW	SC	wealth	;
SE	cm	total loss	S	hh	misfortunes	SW	SC	wealth	W	YN	relation	NW	TY	health	;
SE	TY	health	S	FW	creativity	SW	ls	bodily harm	W	wk	loss	NW	cm	total loss	;
SE	SC	wealth	S	YN	relation	SW	cm	total loss	W	hh	misfortunes	NW	ls	bodily harm	;
SE	wk	loss	S	ls	bodily harm	SW	FW	creativity	W	TY	health	NW	YN	relation	;
SE	YN	relation	S	SC	wealth	SW	hh	misfortunes	W	cm	total loss	NW	wk	loss	;
SE	FW	creativity	S	TY	health	SW	wk	loss	W	ls	bodily harm	NW	hh	misfortunes	;
SE	cm	total loss	S	hh	misfortunes	SW	SC	wealth	W	YN	relation	NW	TY	health	;
SE	hh	misfortunes	S	cm	total loss	SW	YN	relation	W	SC	wealth	NW	FW	creativity	;
SE	ls	bodily harm	S	wk	loss	SW	TY	health	W	FW	creativity	NW	SC	wealth	;
SE	cm	total loss	S	hh	misfortunes	SW	SC	wealth	W	YN	relation	NW	TY	health	;
SE	TY	health	S	FW	creativity	SW	ls	bodily harm	W	wk	loss	NW	cm	total loss	;
SE	SC	wealth	S	YN	relation	SW	cm	total loss	W	hh	misfortunes	NW	ls	bodily harm	;
SE	wk	loss	S	ls	bodily harm	SW	FW	creativity	W	TY	health	NW	YN	relation	;
SE	YN	relation	S	SC	wealth	SW	hh	misfortunes	W	cm	total loss	NW	wk	loss	;
SE	FW	creativity	S	TY	health	SW	wk	loss	W	ls	bodily harm	NW	hh	misfortunes	;
SE	cm	total loss	S	hh	misfortunes	SW	SC	wealth	W	YN	relation	NW	TY	health	;
SE	hh	misfortunes	S	cm	total loss	SW	YN	relation	W	SC	wealth	NW	FW	creativity	;
SE	ls	bodily harm	S	wk	loss	SW	TY	health	W	FW	creativity	NW	SC	wealth	;
SE	cm	total loss	S	hh	misfortunes	SW	SC	wealth	W	YN	relation	NW	TY	health	;
SE	TY	health	S	FW	creativity	SW	ls	bodily harm	W	wk	loss	NW	cm	total loss	;
SE	SC	wealth	S	YN	relation	SW	cm	total loss	W	hh	misfortunes	NW	ls	bodily harm	;
SE	wk	loss	S	ls	bodily harm	SW	FW	creativity	W	TY	health	NW	YN	relation	;
SE	YN	relation	S	SC	wealth	SW	hh	misfortunes	W	cm	total loss	NW	wk	loss	;
SE	FW	creativity	S	TY	health	SW	wk	loss	W	ls	bodily harm	NW	hh	misfortunes	;
SE	cm	total loss	S	hh	misfortunes	SW	SC	wealth	W	YN	relation	NW	TY	health	;
SE	hh	misfortunes	S	cm	total loss	SW	YN	relation	W	SC	wealth	NW	FW	creativity	;

1974	1	23	8	7	N	wk	loss	NE	FW	creativity	E	ls	bodily harm	SE	cm	total loss	S	hh	misfortunes
1975	2	11	7	8	N	hh	misfortunes	NE	YN	relation	E	cm	total loss	SE	ls	bodily harm	S	wk	loss
1976	1	31	6	9	N	ls	bodily harm	NE	TY	health	E	wk	loss	SE	hh	misfortunes	S	cm	total loss
1977	2	18	2	1	N	cm	total loss	NE	SC	wealth	E	hh	misfortunes	SE	wk	loss	S	ls	bodily harm
1978	2	7	4	2	N	SC	wealth	NE	cm	total loss	E	YN	relation	SE	FW	creativity	S	TY	health
1979	1	28	3	3	N	TY	health	NE	ls	bodily harm	E	FW	creativity	SE	YN	relation	S	SC	wealth
1980	2	16	2	4	N	cm	total loss	NE	SC	wealth	E	hh	misfortunes	SE	wk	loss	S	ls	bodily harm
1981	2	5	1	8	N	FW	creativity	NE	wk	loss	E	TY	relation	SE	SC	wealth	S	YN	relation
1982	1	25	9	6	N	YN	relation	NE	hh	misfortunes	E	SC	wealth	SE	TY	health	S	FW	creativity
1983	2	13	8	7	N	wk	loss	NE	FW	creativity	E	ls	bodily harm	SE	cm	total loss	S	hh	misfortunes
1984	2	2	7	8	N	hh	misfortunes	NE	YN	relation	E	cm	total loss	SE	ls	bodily harm	S	wk	loss
1985	2	20	6	9	N	ls	bodily harm	NE	TY	health	E	wk	loss	SE	hh	misfortunes	S	cm	total loss
1986	2	9	2	1	N	cm	total loss	NE	SC	wealth	E	hh	misfortunes	SE	wk	loss	S	ls	bodily harm
1987	1	29	4	2	N	SC	wealth	NE	cm	total loss	E	YN	relation	SE	FW	creativity	S	TY	health
1988	2	17	3	3	N	TY	health	NE	ls	bodily harm	E	FW	creativity	SE	YN	relation	S	SC	wealth
1989	2	6	2	4	N	cm	total loss	NE	SC	wealth	E	hh	misfortunes	SE	wk	loss	S	ls	bodily harm
1990	1	27	1	8	N	FW	creativity	NE	wk	loss	E	TY	relation	SE	SC	wealth	S	YN	relation
1991	2	15	9	6	N	YN	relation	NE	hh	misfortunes	E	SC	wealth	SE	TY	health	S	FW	creativity
1992	2	4	8	7	N	wk	loss	NE	FW	creativity	E	ls	bodily harm	SE	cm	total loss	S	hh	misfortunes
1993	1	23	7	8	N	hh	misfortunes	NE	YN	relation	E	cm	total loss	SE	ls	bodily harm	S	wk	loss
1994	2	10	6	9	N	ls	bodily harm	NE	TY	health	E	wk	loss	SE	hh	misfortunes	S	cm	total loss
1995	1	31	2	1	N	cm	total loss	NE	SC	wealth	E	hh	misfortunes	SE	wk	loss	S	ls	bodily harm
1996	2	19	4	2	N	SC	wealth	NE	cm	total loss	E	YN	relation	SE	FW	creativity	S	TY	health
1997	2	7	3	3	N	TY	health	NE	ls	bodily harm	E	FW	creativity	SE	YN	relation	S	SC	wealth
1998	1	28	2	4	N	cm	total loss	NE	SC	wealth	E	hh	misfortunes	SE	wk	loss	S	ls	bodily harm
1999	2	16	1	8	N	FW	creativity	NE	wk	loss	E	TY	relation	SE	SC	wealth	S	YN	relation
2000	2	5	9	6	N	YN	relation	NE	hh	misfortunes	E	SC	wealth	SE	TY	health	S	FW	creativity
2001	1	24	8	7	N	wk	loss	NE	FW	creativity	E	ls	bodily harm	SE	cm	total loss	S	hh	misfortunes
2002	2	12	7	8	N	hh	misfortunes	NE	YN	relation	E	cm	total loss	SE	ls	bodily harm	S	wk	loss
2003	2	1	6	9	N	ls	bodily harm	NE	TY	health	E	wk	loss	SE	hh	misfortunes	S	cm	total loss
2004	2	22	2	1	N	cm	total loss	NE	SC	wealth	E	hh	misfortunes	SE	wk	loss	S	ls	bodily harm
2005	2	9	4	2	N	SC	wealth	NE	cm	total loss	E	YN	relation	SE	FW	creativity	S	TY	health
2006	1	29	3	3	N	TY	health	NE	ls	bodily harm	E	FW	creativity	SE	YN	relation	S	SC	wealth
2007	2	18	2	4	N	cm	total loss	NE	SC	wealth	E	hh	misfortunes	SE	wk	loss	S	ls	bodily harm
2008	2	7	1	8	N	FW	creativity	NE	wk	loss	E	TY	relation	SE	SC	wealth	S	YN	relation
2009	1	26	9	6	N	YN	relation	NE	hh	misfortunes	E	SC	wealth	SE	TY	health	S	FW	creativity
2010	2	14	8	7	N	wk	loss	NE	FW	creativity	E	ls	bodily harm	SE	cm	total loss	S	hh	misfortunes
2011	2	3	7	8	N	hh	misfortunes	NE	YN	relation	E	cm	total loss	SE	ls	bodily harm	S	wk	loss
2012	1	23	6	9	N	ls	bodily harm	NE	TY	health	E	wk	loss	SE	hh	misfortunes	S	cm	total loss
2013	2	10	2	1	N	cm	total loss	NE	SC	wealth	E	hh	misfortunes	SE	wk	loss	S	ls	bodily harm
2014	1	31	4	2	N	SC	wealth	NE	cm	total loss	E	YN	relation	SE	FW	creativity	S	TY	health
2015	2	19	3	3	N	TY	health	NE	ls	bodily harm	E	FW	creativity	SE	YN	relation	S	SC	wealth
2016	2	8	2	4	N	cm	total loss	NE	SC	wealth	E	hh	misfortunes	SE	wk	loss	S	ls	bodily harm
2017	1	28	1	8	N	FW	creativity	NE	wk	loss	E	TY	relation	SE	SC	wealth	S	YN	relation
2018	2	16	9	6	N	YN	relation	NE	hh	misfortunes	E	SC	wealth	SE	TY	health	S	FW	creativity
2019	2	5	8	7	N	wk	loss	NE	FW	creativity	E	ls	bodily harm	SE	cm	total loss	S	hh	misfortunes
2020	1	25	7	8	N	hh	misfortunes	NE	YN	relation	E	cm	total loss	SE	ls	bodily harm	S	wk	loss
2021	2	12	6	9	N	ls	bodily harm	NE	TY	health	E	wk	loss	SE	hh	misfortunes	S	cm	total loss
2022	2	1	2	1	N	cm	total loss	NE	SC	wealth	E	hh	misfortunes	SE	wk	loss	S	ls	bodily harm
2023	1	22	4	2	N	SC	wealth	NE	cm	total loss	E	YN	relation	SE	FW	creativity	S	TY	health
2024	2	10	3	3	N	TY	health	NE	ls	bodily harm	E	FW	creativity	SE	YN	relation	S	SC	wealth

