General Description

The MAX17536 3.3V output evaluation kit (EV kit) provides a proven design to evaluate this high-voltage, high-efficiency, synchronous step-down DC-DC converter. The EV kit is preset for a 3.3V output at load currents up to 4A and features a 450kHz switching frequency for optimum efficiency and component size. The EV kit features adjustable input, undervoltage lockout, adjustable soft-start, open-drain $\overline{RESET}$ signal, and external frequency synchronization.

Features

- Operates from a 4.5V to 60V Input Supply
- 3.3V Output Voltage
- Up to 4A Output Current
- 450kHz Switching Frequency
- Enable/UVLO Input, Resistor-Programmable UVLO Threshold
- Adjustable Soft-Start Time
- MODE Pin to Select Among PWM, PFM, or DCM Modes
- Open-Drain $\overline{RESET}$ Output
- External Frequency Synchronization
- Overcurrent and Overtemperature Protection
- Proven PCB Layout
- Fully Assembled and Tested

Ordering Information **appears at end of data sheet.**

Quick Start

Recommended Equipment

- MAX17536 3.3V output EV kit
- 4.5V to 60V, 10A DC input power supply
- Load capable of sinking 4A
- Digital voltmeter (DVM)

Procedure

The EV kit is fully assembled and tested. Follow the steps below to verify board operation. **Caution: Do not turn on power supply until all connections are completed.**

1) Set the power supply at a voltage between 4.5V and 60V. Disable the power supply.

2) Connect the positive terminal of the power supply to the VIN PCB pad and the negative terminal to the nearest PGND PCB pad. Connect the positive terminal of the 4A load to the VOUT PCB pad and the negative terminal to the nearest PGND PCB pad.

3) Connect the DVM across the VOUT PCB pad and the nearest PGND PCB pad.

4) Verify that shunts are installed across pins 1-2 on jumper JU1 and pins 2-3 on JU3 (see Table 1 for details).

5) Select the shunt position on JU2 based on the intended mode of operation (see Table 2 for details).

6) Turn on the DC power supply.

7) Enable the load.

8) Verify that the DVM displays 3.3V

![maxim integrated logo]

Detailed Description

The MAX17536 EV kit provides a proven design to evaluate the high-voltage, high-efficiency, synchronous step-down DC-DC converter. The EV kit is preset for a 3.3V output from a 4.5V to 60V input at load currents of up to 4A and features a 450kHz switching frequency for optimum efficiency and component size.

The EV kit includes an EN/UVLO PCB pad and JU1 to enable the output at the desired input voltage. The SYNC PCB pad and JU3 allow an external clock to synchronize the device. JU2 allows the selection of a particular mode of operation based on light-load performance requirements. An additional $\overline{\text{RESET}}$ PCB pad is available for monitoring whether the converter output is in regulation.

Soft-Start Input (SS)

The device utilizes an adjustable soft-start function to limit inrush current during startup. The soft-start time is adjusted by the value of the external capacitor from SS to GND (C3). The selected output capacitance (C_{SEL}) and output voltage (V_{OUT}) determine the minimum value of C3, as shown by the following equation:

$$C3 \geq 28 \times 10^{-6} \times C_{SEL} \times V_{OUT}$$

The soft-start time (t_{SS}) is related to C3 by the following equation:

$$t_{SS} = C3/(5.55 \times 10^{-6})$$

For example, to program a 2.2ms soft-start time, C3 should be 12nF.

Regulator Enable/Undervoltage-Lockout Level (EN/UVLO)

The device offers an adjustable-input, undervoltage-lockout level. For normal operation, a shunt should be installed across pins 1-2 on JU1. To disable the output, install a shunt across pins 2-3 on JU1 and pull the EN/UVLO pin to GND. See Table 1 for JU1 settings.

Set the voltage at which the device turns on with the resistive voltage-divider R1/R2 connected from VIN_ to SGND. Connect the center node of the divider to EN/UVLO.

Choose R1 to be 3.32MΩ and then calculate R2 as follows:

$$R2 = \frac{R1 \times 1.215}{V_{INU} - 1.215}$$

where V_{INU} is the voltage at which the device is required to turn on.