SW	SC	wealth	W	YN	relation	NW	TY	health	N	hh	misfortunes	NE	YN	relation	E	cm	total loss
SW	TY	health	W	FW	creativity	NW	SC	wealth	N	wk	loss	NE	FW	creativity	E	ls	bodily harm
SW	YN	relation	W	SC	wealth	NW	FW	creativity	N	YN	relation	NE	hh	misfortunes	E	SC	wealth
SW	FW	creativity	W	TY	health	NW	YN	relation	N	FW	creativity	NE	wk	loss	E	TY	health
SW	wk	loss	W	ls	bodily harm	NW	hh	misfortunes	N	cm	total loss	NE	SC	wealth	E	hh	misfortunes
SW	hh	misfortunes	W	cm	total loss	NW	wk	loss	N	TY	health	NE	ls	bodily harm	E	FW	creativity
SW	FW	creativity	W	TY	health	NW	YN	relation	N	SC	wealth	NE	cm	total loss	E	YN	relation
SW	cm	total loss	W	hh	misfortunes	NW	ls	bodily harm	N	wk	loss	NE	FW	creativity	E	ls	bodily harm
SW	ls	bodily harm	W	wk	loss	NW	cm	total loss	N	ls	bodily harm	NE	TY	health	E	wk	loss
SW	SC	wealth	W	YN	relation	NW	TY	health	N	hh	misfortunes	NE	YN	relation	E	cm	total loss
SW	TY	health	W	FW	creativity	NW	SC	wealth	N	wk	loss	NE	FW	creativity	E	ls	bodily harm
SW	YN	relation	W	SC	wealth	NW	FW	creativity	N	YN	relation	NE	hh	misfortunes	E	SC	wealth
SW	FW	creativity	W	TY	health	NW	YN	relation	N	FW	creativity	NE	wk	loss	E	TY	health
SW	wk	loss	W	ls	bodily harm	NW	hh	misfortunes	N	cm	total loss	NE	SC	wealth	E	hh	misfortunes
SW	hh	misfortunes	W	cm	total loss	NW	wk	loss	N	TY	health	NE	ls	bodily harm	E	FW	creativity
SW	FW	creativity	W	TY	health	NW	YN	relation	N	SC	wealth	NE	cm	total loss	E	YN	relation
SW	cm	total loss	W	hh	misfortunes	NW	ls	bodily harm	N	wk	loss	NE	FW	creativity	E	ls	bodily harm
SW	ls	bodily harm	W	wk	loss	NW	cm	total loss	N	ls	bodily harm	NE	TY	health	E	wk	loss
SW	SC	wealth	W	YN	relation	NW	TY	health	N	hh	misfortunes	NE	YN	relation	E	cm	total loss
SW	TY	health	W	FW	creativity	NW	SC	wealth	N	wk	loss	NE	FW	creativity	E	ls	bodily harm
SW	YN	relation	W	SC	wealth	NW	FW	creativity	N	YN	relation	NE	hh	misfortunes	E	SC	wealth
SW	FW	creativity	W	TY	health	NW	YN	relation	N	FW	creativity	NE	wk	loss	E	TY	health
SW	wk	loss	W	ls	bodily harm	NW	hh	misfortunes	N	cm	total loss	NE	SC	wealth	E	hh	misfortunes
SW	hh	misfortunes	W	cm	total loss	NW	wk	loss	N	TY	health	NE	ls	bodily harm	E	FW	creativity
SW	FW	creativity	W	TY	health	NW	YN	relation	N	SC	wealth	NE	cm	total loss	E	YN	relation
SW	cm	total loss	W	hh	misfortunes	NW	ls	bodily harm	N	wk	loss	NE	FW	creativity	E	ls	bodily harm
SW	ls	bodily harm	W	wk	loss	NW	cm	total loss	N	ls	bodily harm	NE	TY	health	E	wk	loss
SW	SC	wealth	W	YN	relation	NW	TY	health	N	hh	misfortunes	NE	YN	relation	E	cm	total loss
SW	TY	health	W	FW	creativity	NW	SC	wealth	N	wk	loss	NE	FW	creativity	E	ls	bodily harm
SW	YN	relation	W	SC	wealth	NW	FW	creativity	N	YN	relation	NE	hh	misfortunes	E	SC	wealth
SW	FW	creativity	W	TY	health	NW	YN	relation	N	FW	creativity	NE	wk	loss	E	TY	health
SW	wk	loss	W	ls	bodily harm	NW	hh	misfortunes	N	cm	total loss	NE	SC	wealth	E	hh	misfortunes
SW	hh	misfortunes	W	cm	total loss	NW	wk	loss	N	TY	health	NE	ls	bodily harm	E	FW	creativity
SW	FW	creativity	W	TY	health	NW	YN	relation	N	SC	wealth	NE	cm	total loss	E	YN	relation
SW	cm	total loss	W	hh	misfortunes	NW	ls	bodily harm	N	wk	loss	NE	FW	creativity	E	ls	bodily harm
SW	ls	bodily harm	W	wk	loss	NW	cm	total loss	N	ls	bodily harm	NE	TY	health	E	wk	loss
SW	SC	wealth	W	YN	relation	NW	TY	health	N	hh	misfortunes	NE	YN	relation	E	cm	total loss
SW	TY	health	W	FW	creativity	NW	SC	wealth	N	wk	loss	NE	FW	creativity	E	ls	bodily harm
SW	YN	relation	W	SC	wealth	NW	FW	creativity	N	YN	relation	NE	hh	misfortunes	E	SC	wealth
SW	FW	creativity	W	TY	health	NW	YN	relation	N	FW	creativity	NE	wk	loss	E	TY	health
SW	wk	loss	W	ls	bodily harm	NW	hh	misfortunes	N	cm	total loss	NE	SC	wealth	E	hh	misfortunes
SW	hh	misfortunes	W	cm	total loss	NW	wk	loss	N	TY	health	NE	ls	bodily harm	E	FW	creativity
SW	FW	creativity	W	TY	health	NW	YN	relation	N	SC	wealth	NE	cm	total loss	E	YN	relation
SW	cm	total loss	W	hh	misfortunes	NW	ls	bodily harm	N	wk	loss	NE	FW	creativity	E	ls	bodily harm
SW	ls	bodily harm	W	wk	loss	NW	cm	total loss	N	ls	bodily harm	NE	TY	health	E	wk	loss
SW	SC	wealth	W	YN	relation	NW	TY	health	N	hh	misfortunes	NE	YN	relation	E	cm	total loss
SW	TY	health	W	FW	creativity	NW	SC	wealth	N	wk	loss	NE	FW	creativity	E	ls	bodily harm
SW	YN	relation	W	SC	wealth	NW	FW	creativity	N	YN	relation	NE	hh	misfortunes	E	SC	wealth
SW	FW	creativity	W	TY	health	NW	YN	relation	N	FW	creativity	NE	wk	loss	E	TY	health
SW	wk	loss	W	ls	bodily harm	NW	hh	misfortunes	N	cm	total loss	NE	SC	wealth	E	hh	misfortunes
SW	hh	misfortunes	W	cm	total loss	NW	wk	loss	N	TY	health	NE	ls	bodily harm	E	FW	creativity

SE	ls	bodily harm	S	wk	loss	SW	TY	health	W	FW	creativity	NW	SC	wealth	;
SE	cm	total loss	S	hh	misfortunes	SW	SC	wealth	W	YN	relation	NW	TY	health	;
SE	TY	health	S	FW	creativity	SW	ls	bodily harm	W	wk	loss	NW	cm	total loss	;
SE	SC	wealth	S	YN	relation	SW	cm	total loss	W	hh	misfortunes	NW	ls	bodily harm	;
SE	wk	loss	S	ls	bodily harm	SW	FW	creativity	W	TY	health	NW	YN	relation	;
SE	YN	relation	S	SC	wealth	SW	hh	misfortunes	W	cm	total loss	NW	wk	loss	;
SE	FW	creativity	S	TY	health	SW	wk	loss	W	ls	bodily harm	NW	hh	misfortunes	;
SE	cm	total loss	S	hh	misfortunes	SW	SC	wealth	W	YN	relation	NW	TY	health	;
SE	hh	misfortunes	S	cm	total loss	SW	YN	relation	W	SC	wealth	NW	FW	creativity	;
SE	ls	bodily harm	S	wk	loss	SW	TY	health	W	FW	creativity	NW	SC	wealth	;
SE	cm	total loss	S	hh	misfortunes	SW	SC	wealth	W	YN	relation	NW	TY	health	;
SE	TY	health	S	FW	creativity	SW	ls	bodily harm	W	wk	loss	NW	cm	total loss	;
SE	SC	wealth	S	YN	relation	SW	cm	total loss	W	hh	misfortunes	NW	ls	bodily harm	;
SE	wk	loss	S	ls	bodily harm	SW	FW	creativity	W	TY	health	NW	YN	relation	;
SE	YN	relation	S	SC	wealth	SW	hh	misfortunes	W	cm	total loss	NW	wk	loss	;
SE	FW	creativity	S	TY	health	SW	wk	loss	W	ls	bodily harm	NW	hh	misfortunes	;
SE	cm	total loss	S	hh	misfortunes	SW	SC	wealth	W	YN	relation	NW	TY	health	;
SE	hh	misfortunes	S	cm	total loss	SW	YN	relation	W	SC	wealth	NW	FW	creativity	;
SE	ls	bodily harm	S	wk	loss	SW	TY	health	W	FW	creativity	NW	SC	wealth	;
SE	cm	total loss	S	hh	misfortunes	SW	SC	wealth	W	YN	relation	NW	TY	health	;
SE	TY	health	S	FW	creativity	SW	ls	bodily harm	W	wk	loss	NW	cm	total loss	;
SE	SC	wealth	S	YN	relation	SW	cm	total loss	W	hh	misfortunes	NW	ls	bodily harm	;
SE	wk	loss	S	ls	bodily harm	SW	FW	creativity	W	TY	health	NW	YN	relation	;
SE	YN	relation	S	SC	wealth	SW	hh	misfortunes	W	cm	total loss	NW	wk	loss	;
SE	FW	creativity	S	TY	health	SW	wk	loss	W	ls	bodily harm	NW	hh	misfortunes	;
SE	cm	total loss	S	hh	misfortunes	SW	SC	wealth	W	YN	relation	NW	TY	health	;
SE	hh	misfortunes	S	cm	total loss	SW	YN	relation	W	SC	wealth	NW	FW	creativity	;
SE	ls	bodily harm	S	wk	loss	SW	TY	health	W	FW	creativity	NW	SC	wealth	;
SE	cm	total loss	S	hh	misfortunes	SW	SC	wealth	W	YN	relation	NW	TY	health	;
SE	TY	health	S	FW	creativity	SW	ls	bodily harm	W	wk	loss	NW	cm	total loss	;
SE	SC	wealth	S	YN	relation	SW	cm	total loss	W	hh	misfortunes	NW	ls	bodily harm	;
SE	wk	loss	S	ls	bodily harm	SW	FW	creativity	W	TY	health	NW	YN	relation	;
SE	YN	relation	S	SC	wealth	SW	hh	misfortunes	W	cm	total loss	NW	wk	loss	;
SE	FW	creativity	S	TY	health	SW	wk	loss	W	ls	bodily harm	NW	hh	misfortunes	;
SE	cm	total loss	S	hh	misfortunes	SW	SC	wealth	W	YN	relation	NW	TY	health	;
SE	hh	misfortunes	S	cm	total loss	SW	YN	relation	W	SC	wealth	NW	FW	creativity	;
SE	ls	bodily harm	S	wk	loss	SW	TY	health	W	FW	creativity	NW	SC	wealth	;
SE	cm	total loss	S	hh	misfortunes	SW	SC	wealth	W	YN	relation	NW	TY	health	;
SE	TY	health	S	FW	creativity	SW	ls	bodily harm	W	wk	loss	NW	cm	total loss	;
SE	SC	wealth	S	YN	relation	SW	cm	total loss	W	hh	misfortunes	NW	ls	bodily harm	;
SE	wk	loss	S	ls	bodily harm	SW	FW	creativity	W	TY	health	NW	YN	relation	;
SE	YN	relation	S	SC	wealth	SW	hh	misfortunes	W	cm	total loss	NW	wk	loss	;
SE	FW	creativity	S	TY	health	SW	wk	loss	W	ls	bodily harm	NW	hh	misfortunes	;
SE	cm	total loss	S	hh	misfortunes	SW	SC	wealth	W	YN	relation	NW	TY	health	;
SE	hh	misfortunes	S	cm	total loss	SW	YN	relation	W	SC	wealth	NW	FW	creativity	;
SE	ls	bodily harm	S	wk	loss	SW	TY	health	W	FW	creativity	NW	SC	wealth	;
SE	cm	total loss	S	hh	misfortunes	SW	SC	wealth	W	YN	relation	NW	TY	health	;
SE	TY	health	S	FW	creativity	SW	ls	bodily harm	W	wk	loss	NW	cm	total loss	;
SE	SC	wealth	S	YN	relation	SW	cm	total loss	W	hh	misfortunes	NW	ls	bodily harm	;
SE	wk	loss	S	ls	bodily harm	SW	FW	creativity	W	TY	health	NW	YN	relation	;
SE	YN	relation	S	SC	wealth	SW	hh	misfortunes	W	cm	total loss	NW	wk	loss	

Database *Flying Star* periode 7

p7	N1	638	NE	816	E	451	SE	362	S	727	SW	549	W	995	NW	184	273	;
p7	N2/3	737	NE	519	E	955	SE	164	S	628	SW	846	W	491	NW	382	273	;
p7	NE1	114	E	658	SE	569	S	925	SW	747	W	293	NW	382	N	836	471	;
p7	NE2/3	717	E	253	SE	362	S	826	SW	144	W	698	NW	589	N	935	471	;
p7	E1	753	SE	864	S	429	SW	642	W	297	NW	186	N	531	NE	318	975	;
p7	E2/3	257	SE	166	S	521	SW	348	W	793	NW	884	N	439	NE	612	975	;
p7	SE1	967	S	422	SW	249	W	694	NW	785	N	331	NE	513	E	158	876	;
p7	SE2/3	765	S	321	SW	543	W	198	NW	981	N	432	NE	219	E	654	876	;
p7	S1	727	SW	945	W	599	NW	481	N	836	NE	618	E	154	SE	263	372	;
p7	S2/3	826	SW	648	W	194	NW	283	N	737	NE	915	E	559	SE	461	372	;
p7	SW1	747	W	392	NW	283	N	638	NE	411	E	856	SE	965	S	529	174	;
p7	SW2/3	441	W	896	NW	985	N	539	NE	717	E	352	SE	263	S	628	174	;
p7	W1	792	NW	681	N	135	NE	813	E	357	SE	468	S	924	SW	246	579	;
p7	W2/3	397	NW	488	N	934	NE	216	E	752	SE	661	S	125	SW	843	579	;
p7	NW1	587	N	133	NE	315	E	851	SE	769	S	224	SW	942	W	496	678	;
p7	NW2/3	789	N	234	NE	912	E	456	SE	567	S	123	SW	345	W	891	678	

Database *Flying Star* periode 8

p8	N1	848	NE	621	E	166	SE	275	S	739	SW	957	W	512	NW	493	384	;
p8	N2/3	749	NE	927	E	562	SE	473	S	838	SW	651	W	116	NW	295	384	;
p8	NE1	228	E	764	SE	673	S	137	SW	855	W	319	NW	491	N	946	582	;
p8	NE2/3	825	E	369	SE	471	S	936	SW	258	W	714	NW	693	N	147	582	;
p8	E1	868	SE	977	S	532	SW	759	W	314	NW	295	N	641	NE	423	186	;
p8	E2/3	364	SE	275	S	631	SW	453	W	818	NW	997	N	542	NE	729	186	;
p8	SE1	876	S	432	SW	654	W	219	NW	198	N	543	NE	321	E	765	987	;
p8	SE2/3	178	S	533	SW	351	W	715	NW	896	N	442	NE	624	E	269	987	;
p8	S1	937	SW	759	W	215	NW	394	N	848	NE	126	E	661	SE	572	483	;
p8	S2/3	838	SW	156	W	611	NW	592	N	947	NE	729	E	265	SE	374	483	;
p8	SW1	558	W	913	NW	194	N	649	NE	822	E	467	SE	376	S	731	285	;
p8	SW2/3	852	W	417	NW	396	N	741	NE	528	E	963	SE	174	S	639	285	;
p8	W1	413	NW	592	N	146	NE	324	E	868	SE	779	S	235	SW	957	681	;
p8	W2/3	818	NW	799	N	245	NE	927	E	463	SE	572	S	136	SW	354	681	;
p8	NW1	891	N	345	NE	123	E	567	SE	678	S	234	SW	456	W	912	789	;
p8	NW2/3	698	N	244	NE	426	E	962	SE	871	S	355	SW	153	W	517	789	