Mode/SYNC Selection (MODE)

The device's MODE pin should be used to select among the PWM, PFM, or DCM modes of operation. The logic state of the MODE pin is latched when the V_{CC} and EN/UVLO voltages exceed the respective UVLO rising thresholds and all internal voltages are ready to allow LX switching. State changes on the MODE pin are ignored during normal operation. Refer to the MAX17536 IC data sheet for more information on the PWM, PFM, and DCM modes of operation.

Table 2 shows EV kit jumper settings that can be used to configure the desired mode of operation.

The internal oscillator of the device can be synchronized to an external clock signal on the SYNC pin. The external synchronization clock frequency must be between $1.1f_{SW}$ and $1.4f_{SW}$, where f_{SW} is the frequency of operation set by R5. The minimum external clock high pulse width should be greater than 50ns and the minimum external clock low pulse width should be greater than 160ns.

Table 1. Regulator Enable (EN/UVLO) Description (JU1)

SHUNT POSITION	EN/UVLO PIN	MAX17536_ OUTPUT
1-2*	Connected to VIN	Enabled
Not installed	Connected to the center node of resistor-divider R1 and R2	Enabled, UVLO level set through the R1 and R2 resistors
2-3	Connected to SGND	Disabled

*Default position.

Table 2. MODE Description (JU2)

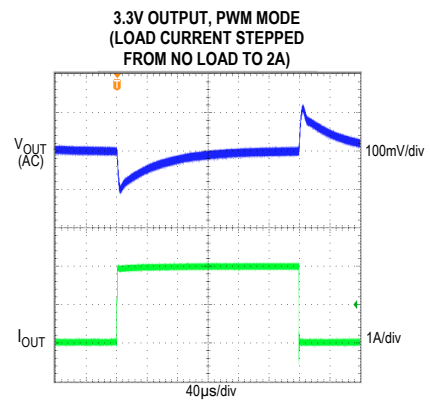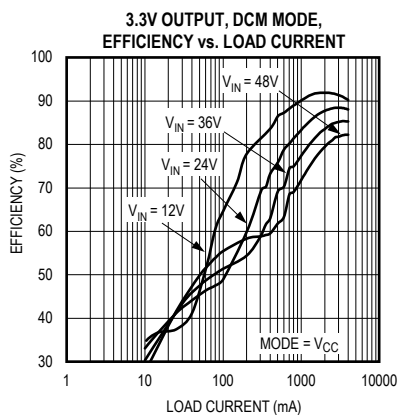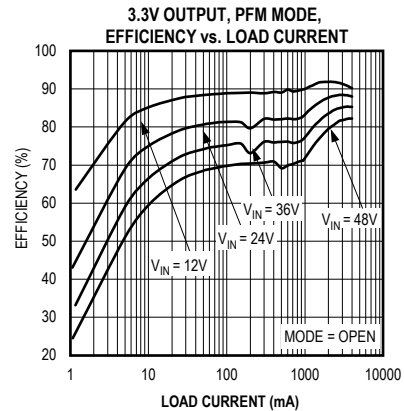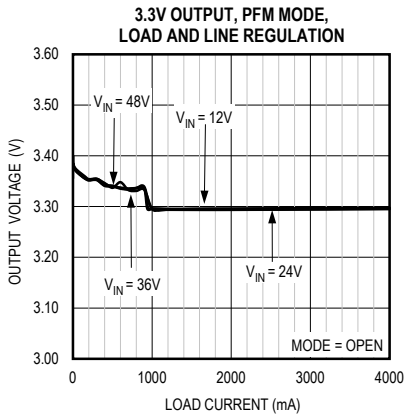| SHUNT POSITION	MODE PIN	MAX17536_ MODE
Not installed*	Unconnected	PFM mode of operation
1-2	Connected to SGND	PWM mode of operation
2-3	Connected to VCC	DCM mode of operation

*Default position.