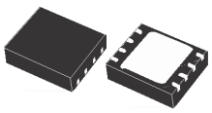
LAMPIRAN C
DATA SHEET ST1S10

ST1S10

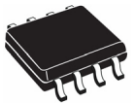
3 A, 900 kHz, monolithic synchronous step-down regulator IC

Features

- Step-down current mode PWM regulator
- Output voltage adjustable from 0.8 V
- Input voltage from 2.5 V up to 18 V
- 2% DC output voltage tolerance
- Synchronous rectification
- Inhibit function
- Synchronizable switching frequency from 400 kHz up to 1.2 MHz
- Internal soft start
- Dynamic short circuit protection
- Typical efficiency: 90%
- 3 A output current capability
- Stand-by supply current: max 6 µA over temperature range
- Operative junction temp: from - 25 °C to 125 °C



DFN8 (4 x 4 mm)



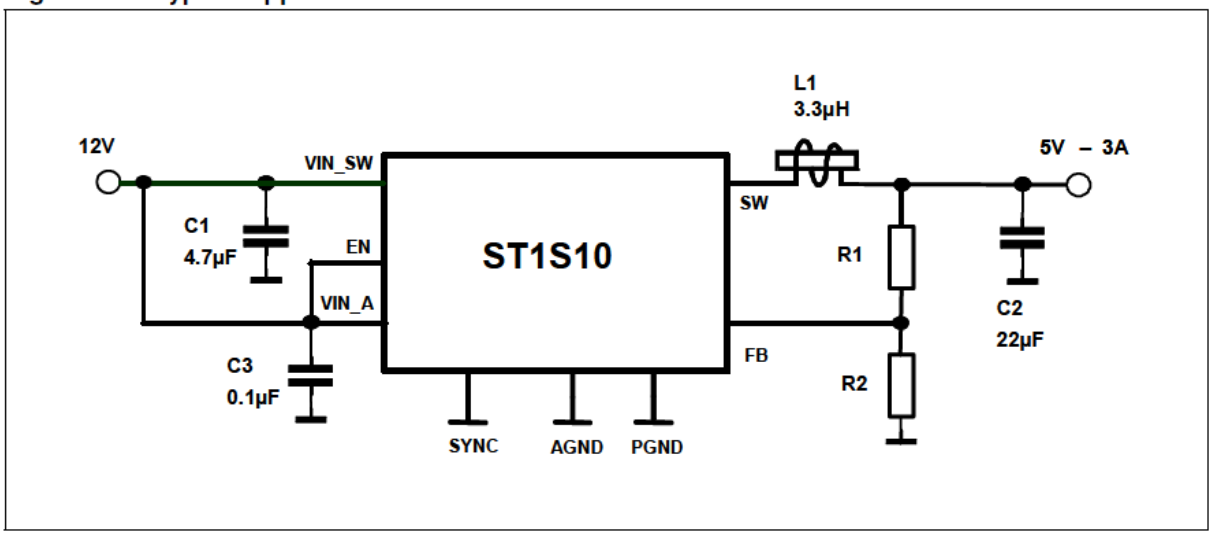
PowerSO-8

Description

The ST1S10 is a high efficiency step-down PWM current mode switching regulator capable of providing up to 3 A of output current. The device operates with an input supply range from 2.5 V to 18 V and provides an adjustable output voltage from 0.8 V (V_{FB}) to 0.85*V_{IN_SW} [$V_{OUT} = V_{FB}$*(1 + R1 / R2)]. It operates either at a 900 kHz fixed frequency or can be synchronized to an external clock (from 400 kHz to 1.2 MHz). The high switching frequency allows the use of tiny SMD external components, while the integrated synchronous rectifier eliminates the need for a Schottky diode. The ST1S10 provides excellent transient response, and is fully protected against thermal overheating, switching over-current and output short circuit. The ST1S10 is the ideal choice for point-of-load regulators or LDO pre-regulation.

1 Application circuit

Figure 1. Typical application circuit



2 Pin configuration

Figure 2. Pin connections (top view for PowerSO-8, bottom view for DFN8)

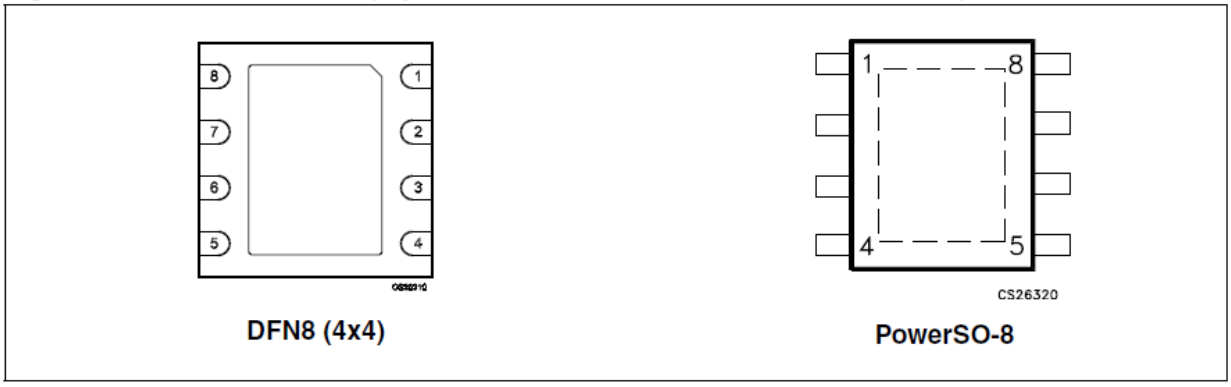


Table 2. Pin description

Pin n°	Symbol	Name and function
1	V_{IN_A}	Analog input supply voltage to be tied to V_{IN} supply source
2	INH (EN)	Inhibit pin active low. Connect to V_{IN_A} if not used
3	V_{FB}	Feedback voltage for connection to external voltage divider to set the V_{OUT} from 0.8 V up to 0.85 * V_{IN_SW}. (see *Section 4.5: Output voltage selection*)
4	AGND	Analog ground
5	SYNC	Synchronization and frequency select. Connect SYNC to GND for 900 kHz operation, or to an external clock from 400 kHz to 1.2 MHz. (see *Section 4.8.1: Sync operation*)
6	V_{IN_SW}	Power input supply voltage to be tied to V_{IN} power supply source
7	SW	Switching node to be connected to the inductor
8	PGND	Power ground
epad	epad	Exposed pad to be connected to ground

3 Maximum ratings

Table 3. Absolute maximum ratings

Symbol	Parameter	Value	Unit
V_{IN_SW}	Positive power supply voltage	-0.3 to 20	V
V_{IN_A}	Positive supply voltage	-0.3 to 20	V
V_{INH}	Inhibit voltage	-0.3 to V_{IN_A}	V
V_{SW}	Output switch voltage	-0.3 to 20	V
V_{FB}	Feedback voltage	-0.3 to 2.5	V
I_{FB}	FB current	-1 to +1	mA
Sync	Synchronization	-0.3 to 6	V
T_{STG}	Storage temperature range	-40 to 150	°C
T_{OP}	Operating junction temperature range	-25 to 125	°C

Note: Absolute maximum ratings are the values beyond which damage to the device may occur. Functional operation under these conditions is not implied.

Table 4. Thermal data

Symbol	Parameter	PowerSO-8	DFN8	Unit
R_{thJA}	Thermal resistance junction-ambient	40	40	°C/W
R_{thJC}	Thermal resistance junction-case	12	4	°C/W

4 Application information

4.1 Description

The ST1S10 is a high efficiency synchronous step-down DC-DC converter with inhibit function. It provides up to 3 A over an input voltage range of 2.5 V to 18 V, and the output voltage can be adjusted from 0.8 V up to 85% of the input voltage level. The synchronous rectification removes the need for an external Schottky diode and allows higher efficiency even at very low output voltages.

A high internal switching frequency (0.9 MHz) allows the use of tiny surface-mount components, as well as a resistor divider to set the output voltage value. In typical application conditions, only an inductor and 3 capacitors are required for proper operation.

The device can operate in PWM mode with a fixed frequency or synchronized to an external frequency through the SYNC pin. The current mode PWM architecture and stable operation with low ESR SMD ceramic capacitors results in low, predictable output ripple. No external compensation is needed.

To maximize power conversion efficiency, the ST1S10 works in pulse skipping mode at light load conditions and automatically switches to PWM mode when the output current increases.

The ST1S10 is equipped with thermal shut down protection activated at 150 °C (typ.).

Cycle-by-cycle short circuit protection provides protection against shorted outputs for

the
application and the regulator. An internal soft start for start-up current limiting and power ON delay of 275 µs (typ.) helps to reduce inrush current during start-up.

4.2 External components selection

4.2.1 Input capacitor

The ST1S10 features two V_{IN} pins: V_{IN_SW} for the power supply input voltage where the switching peak current is drawn, and V_{IN_A} to supply the ST1S10 internal circuitry and drivers.

The V_{IN_SW} input capacitor reduces the current peaks drawn from the input power supply and reduces switching noise in the IC. A high power supply source impedance requires larger input capacitance.

For the V_{IN_SW} input capacitor the RMS current rating is a critical parameter that must be higher than the RMS input current. The maximum RMS input current can be calculated using the following equation:

Equation 1

$$I_{RMS} = I_O \cdot \sqrt{D - \frac{2 \cdot D^2}{\eta} + \frac{D^2}{\eta}}$$

where η is the expected system efficiency, D is the duty cycle and I_O is the output DC current. The duty cycle can be derived using the equation:

Equation 2

$D = (V_{OUT} + V_F) / (V_{IN} - V_{SW})$

where V_F is the voltage drop across the internal NMOS, and V_{SW} represents the voltage drop across the internal PDMOS. The minimum duty cycle (at V_{IN_max}) and the maximum duty cycle (at V_{IN_min}) should be considered in order to determine the max I_{RMS} flowing through the input capacitor.

A minimum value of 4.7 µF for the V_{IN_SW} and a 0.1 µF ceramic capacitor for the V_{IN_A} are suitable in most application conditions. A 10 µF or higher ceramic capacitor for the V_{IN_SW} and a 1 µF or higher for the V_{IN_A} are recommended in cases of higher power supply source impedance or where long wires are needed between the power supply source and the V_{IN} pins. The above higher input capacitor values are also recommended in cases where an output capacitive load is present (47 µF < C_{LOAD} < 100 µF), which could impact the switching peak current drawn from the input capacitor during the start-up transient.

In cases of very high output capacitive loads (C_{LOAD} > 100 µF), all input/output capacitor values shall be modified as described in the OCP and SCP operation *Section 4.8.5* of this document.

The input ceramic capacitors should have a voltage rating in the range of 1.5 times the maximum input voltage and be located as close as possible to V_{IN} pins.

4.3 Output capacitor (V_{OUT} > 2.5 V)

The most important parameters for the output capacitor are the capacitance, the ESR and the voltage rating. The capacitance and the ESR affect the control loop stability, the output ripple voltage and transient response of the regulator.

The ripple due to the capacitance can be calculated with the following equation:
Equation 3

$V_{RIPPLE(C)} = (0.125 \times \Delta I_{SW}) / (F_S \times C_{OUT})$

where F_S is the PWM switching frequency and ΔI_{SW} is the inductor peak-to-peak switching current, which can be calculated as:
Equation 4

$\Delta I_{SW} = [(V_{IN} - V_{OUT}) / (F_S \times L)] \times D$

where D is the duty cycle.

The ripple due to the ESR is given by:
Equation 5

$V_{RIPPLE}(ESR) = \Delta I_{SW} \times ESR$

The equations above can be used to define the capacitor selection range, but final values should be verified by testing an evaluation circuit.

Lower ESR ceramic capacitors are usually recommended to reduce the output ripple voltage. Capacitors with higher voltage ratings have lower ESR values, resulting in lower output ripple voltage.

Also, the capacitor ESL value impacts the output ripple voltage, but ceramic capacitors usually have very low ESL, making ripple voltages due to the ESL negligible. In order to

reduce ripple voltages due to the parasitic inductive effect, the output capacitor connection paths should be kept as short as possible.

The ST1S10 has been designed to perform best with ceramic capacitors. Under typical application conditions a minimum ceramic capacitor value of 22 µF is recommended on the output, but higher values are suitable considering that the control loop has been designed to work properly with a natural output LC frequency provided by a 3.3 µH inductor and 22 µF output capacitor. If the high capacitive load application circuit shown in *Figure 3* is used, a
47 µF (or 2 x 22 µF capacitors in parallel) could be needed as described in the OCP and SCP operation *Section 4.8.5*. of this document.

The use of ceramic capacitors with voltage ratings in the range of 1.5 times the maximum output voltage is recommended.

4.4 Output capacitor (0.8 V < V_{OUT} < 2.5 V)

For applications with lower output voltage levels (V_{OUT} < 2.5 V) the output capacitance and inductor values should be selected in a way that improves the DC-DC control loop behavior. In this output condition two cases must be considered: V_{IN} > 8 V and V_{IN} < 8 V.

For V_{IN} < 8 V the use of 2 x 22 µF capacitors in parallel to the output is recommended, as shown in *Figure 4*.

For V_{IN} > 8 V, a 100 µF electrolytic capacitor with ESR < 0.1 Ω should be added in parallel to the 2 x 22 µF output capacitors as shown in *Figure 5*.

4.5 Output voltage selection

The output voltage can be adjusted from 0.8 V up to 85% of the input voltage level by connecting a resistor divider (see R1 and R2 in the typical application circuit) between the output and the V_{FB} pin. A resistor divider with R2 in the range of 20 kΩ is a suitable compromise in terms of current consumption. Once the R2 value is selected, R1 can be calculated using the following equation:

Equation 6

$$R1 = R2 \times (V_{OUT} - V_{FB}) / V_{FB}$$

where V_{FB} = 0.8 V (typ.).

Lower values are suitable as well, but will increase current consumption. Be aware that duty cycle must be kept below 85% at all application conditions, so that:

Equation 7

$$D = (V_{OUT} + V_F) / (V_{IN} - V_{SW}) < 0.85$$

where V_F is the voltage drop across the internal NMOS, and V_{SW} represents the voltage drop across the internal PDMOS.

Note that once the output current is fixed, higher V_{OUT} levels increase the power dissipation of the device leading to an increase in the operating junction temperature. It is recommended to select a V_{OUT} level which maintains the junction temperature below the thermal shut-down protection threshold (150°C typ.) at the rated output current. The following equation can be used to calculate the junction temperature (T_J):

Equation 8

$T_J = \{[V_{OUT} \times I_{OUT} \times R_{thJA} \times (1-\eta)] / \eta\} + T_{AMB}$

where R_{thJA} is the junction-to-ambient thermal resistance, η is the efficiency at the rated I_{OUT} current and T_{AMB} is the ambient temperature.

To ensure safe operating conditions the application should be designed to keep $T_J < 140°C$.

4.6 Inductor ($V_{OUT} > 2.5$ V)

The inductor value fixes the ripple current flowing through output capacitor and switching peak current. The ripple current should be kept in the range of 20 - 40% of I_{OUT_MAX} (for example it is 0.6 - 1.2 A at $I_{OUT} = 3$ A). The approximate inductor value can be obtained with the following equation:

Equation 9

$L = [(V_{IN} - V_{OUT}) / \Delta I_{SW}] \times T_{ON}$

where T_{ON} is the ON time of the internal switch, given by:

$T_{ON} = D/F_S$

The inductor should be selected with saturation current (I_{SAT}) equal to or higher than the inductor peak current, which can be calculated with the following equation:

Equation 10

$I_{PK} = I_O + (\Delta I_{SW}/2)$, $I_{SAT} \geq I_{PK}$

The inductor peak current must be designed so that it does not exceed the switching current limit.

4.7 Inductor (0.8 V < V_{OUT} < 2.5 V)

For applications with lower output voltage levels ($V_{OUT} < 2.5$ V) the description in the previous section is still valid but it is recommended to keep the inductor values in a range from 1 µH to 2.2 µH in order to improve the DC-DC control loop behavior, and increase the output capacitance depending on the V_{IN} level as shown in the *Figure 4* and *Figure 5*. In most application conditions a 2.2 µH inductor is the best compromise between DC-DC control loop behavior and output voltage ripple.

4.8 Function operation

4.8.1 Sync operation

The ST1S10 operates at a fixed frequency or can be synchronized to an external frequency with the SYNC pin. The ST1S10 switches at a frequency of 900 kHz when the SYNC pin is connected to ground, and can synchronize the switching frequency between 400 kHz to 1.2 MHz from an external clock applied to the SYNC pin. When the SYNC feature is not used, this pin must be connected to ground with a path as short as possible to avoid any possible noise injected in the SYNC internal circuitry.

4.8.2 Inhibit function

The inhibit pin can be used to turn OFF the regulator when pulled down, thus drastically reducing the current consumption down to less than 6 µA. When the inhibit feature is not used, this pin must be tied to V_{IN} to keep the regulator output ON at all times. To ensure proper operation, the signal source used to drive the inhibit pin must be able to swing above and below the specified thresholds listed in the electrical characteristics section under V_{INH}. Any slew rate can be used to drive the inhibit pin.

4.8.3 OCP (over-current protection)

The ST1S10 DC-DC converter is equipped with a switch over-current protection. In order to provide protection for the application and the internal power switches and bonding wires, the device goes into a shutdown state if the switch current limit is reached and is kept in this condition for the T_{OFF} period ($T_{OFF(OCP)}$ = 135 µs typ.) and turns on again for the T_{ON} period ($T_{ON(OCP)}$ = 22 µs typ.) under typical application conditions. This operation is repeated cycle by cycle. Normal operation is resumed when no over-current is detected.

4.8.4 SCP (short circuit protection)

In order to protect the entire application and reduce the total power dissipation during an overload or an output short circuit condition, the device is equipped with dynamic short circuit protection which works by internally monitoring the V_{FB} (feedback voltage).

In the event of an overload or output short circuit, if the V_{OUT} voltage is reduced causing the feedback voltage (V_{FB}) to drop below 0.3 V (typ.), the device goes into shutdown for the T_{OFF} time ($T_{OFF(SCP)}$ = 288 µs typ.) and turns on again for the T_{ON} period ($T_{ON(SCP)}$ = 130 µs typ.). This operation is repeated cycle by cycle, and normal operation is resumed when no overload is detected (V_{FB} > 0.3 V typ.) for the full T_{ON} period.

This dynamic operation can greatly reduce the power dissipation in overload conditions, while still ensuring excellent power-on startup in most conditions.

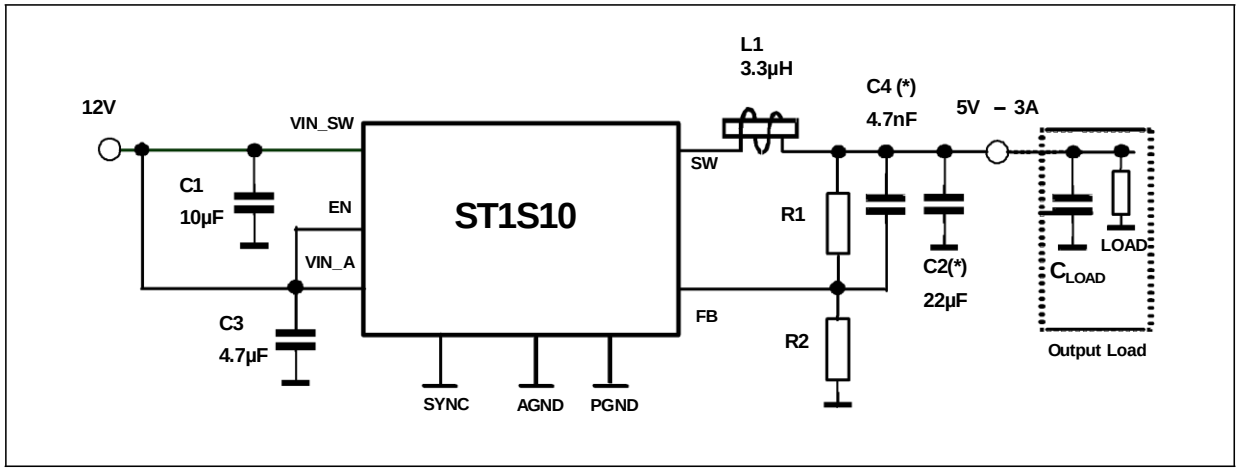
4.8.5 SCP and OCP operation with high capacitive load

Thanks to the OCP and SCP circuit, ST1S10 is strongly protected against damage from short circuit and overload.

However, a highly capacitive load on the output may cause difficulties during start-up. This can be resolved by using the modified application circuit shown in *Figure 3*, in which a minimum of 10 µF for C1 and a 4.7 µF ceramic capacitor for C3 are used. Moreover, for C_{LOAD} > 100 µF, it is necessary to add the C4 capacitor in parallel to the upper voltage divider resistor (R1) as shown in *Figure 3* The recommended value for C4 is 4.7 nF.

Note that C4 may impact the control loop response and should be added only when a capacitive load higher than 100 µF is continuously present. If the high capacitive load is variable or not present at all times, in addition to C4 an increase in the output ceramic capacitor C2 from 22 µF to 47 µF (or 2 x 22 µF capacitors in parallel) is recommended. Also in this case it is suggested to further increase the input capacitors to a minimum of 10 µF for C1 and a 4.7 µF ceramic capacitor for C3 as shown in *Figure 3*.

Figure 3. Application schematic for heavy capacitive load



(*) see OCP and SCP descriptions for C2 and C4 selection

Figure 4. Application schematic for low output voltage (V_{OUT} < 2.5 V) and 2.5 V < V_{IN} < 8 V

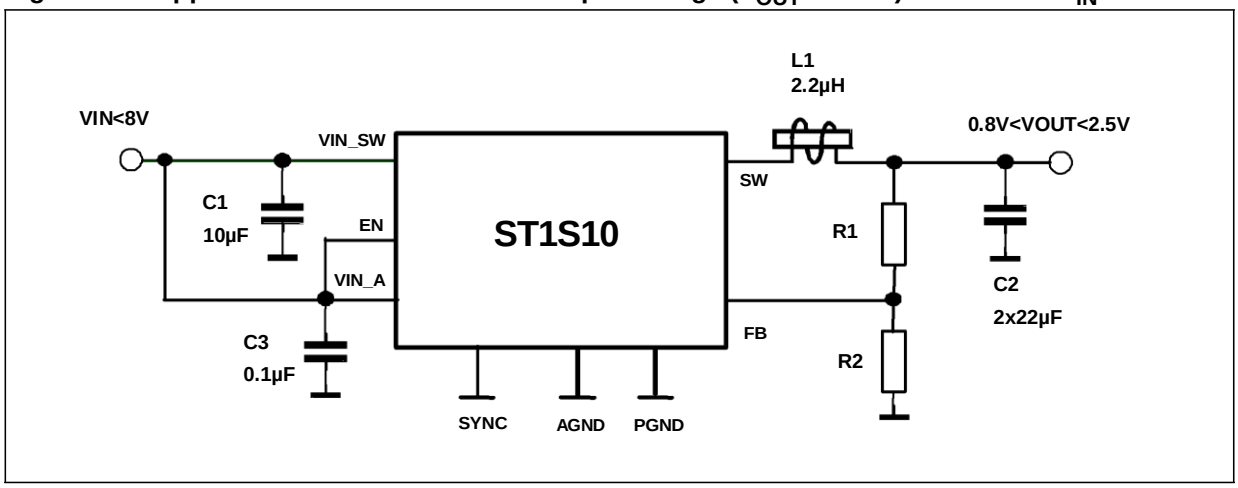
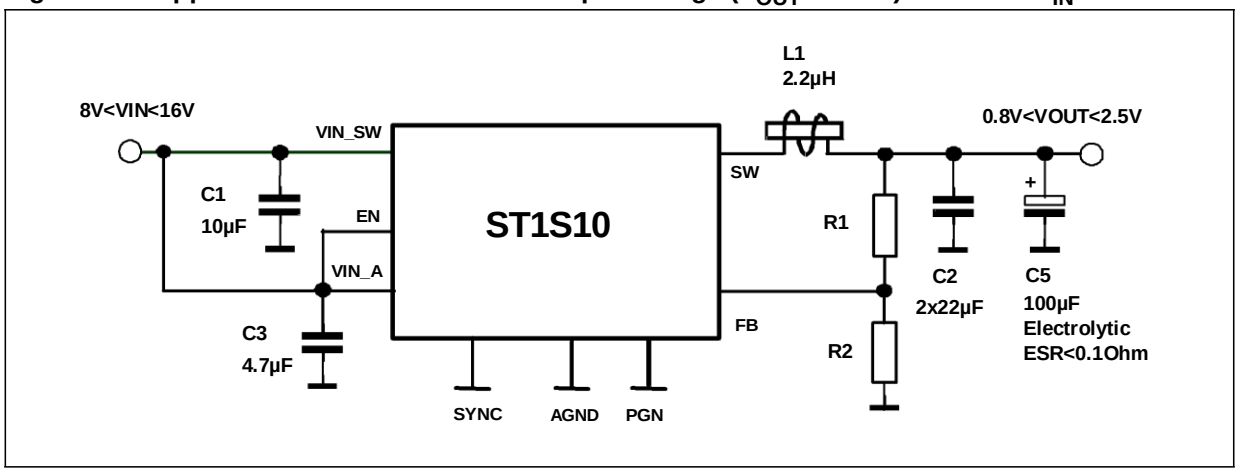
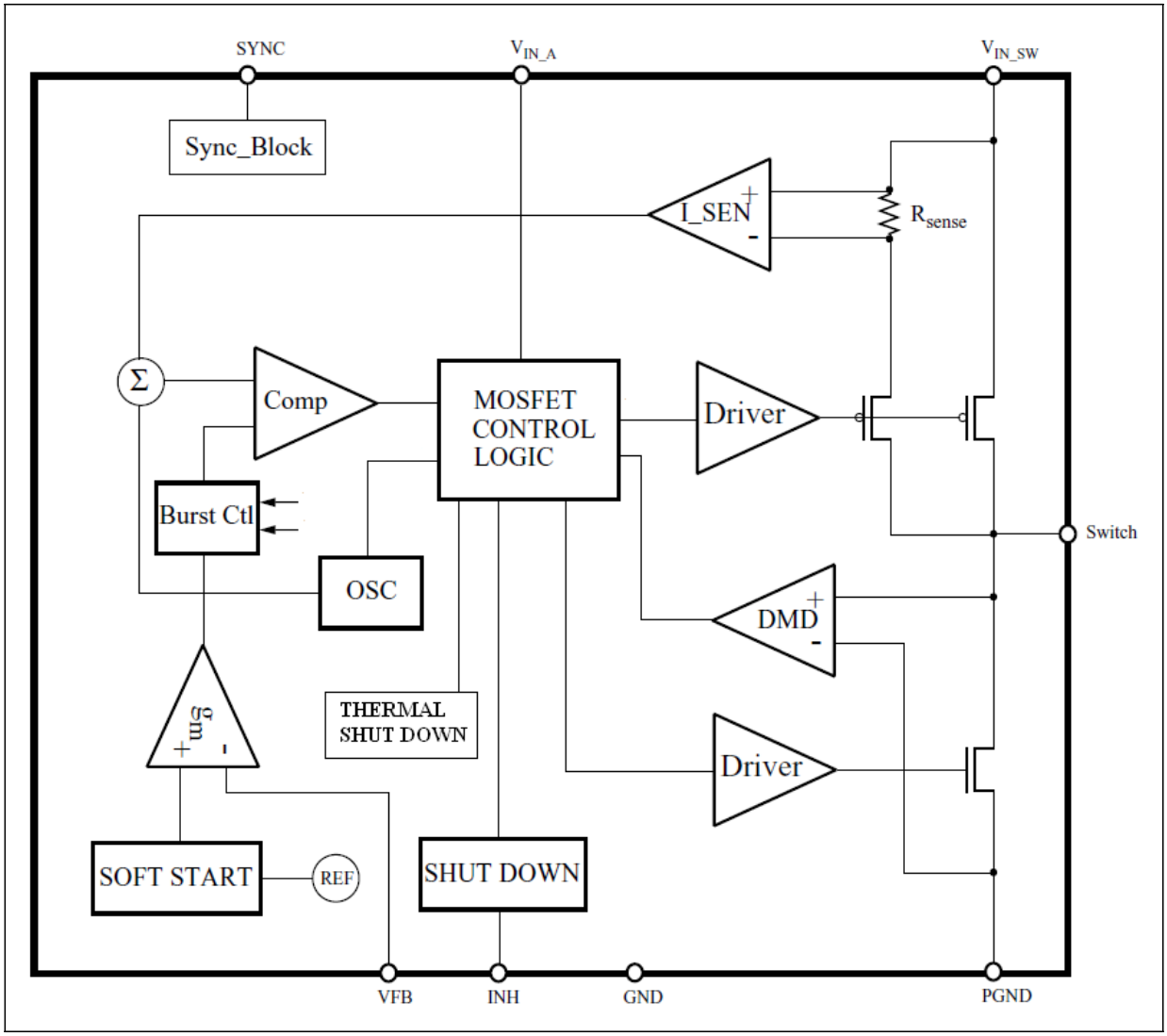


Figure 5. Application schematic for low output voltage (V_{OUT} < 2.5 V) and 8 V < V_{IN} < 16 V



5 Diagram

Figure 6. Block diagram



LAMPIRAN D
DATA SHEET AS1362

AS1361/AS1362

150mA/300mA, Ultra-Low-Noise, High-PSRR Low Dropout Regulators, with POK

1 General Description

The AS1361/AS1362 are ultra-low-noise, low-dropout linear regulators specifically designed to deliver up to 150/300mA continuous output current, and can achieve a low 140mV dropout for 300mA load current. The LDOs are designed and optimized to work with low-cost, small-capacitance ceramic capacitors.

The devices are available as the standard products listed in Table 1.

Table 1. Standard Products

Model	Load Current	Output Voltage
AS1361	150mA	Preset – 1.5 to 4.5V
AS1362	300mA	Preset – 1.5 to 4.5V

An integrated P-channel MOSFET pass transistor allows the devices to maintain extremely low quiescent current (40µA).

The AS1361/AS1362 uses an advanced architecture to achieve ultra-low output voltage noise of 9µVRMS and a power-supply rejection-ratio of better than 80dB (up to 10kHz).

An active-Low, open-drain power-ok output indicates if the output voltage is within regulation.

The AS1361/AS1362 requires only 1µF output capacitor for stability at any load. When the LDO is disabled, current consumption drops below 500nA.

The devices are available in a TSOT23 6-pin package.

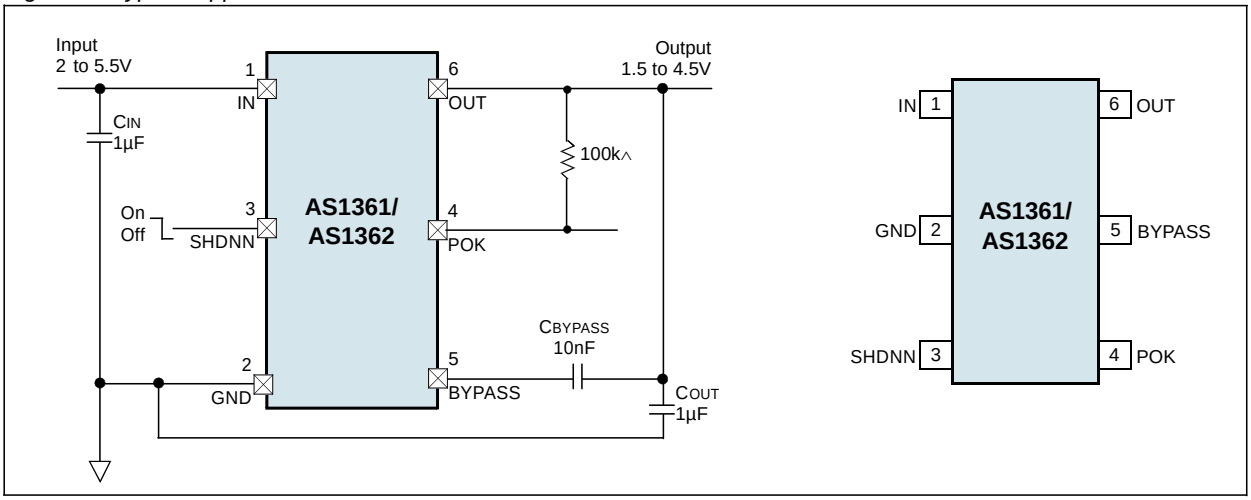
2 Key Features

- Preset Output Voltages: 1.5 to 4.5V (in 50mV steps)
- Output Noise: 9µVRMS @ 100Hz to 100kHz
- Power-Supply Rejection Ratio: 92dB @ 1kHz
- Low Dropout: 140mV @ 300mA Load
- Power-OK Output
- Stable with 1µF Ceramic Capacitor for any Load
- Guaranteed 150/300mA Output
- 1.25V Internal Reference
- Extremely-Low Quiescent Current: 40µA
- Excellent Load/Line Transient
- Overcurrent and Thermal Protection
- TSOT23 6-pin Package

3 Applications

The devices are ideal for mobile phones, wireless phones, PDAs, handheld computers, mobile phone base stations, Bluetooth portable radios and accessories, wireless LANs, digital cameras, personal audio devices, and any other portable, battery-powered application.

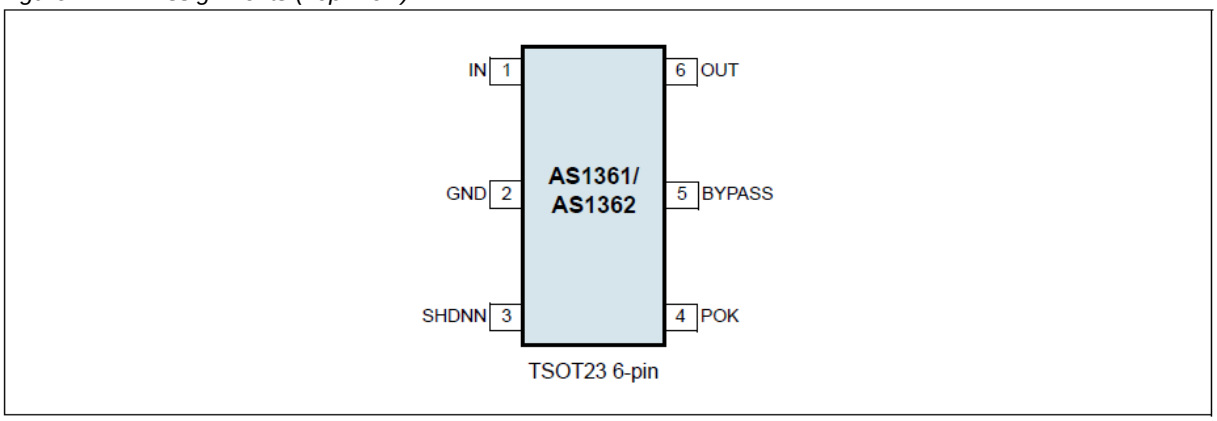
Figure 1. Typical Application Circuit



4 Pinout

Pin Assignments

Figure 2. Pin Assignments (Top View)



Pin Descriptions

Table 2. Pin Descriptions

Pin Number	Pin Name	Description
1	IN	**Unregulated Input Supply.**
2	GND	**Ground**
3	SHDNN	**Shutdown.** Pull this pin low to disable the LDO.
4	POK	**Power-OK Output.** Active-Low, open-drain output indicates if the output voltage is within regulation. 0 = V_{OUT} <94% V_{OUTNOM} 1 = V_{OUT} >94% V_{OUTNOM}
5	BYPASS	**Noise Bypass for Low-Noise Operation.** Connect a 10nF capacitor from this pin to **OUT**. **Note:** This pin is shorted to GND in shutdown mode.
6	OUT	**Regulated Output Voltage.** Bypass this pin with a capacitor to GND. See Capacitor Selection and Regulator Stability on page 12 for more details.

5 Absolute Maximum Ratings

Exposure to absolute maximum rating conditions for extended periods may affect device reliability.

Table 3. Absolute Maximum Ratings

Parameter	Min	Max	Units	Comments
IN to GND	-0.3	+7	V	
OUT, SHDNN, POK to GND	-0.3	IN + 0.3	V	
BYPASS to GND	-0.3	OUT + 0.3	V	
Output Short-Circuit Duration		Infinite		
Thermal Resistance ∪JA		201.7	ºC/W	on PCB
Operating Temperature Range	-40	+85	ºC	
Junction Temperature		+150	ºC	
Storage Temperature Range	-65	+150	ºC	
Package Body Temperature		+260	ºC	The reflow peak soldering temperature (body temperature) specified is in accordance with *IPC/JEDEC J-STD-020D "Moisture/Reflow Sensitivity Classification for Non-Hermetic Solid State Surface Mount Devices".* The lead finish for Pb-free leaded packages is matte tin (100% Sn).

6 Detailed Description

The AS1361/AS1362 are ultra-low-noise, low-dropout, low-quiescent current linear-regulators specifically designed for space-limited applications. The devices are available with preset output voltages from 1.5 to 4.5V in 50mV increments.

These devices can supply loads up to 150/300mA. As shown in Figure 3, the AS1361/AS1362 consist of an inte- grated bandgap core and noise bypass circuitry, error amplifier, P-channel MOSFET pass transistor, and internal feed- back voltage-divider.

The output voltage is fed back through an internal resistor voltage-divider connected to pin OUT. An external bypass capacitor connected to pin BYPASS reduces noise at the output. Additional blocks include a current limiter, thermal sensor, and shutdown logic.

Internal Voltage Reference

The 1.25V bandgap reference is connected to the error amplifier's inverting input. The error amplifier compares this reference with the feedback voltage and amplifies the difference. If the feedback voltage is lower than the reference voltage, the pass-transistor gate is pulled low. This allows more current to pass to the output and increases the output voltage. If the feedback voltage is too high, the pass transistor gate is pulled high, allowing less current to pass to the output.

Internal P-Channel Pass Transistor

The AS1361/AS1362 feature a 0.5∧ (typ) P-channel MOSFET pass transistor, which provides several advantages over similar designs using a PNP pass transistor, including prolonged battery life. The P-channel MOSFET does not require a base driver, thus quiescent current is dramatically reduced. The AS1361/AS1362 LDOs do not exhibit prob- lems associated with typical PNP-based LDOs, and consume only 40µA of quiescent current in light load and 220µA in dropout

Output Voltage

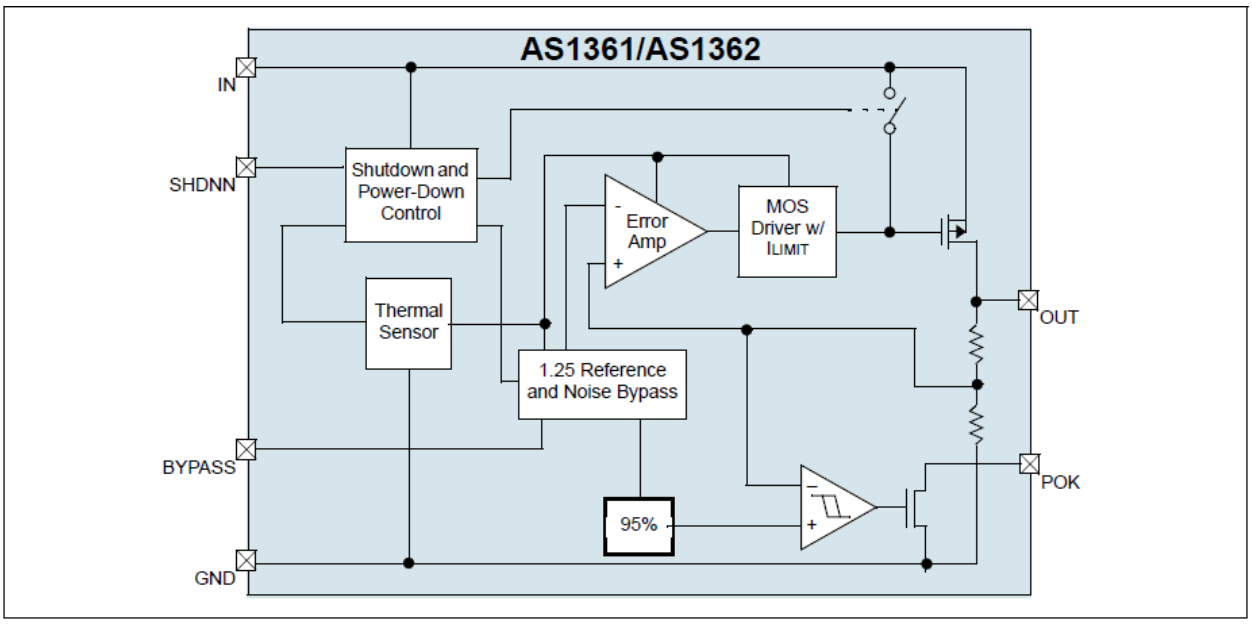
The AS1361/AS1362 deliver preset output voltages from 1.5 to 4.5V, in 50mV increments

Shutdown

The AS1361/AS1362 feature a low-power shutdown mode that reduces quiescent current to <200nA. Driving SHDNN low disables the internal voltage reference, error amplifier, gate-drive circuitry, and P-channel MOSFET pass transistor (see Figure 3), and the device output enters a high-impedance state.

Note: For normal operation connect pin SHDNN to pin IN.

Figure 3. AS1361/AS1362 - Block Diagram



Power-OK

The power-ok circuitry is built around an N-channel MOSFET. The circuitry monitors the output voltage and if the volt- age goes out of regulation (e.g. during dropout, current limit, or thermal shutdown) pin POK goes low.

The power-OK feature is not active during shutdown and provides a power-on-reset (POR) function that can operate down to V_{IN} = 1V. A capacitor to GND may be added to generate a POR delay.

To obtain a logic-level output, connect a pull-up resistor from pin POK to pin OUT. Larger values for this resistor will help minimize current consumption; a 100kΛ resistor is perfect for most applications.

Current Limit

The AS1361/AS1362 include a current limiting circuitry to monitor and control the P-channel MOSFET pass transis- tor's gate voltage, thus limiting the device output current to 270mA (AS1361) and 510mA (AS1362).

Note: The output can be shorted to ground indefinitely without causing damage to the device.

Thermal Protection

Integrated thermal protection circuitry limits total power dissipation in the AS1361/AS1362. When the junction temper- ature (T_J) exceeds +160ºC, the thermal sensor signals the shutdown logic, turning off the P-channel MOSFET pass transistor and allowing the device to cool down. The thermal sensor turns the pass transistor on again after the device's junction temperature drops by 10ºC, resulting in a pulsed output during continuous thermal-overload condi- tions.

Note: Thermal protection is designed to protect the devices in the event of fault conditions. For continuous operation, do not exceed the absolute maximum junction temperature rating of +150ºC.

Operating Region and Power Dissipation

The AS1361/AS1362 maximum power dissipation is dependant on the thermal resistance of the case and PCB, the temperature difference between the die junction and T_{AMB}, and airflow rate.
Power dissipation across the device is calculated as:

$$PD = I_{OUT} (V_{IN} - V_{OUT}) \qquad (EQ\ 1)$$

The maximum power dissipation is calculated:

$$PDMAX = (T_J - T_{AMB})/(\theta_{JC} + \theta_{CA}) \quad \text{(EQ 2)}$$

Where:
$T_J - T_{AMB}$ is the temperature difference between the AS1361/AS1362 die junction and the surrounding air;
θ_{JC} is the thermal resistance of the package;
θ_{CA} is the thermal resistance through the PC board/copper traces/other materials to the surrounding air.

Note: Pin GND of the AS1361/AS1362 provides the electrical connection to system ground and also serves as a heat sink. Connect pin GND to the system ground using a large pad or ground plane.

Noise Reduction

The AS1361/AS1362 noise bypass circuitry dramatically reduces output noise, exhibiting 9µVRMS of output voltage noise with C_{BYPASS} = 0.01µF and C_{OUT} = 1µF. Use an external 0.01µF bypass capacitor between pin BYPASS and pin OUT.

Note: Startup time is minimized by internal power-on circuitry which pre-charges C_{BYPASS}.

7 Application Information

Capacitor Selection and Regulator Stability

For normal operation, use a 1µF capacitor at pin IN and a 1µF capacitor at pin OUT. Larger input capacitor values and lower ESR provide better noise rejection and line-transient response. Reduce output noise and improve load-transient response, stability, and power-supply rejection by using large output capacitors.

Note: Some ceramic dielectrics exhibit large capacitance and ESR variation with temperature. With dielectrics such as Z5U and Y5V, it may be necessary to use a 2.2µF or larger output capacitor to ensure stability at tempera- tures below -10°C. With X7R or X5R dielectrics, 1µF is sufficient at all operating temperatures.

Bypass Capacitor

Use a 0.01µF bypass capacitor at pin BYPASS for low-output voltage noise reduction. The leakage current going into pin BYPASS should be less than 10nA. Increasing the capacitance slightly decreases the output noise. Values above 0.1µF and below 0.001µF are not recommended.

Noise, PSRR, and Transient Response

The AS1361/AS1362 are designed to deliver ultra-low noise and high PSRR, as well as low dropout and low quiescent currents in battery-powered systems. The power-supply rejection is 92dB at 1kHz and 62dB at 100kHz.

When operating from sources other than batteries, improved supply-noise rejection and transient response can be achieved by increasing the values of the input and output capacitors, and through passive filtering techniques.

Dropout Voltage

The AS1361/AS1362 minimum dropout voltage determines the lowest usable supply voltage. In battery-powered sys- tems, this determines the useful end-of-life battery voltage.

Since the AS1361/AS1362 use a P-channel MOSFET pass transistor, the dropout voltage is a function of drain-to- source on-resistance ($R_{DS(ON)}$) multiplied by I_{LOAD}.

8 Ordering Information

The devices are available as the standard products shown in Table 4.

Table 4. Ordering Information

Ordering Code	Marking	Output Current	Output Voltage	Delivery Form	Package
AS1361-BTTT-15	ASL2	150mA	1.5V	Tape and Reel	TSOT23 6-pin
AS1361-BTTT-18	ASL3	150mA	1.8V	Tape and Reel	TSOT23 6-pin
AS1361-BTTT-25	ASL4	150mA	2.5V	Tape and Reel	TSOT23 6-pin
AS1361-BTTT-26	ASL5	150mA	2.6V	Tape and Reel	TSOT23 6-pin
AS1361-BTTT-27	ASL6	150mA	2.7V	Tape and Reel	TSOT23 6-pin
AS1361-BTTT-28	ASL7	150mA	2.8V	Tape and Reel	TSOT23 6-pin
AS1361-BTTT-285	ASL8	150mA	2.85V	Tape and Reel	TSOT23 6-pin
AS1361-BTTT-30	ASL9	150mA	3.0V	Tape and Reel	TSOT23 6-pin
AS1361-BTTT-33	ASMA	150mA	3.3V	Tape and Reel	TSOT23 6-pin
AS1361-BTTT-45	ASMB	150mA	4.5V	Tape and Reel	TSOT23 6-pin
AS1362-BTTT-15	ASMC	300mA	1.5V	Tape and Reel	TSOT23 6-pin
AS1362-BTTT-18	ASMD	300mA	1.8V	Tape and Reel	TSOT23 6-pin
AS1362-BTTT-25	ASME	300mA	2.5V	Tape and Reel	TSOT23 6-pin
AS1362-BTTT-26	ASMF	300mA	2.6V	Tape and Reel	TSOT23 6-pin
AS1362-BTTT-27	ASMG	300mA	2.7V	Tape and Reel	TSOT23 6-pin
AS1362-BTTT-28	ASMH	300mA	2.8V	Tape and Reel	TSOT23 6-pin
AS1362-BTTT-285	ASMI	300mA	2.85V	Tape and Reel	TSOT23 6-pin
AS1362-BTTT-30	ASMJ	300mA	3.0V	Tape and Reel	TSOT23 6-pin
AS1362-BTTT-33	ASMK	300mA	3.3V	Tape and Reel	TSOT23 6-pin
AS1362-BTTT-45	ASML	300mA	4.5V	Tape and Reel	TSOT23 6-pin

Non-standard devices from 1.5V to 4.5V are available in 50mV steps. For more information and inquiries contact http://www.austriamicrosystems.com/contact

Note: All products are RoHS compliant and Pb-free.
Buy our products or get free samples online at ICdirect: http://www.austriamicrosystems.com/ICdirect

For further information and requests, please contact us mailto:sales@austriamicrosystems.com or find your local distributor at http://www.austriamicrosystems.com/distributor

LAMPIRAN E

DATA SHEET LTC2951

LTC2951-1/LTC2951-2

Pushbutton On/Off Controller

FEATURES

- Adjustable Pushbutton Debounce and Delay Timers
- Low Supply Current: 6µA
- Wide Operating Voltage Range: 2.7V to 26.4V
- EN Output (LTC2951-1) Allows DC/DC Converter Control
- EN Output (LTC2951-2) Allows Circuit Breaker Control
- Simple Interface Allows Graceful µP Shutdown
- High Input Voltage PB Pin with Internal Pull-Up Resistor
- ±10kV ESD HBM on PB Input
- Accurate 0.6V Threshold on KILL Comparator Input
- 8-Pin 3mm × 2mm DFN and ThinSOT™ Packages

APPLICATIONS

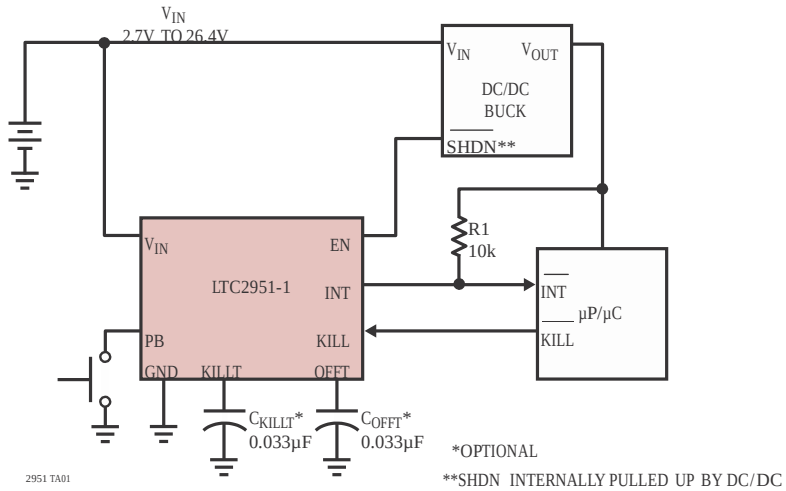
- Portable Instrumentation Meters
- Blade Servers
- Portable Customer Service PDA
- Desktop and Notebook Computers

DESCRIPTION

The LTC®2951 is a micropower, wide input voltage range pushbutton ON/OFF controller. The part contains a pushbutton input which controls the toggling of an open-drain enable output. The pushbutton turn OFF debounce time is externally programmable, while the turn ON debounce time is fixed at 128ms. A simple microprocessor interface allows for proper system housekeeping prior to power- down. Under system fault conditions, an adjustable KILL timeout delay ensures proper power-down.

The LTC2951 operates over a 2.7V to 26.4V input voltage range to accommodate a variety of input power supplies. Very low quiescent current (6µA typical) makes the LTC2951 ideally suited for battery powered applications. Two versions of the part are available to accommodate either positive or negative enable polarities. The parts are available in 8-pin 3mm × 2mm DFN and ThinSOT packages.

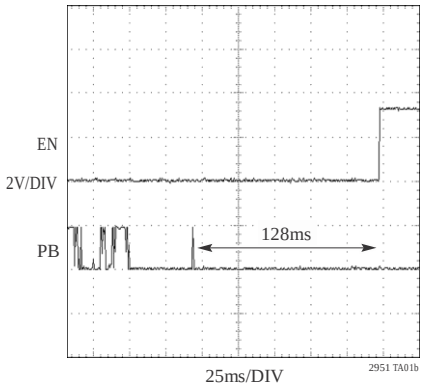
TYPICAL APPLICATION



*OPTIONAL

**SHDN INTERNALLY PULLED UP BY DC/DC

Turn-On Debounce



ABSOLUTE MAXIMUM RATINGS (Note 1)

Supply Voltage (V_{IN}) ..... –0.3V to 33V
Input Voltages
- PB ..... – 6V to 33V
- KILLT ..... – 0.3V to 2.7V
- OFFT ..... – 0.3V to 2.7V
- KILL ..... –0.3V to 7V

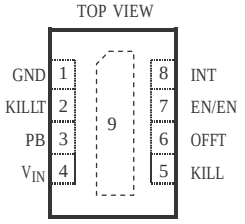
Output Voltages
- INT ..... – 0.3V to 10V
- EN/EN ..... –0.3V to 10V

Operating Temperature Range
- LTC2951C-1 ..... 0°C to 70°C
- LTC2951C-2 ..... 0°C to 70°C
- LTC2951I-1 ..... – 40°C to 85°C
- LTC2951I-2 ..... –40°C to 85°C

Storage Temperature Range
- DFN Package ..... –65°C to 125°C
- TSOT-23 ..... –65°C to 150°C

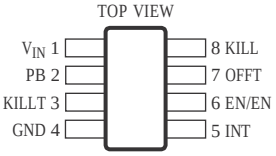
Lead Temperature (Soldering, 10 sec) ..... 300°C

PIN CONFIGURATION



DDB PACKAGE
8-LEAD (3mm × 2mm) PLASTIC DFN

T_{JMAX} = 125°C, θ_{JA} = 165°C/W
EXPOSED PAD (PIN 9) PCB GND CONNECTION OPTIONAL



TS8 PACKAGE
8-LEAD PLASTIC TSOT-23

T_{JMAX} = 125°C, θ_{JA} = 140°C/W

PIN FUNCTIONS

V_{IN} (Pin 1/Pin 4): Power Supply Input: 2.7V to 26.4V.

PB (Pin 2/Pin 3): Pushbutton Input. Connecting PB to ground through a momentary switch provides on/off control via the EN/EN pin. An internal 100k pull-up resis- tor connects to an internal 1.9V bias voltage. The rugged PB input can be pulled up to 26.4V externally without consuming extra current.

KILLT (Pin 3/Pin 2): Additional, Adjustable KILL Turn-Off Delay Input ($t_{KILL,\ OFF\ DELAY,\ ADDITIONAL}$). A capacitor to ground provides additional delay time (beyond the internal default 128ms, $t_{KILL,\ OFF\ DELAY}$) from INT falling to the automatic release of the enable output. The KILL turn-off delay feature ensures the release of the enable pin under system fault conditions, such as the µP not responding to the LTC2951 interrupt signal (INT low).

GND (Pin 4/Pin 1): Device Ground.

INT (Pin 5/Pin 8): Open-Drain Interrupt Output. After a pushbutton turn-off event is detected ($t_{DB,\ OFF} + t_{OFFT}$), the LTC2951 interrupts the system (µP) by bringing the INT pin low. Once the system finishes its power-down and housekeeping tasks, it sets KILL low, which in turn releases the enable output. If at the end of the power-down timer
period ($t_{KILL,\ OFF\ DELAY} + t_{KILL,\ OFF\ DELAY,\ ADDITIONAL}$) KILL is still high, the enable output is released immediately. INT may optionally be tied to KILL to release the enable output immediately after the turn-off event has been detected (INT low).

EN (LTC2951-1, Pin 6/Pin 7): Open-Drain Enable Output. This pin is intended to enable system power. EN goes high after a valid PB turn-on event ($t_{DB,\ ON}$). EN goes low if: a) KILL is not driven high within 512ms of the initial valid PB power turn-on event, b) KILL is driven low during normal operation, or c) a second valid PB event (power turn-off) is detected. This pin can connect directly to a DC/DC converter shutdown pin that provides an internal pull-up. Otherwise, a pull-up resistor to an external supply is required. The operating range for this pin is 0V to 10V.

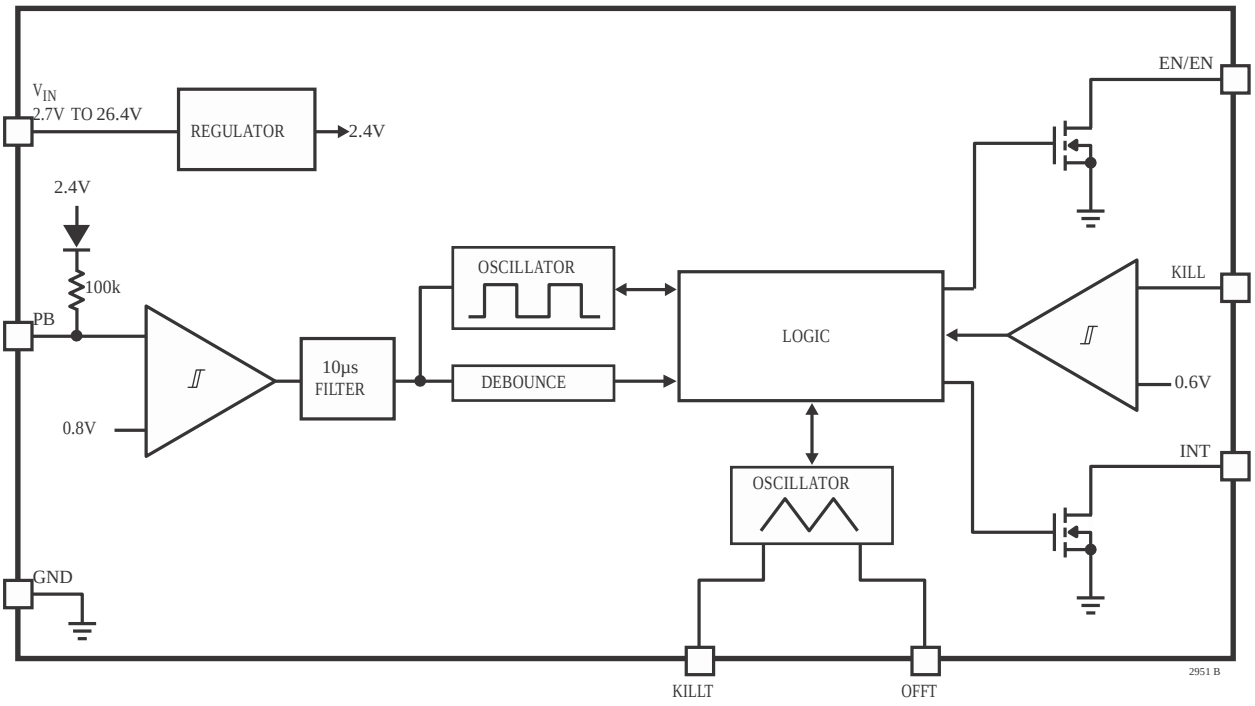
EN (LTC2951-2, Pin 6/Pin 7): Open-Drain Enable Output. This pin is intended to enable system power. EN is asserted low after a valid PB turn-on event ($t_{DB,\ ON}$). EN releases high if: a) KILL is not driven high within 512ms of the initial valid PB power turn-on event, b) KILL is driven low during normal operation, or c) a second valid PB event (power turn-off) is detected. This pin can connect directly to a DC/DC converter shutdown pin that provides an internal pull-up. Otherwise, a pull-up resistor to an external supply is required. The operating range of this pin is 0V to 10V.

OFFT (Pin 7/Pin 6): Additional Adjustable Turn-Off Time Input (t_{OFFT}). A capacitor to ground determines the ad- ditional time (beyond the internal default 32ms, $t_{DB,\ OFF}$) that the PB pin must be held low before initiating a power- down sequence (INT falling). Floating this pin results in a default turn-off debounce time of 32ms.

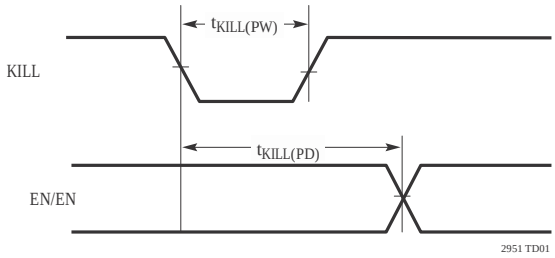
KILL (Pin 8/Pin 5): KILL Input. Forcing KILL low releases the enable output. During system turn-on, this pin is blanked by a 512ms internal timer ($t_{KILL,\ ON\ BLANK}$) to allow the system to pull KILL high. This pin has an accu- rate 0.6V threshold and can be used as a voltage monitor input. If unused, connect to a low voltage output supply (see Figure 6).

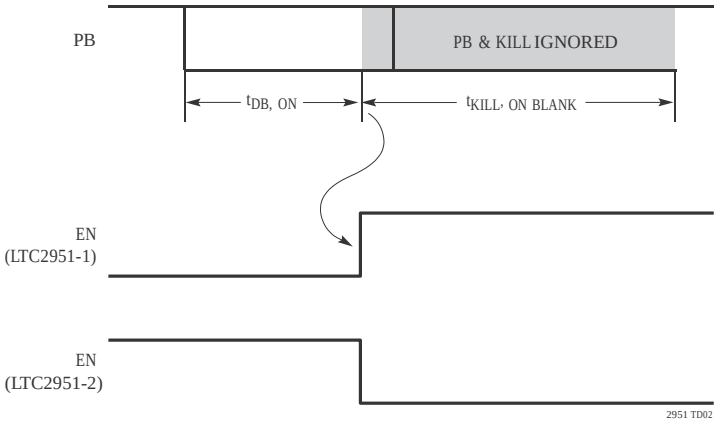
Exposed Pad (Pin 9): Exposed Pad may be left open or connected to device ground.

BLOCK DIAGRAM



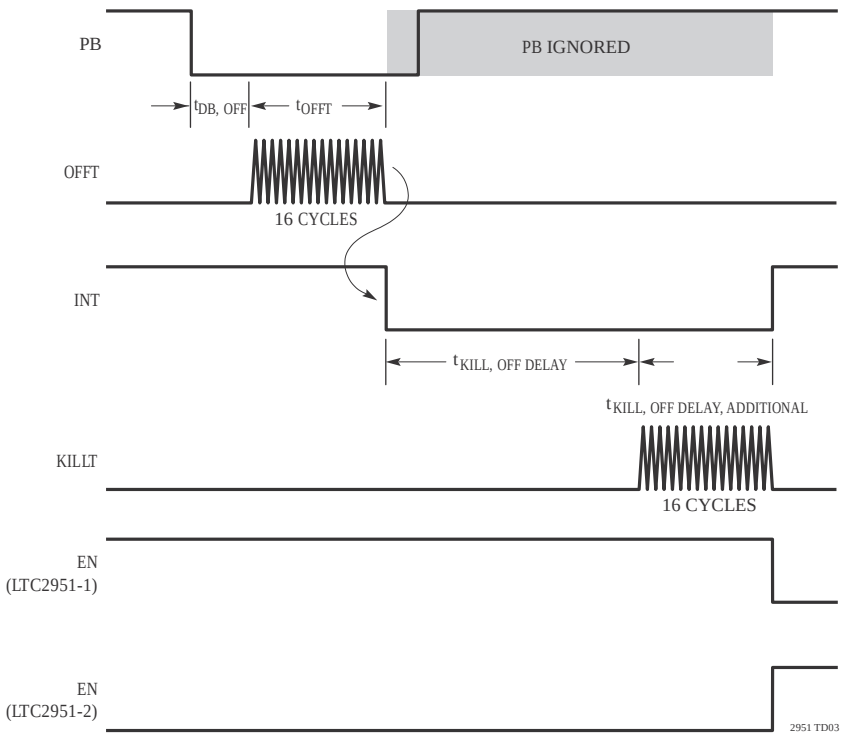
TIMING DIAGRAMS





Power-On Timing

TIMING DIAGRAMS



Power-Off Timing, KILL > 0.6V

Description

The LTC2951 is a low power (6µA), wide input voltage range (2.7V to 26.4V), pushbutton On/Off controller that can interface to a µP and a power supply. The part incorporates all the flexible timing needed to debounce the pushbutton input (PB). The LTC2951 also provides a simple interface (INT output, KILL input) to allow a system to power on and power off in a controlled manner. The wide input voltage range allows a system designer to operate from single cell to multi-cell battery stacks. Very low quiescent current makes the LTC2951 ideal for continuously monitoring the on/off pushbutton of a handheld device.

Turn-On

When power is first applied to the LTC2951, the part initializes the output pins. Any DC/DC converters connected to the EN/EN pin will, therefore, be off. To assert the enable output, PB must be held low for a minimum of 128ms ($t_{DB,\ ON}$).

Once the enable output is asserted, any DC/DC converters connected to this pin are turned on. The KILL input from the µP is ignored during the succeeding 512ms blanking time ($t_{KILL,\ ON\ BLANK}$). This blanking time represents the maximum time required to power up the DC/DC converter and the µP. If KILL is not brought high during this 512ms time window, the enable output is released. The assumption is that 512ms is sufficient time for the system to power up.

Turn-Off

To initiate a power-off sequence, PB must be held low for a minimum of 32ms ($t_{DB,\ OFF}$). Additional turn-off debounce time may be added via an optional capacitor connected to the OFFT pin (t_{OFFT}). The following equation describes the additional time that PB must be held low to initiate a power-off sequence. C_{OFFT} is the OFFT external capacitor:

$$C_{OFFT} = 1.56E\text{-}4\ [\mu F/ms] \bullet (t_{OFFT} - 1ms)$$

Once PB has been validly pressed, INT is switched low. This alerts the µP to perform its power-down and housekeeping tasks.

KILL Turn-Off Delay

The LTC2951 provides a failsafe feature that allows the user to turn off system power (via PB) under system fault conditions. During a normal power-down sequence, the LTC2951 first interrupts the µP by setting INT low. The µP then performs power-down and housekeeping tasks and drives KILL low when done. The LTC2951 releases the enable output, thus turning off system power. The KILL turn-off timer starts when INT is driven low. If the µP fails to respond during this timeout period, the enable output will automatically release. The default power-down timeout period is 128ms ($t_{KILL,\ OFF\ DELAY}$), which can be extended by placing an optional capacitor on the KILLT pin ($t_{KILL,\ OFF\ DELAY,\ ADDITIONAL}$). The following equation describes the additional power-down timeout period. C_{KILLT} is the KILLT external capacitor:

$$C_{KILLT} = 1.56e\text{-}4\ [\mu F/ms] \bullet (t_{KILL,\ OFF\ DELAY,\ ADDITIONAL} - 1ms)$$

Note that KILL can be driven low (thereby releasing the enable output) at any time after $t_{KILL,\ ON\ BLANK}$ period.

LAMPIRAN F

DATA SHEET TC013 Series

TC013 SERIES
LED TACT SWITCH

Feature -
small size
bi-color LED illuminated available long life cycles

Application -
consumer products computer products instrumentation communication equipments

▶ SPECIFICATIONS

SWITCH SPECIFICATIONS	
POLE - POSITION	1P1T , with LED
CONTACT RATING	12 V DC , 50 mA
CONTACT RESISTANCE	100 mΩ MAX. 1.5 V DC ; 100 mA , by Method of Voltage DROP
INSULATION RESISTANCE	100 MΩ MIN. 500 V DC
DIELECTRIC STRENGTH	Breakdown is not Allowable ; 500 V AC for 1 Minute
OPERATING FORCE	180 ± 50 gf
OPERATING LIFE	500,000 cycles
OPERATING TEMPERATURE RANGE	-20°C ~ 70°C
TOTAL TRAVEL	0.2 ± 0.1 mm

LED SPECIFICATIONS							
ATTENTION (+) (-) LEDs are Electrostatic Sensitive devices		Unit	Value / LED Color				
			Blue	Green	Red	White	Yellow
FORWARD CURRENT	If	mA	10	20	20	2	20
REVERSE VOLTAGE	Vr	V	5.0	5.0	5.0	5.0	5.0
REVERSE CURRENT	Ir	μA	10	10	10	10	10
FORWARD VOLTAGE	Vf	V	@ 10mA 3.0-4.0	2.1-2.5	2.0-2.5	@ 2mA 2.8-4.0	2.0-2.5
LUMINOUS INTENSITY	Iv	mcd	@ 10mA 200	800	1800	@ 2mA 12	1800

LAMPIRAN G
DATA SHEET KOMPAS OS5000

Introduction to the Tiny Compass Family

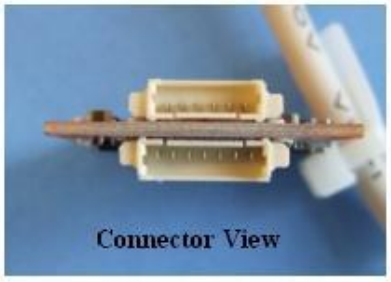
The OceanServer precision 3-Axis Tilt Compensated compass products use state of the art technology to provide outstanding performance and ease of use in a low cost design.

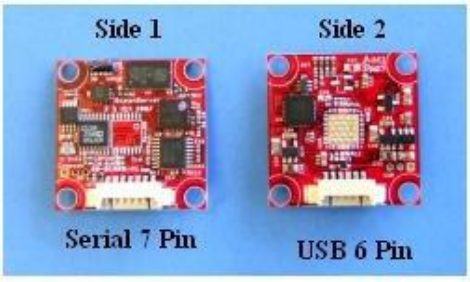
The OS5000 family of compasses are a new class of sensor components providing best in class performance for under $200.00 (USD) in low volume.

Features:

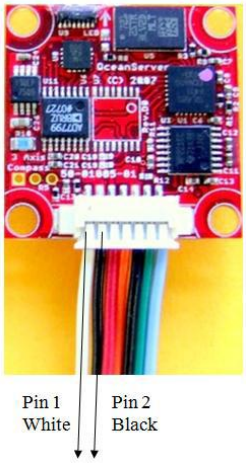
- **Compass accuracy, 0.5 degrees RMS heading while level, 1° RMS <±30° Tilt, 1.5° RMS <±60° Tilt, undisturbed field, .1 Degree resolution**
- **Roll & Pitch full rotation, typical 1° accuracy <±30° tilt**
- **Pitch Angles +/-90 degrees, Roll Angles +/- 180 degrees**
- **Tilt-compensated (electronically gimbaled)**
- **Tiny size, 1"x1"x0.3", less than 2 grams weight**
- **Low Power Consumption, @4.5V**
- **Hard and soft-iron compensation routines**
- **Optional support for a high resolution Depth or Altitude sensor (24 bit AD)**
- **Serial Interface:**
    - **RS232, USB or TTL**
    - **Baud rate programmable 4,800 to 115,000 baud**
- **Rugged design**
    - **10,000 G shock survival**
    - **-40° C to 80° C operating temperature (Accuracy specified for 0° C to 50° C)**
- **ASCII sentence output, in several formats, NMEA checksum**
- **High Data Update Rate to 40HZ**
- **Support for True or Magnetic North Output**
- **Precision components**
    - **3 Axis magnetic sensors from Honeywell**
    - **3 Axis Accelerometers from ST Microelectronics**
    - **24 bit differential Analog to Digital converters from Analog Devices**
    - **50 MIPS processor supporting IEEE floating point math**

OS5000-US -- Signals USB or RS-232: 3-Axis tilt compensated compass, 1" x 1". Has both Serial & USB direct interface and has connectors on both sides of the module.



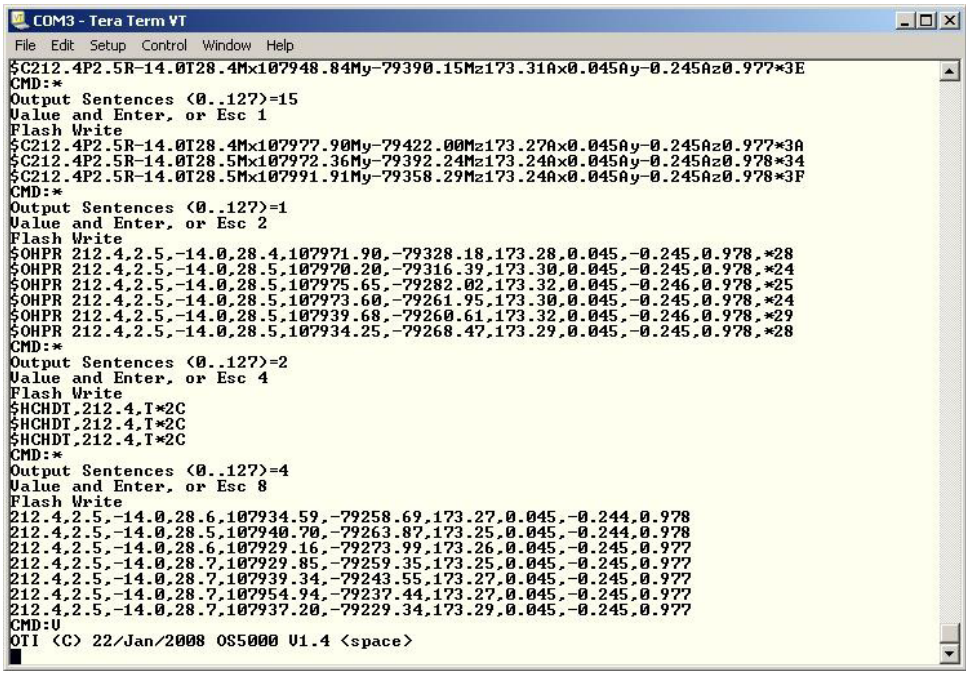


Electrical Connector and pin assignment



Pin	**Color**	**Signal**	**Description**
1	White	P-in	*Pressure Input* from Tranducer
2	Black	GND	*Ground*
3	Red	Vin-Unreg	DC *Power Input* (4.5v)
4	Orange	NC	*RESERVED* – not connected
5	Black	GND	*Ground* for RS232
6	Green	Tx	RS-232 *Transmit* (DB9-F *pin*: 2)
7	Blue	Rx	RS-232 *Receive* (DB9-F *Pin*: 3)

Output Sentence Formats



Format Type 0x01, 1(10): "$C" format

$Chhh.hPpp.pRrr.rTtt.tMx0.000My0.000Mz0.000Ax000.0Ay000.0Az000.0*cc
$C212.4P2.5R-14.0T28.4Mx107977.90My-79422.00Mz173.27Ax0.045Ay-0.245Az0.977*3A

Hhh.h Heading in degrees, corrected for Declination if one is entered
Ppp.p: Pitch angle, "P" precedes the pitch angle in degrees
Rrr.rr Roll angle, "R" precedes the roll angle in degrees
Ttt.t: Temperature of the compass board
Mx,My,Mz Magnetic field strength reported on each sensor. The units are calibrated to milligauss by the user setting the local horizontal field strength before a full calibration.
Ax,Ay,Az Acceleration measured on all three sensors. The units are in "G" for each sensor. You can also output the vector length (acceleration scalar) which will be close to 1G

Format Type 0x02, 2(10): "$OHPR" Sentence

$OHPR value1,value2,value3,value4….*cc

The $OHPR sentence is activated with the <esc>*2<space> command. It provides a comma-delimited list of all of the parameters selected for output with the <esc>X command.

Format Type 0x04, 4(10): "$HCHDT" Sentence

$HCHDT,212.4,T*2C

The NMEA0183 standard true heading sentence is supported for output. The $HCHDT sentence is activated with the <esc>*4<space> command. To have the heading be true the user must program the compass with the local declination value using the <esc>Qnnnn<space> where nnnn is the degress times 10 for local heading offset. Example <esc>Q125<enter> will offset the heading 12.5 degrees for every value reported.

Format Type 0x08, 8(10): "comma delimited" Sentence

value1,value2,value3,va,….

This sentence outputs the data as a simple comma delimited list of the requested values. This sentence is activated by the <esc>*8<space> command and it outputs all data elements selected in the <esc>Xmask<space> command. This sentence format is only available with firmware version 1.4 or later.

Key Command	Description of the command
<Esc> B	**BAUD RATE** Set new baud rate, 0-6, change takes effect after power cycle. 0=4800,1=9600,2=14400, 3= 192000, 4=38400,5=57600,6=115200
<Esc> R	**SENTENCE OUTPUT RATE** Set the compass output rate, -50 to +40. Rate is in samples per second and negative are seconds per sample. .i.e. 20=20 samples/second, -10=10 seconds per sample. A rate of 0 will stop output. At higher output rates the baud rate will need to be increase beyond the standard setting.
<Esc> *	**OUTPUT SENTENCE FORMAT** Change Output Sentence Formats, bit mask, 1,2,4,8,16 are valid values. Format 8 requires firmware version 1.4 or later, and 16 version 1.6 or later, Default=1. *=2 is a simple NMEA like output with comma delimited data, this is easy to tag and parse in user programs, *=4 is even simpler comma delimited data with no sentence NAME or handle.
<Esc> $	SOFT IRON COMPENSATION Soft Iron Compensation. The values are 0=disable, 1=enable, 2=generate calibration. When you enter generate (2) you need to have the system with the compass in installed and freshly calibrated, (via the <esc>C,<esc>Z commands). You will need to align the system to cardinal points according to a magnetic compass, N,S,E,W in an area free of magnetic disturbance.

LAMPIRAN H
DATA SHEET MINI2440

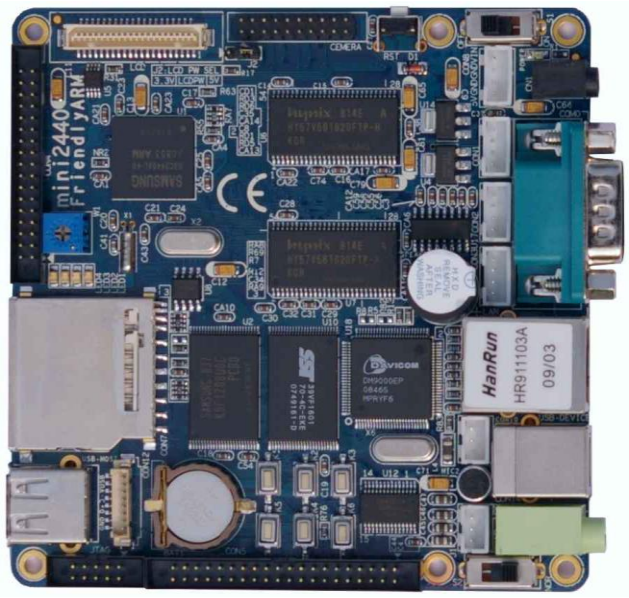
FriendlyARM mini2440

1. Overview

1.1 Description

The MINI2440 is a single board computer based on Samsung S3C2440 microprocessor.

1.1.1 Topview of Board



1.1.2 Hardware Features

CPU
- Samsung S3C2440A， 400MHz， Max. 533Mhz

SDRAM
- 64M SDRAM
- 32bit DataBus
- SDRAM Clock 100MHz

Flash
- 64M or 128M Nand Flash,
- 2M Nor Flash,BIOS installed

LCD
- 4 wire resistive touch screen interface
- Up to 4096 color STN,3.5 inches to12.1 inches, up to 1024x768 pixels
- Up to 64K color TFT,3.5 inches to 12.1 inches, up to1024x768 pixels

Interface and Resource
- 1 10/100M Ethernet RJ-45(DM9000)
- 3 Serial Port
- 1 USB Host
- 1 USB Slave Type B
- 1 SD Card Interface
- 1 Stereo Audio out， 1 Micro In；
- 1 20-Pin JTAG
- 4 USER LEDs
- 6 USER buttons
- 1 PWM Beeper
- 1 POT can be used for A/D converter adjust
- 1 AT24C08 for I2C test
- 1 20-Pin Camera Interface
- 1 Battery for RTC
- Power In(5V), with switch and lamp

Oscillator Frequency
- 12MHz

RTC
- Internal

Expand Interface
- 1 34-Pin 2.0mm GPIO
- 1 40-Pin 2.0mm System Bus

Dimension
- 100 x 100(mm)

OS Support
- Linux 2.6
- Android
- WinCE 5 and 6

1.2 Interfaces