EV Kit Performance Report

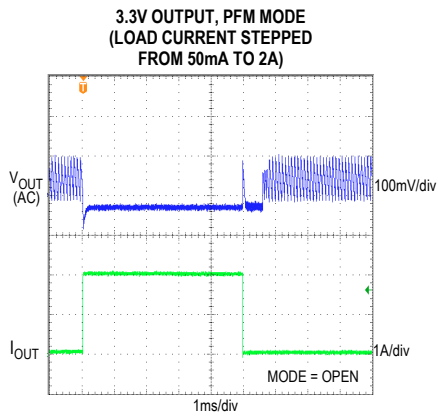(24V input voltage, unless otherwise noted.)
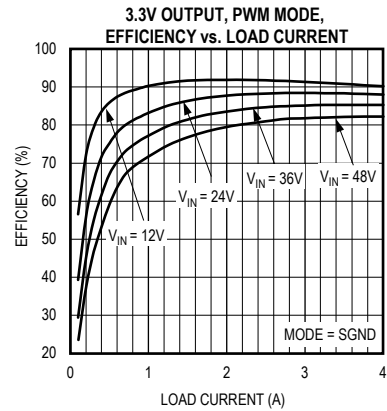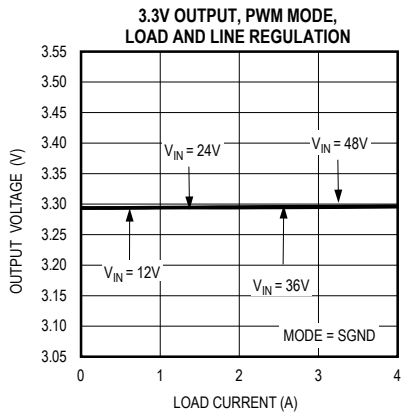
3.3V OUTPUT, PWM MODE, LOAD AND LINE REGULATION

$V_{IN} = 24V$ $V_{IN} = 48V$
$V_{IN} = 12V$ $V_{IN} = 36V$
MODE = SGND

3.3V OUTPUT, PWM MODE, EFFICIENCY vs. LOAD CURRENT

$V_{IN} = 36V$ $V_{IN} = 48V$
$V_{IN} = 24V$
$V_{IN} = 12V$
MODE = SGND

3.3V OUTPUT, PFM MODE, LOAD AND LINE REGULATION

$V_{IN} = 48V$ $V_{IN} = 12V$
$V_{IN} = 36V$ $V_{IN} = 24V$
MODE = OPEN

3.3V OUTPUT, PFM MODE, EFFICIENCY vs. LOAD CURRENT

$V_{IN} = 36V$ $V_{IN} = 48V$
$V_{IN} = 24V$
$V_{IN} = 12V$
MODE = OPEN

3.3V OUTPUT, DCM MODE, EFFICIENCY vs. LOAD CURRENT

$V_{IN} = 48V$
$V_{IN} = 36V$
$V_{IN} = 24V$
$V_{IN} = 12V$
MODE = V_{CC}

3.3V OUTPUT, PWM MODE (LOAD CURRENT STEPPED FROM NO LOAD TO 2A)

V_{OUT} (AC) 100mV/div
I_{OUT} 1A/div
40µs/div

EV Kit Performance Report (continued)

(24V input voltage, unless otherwise noted.)
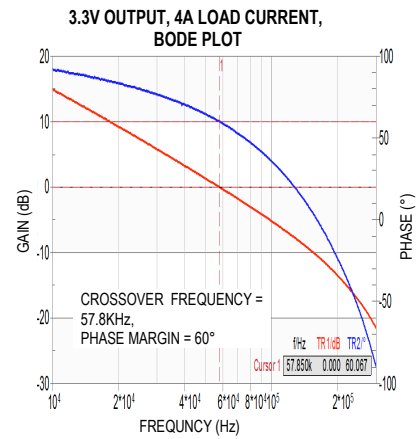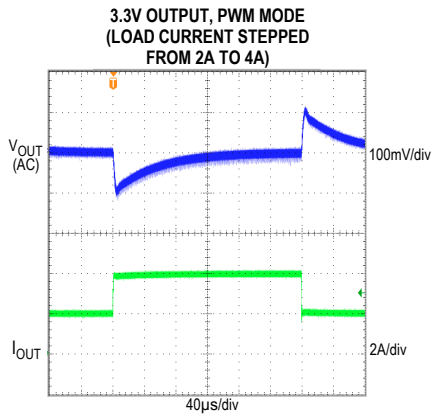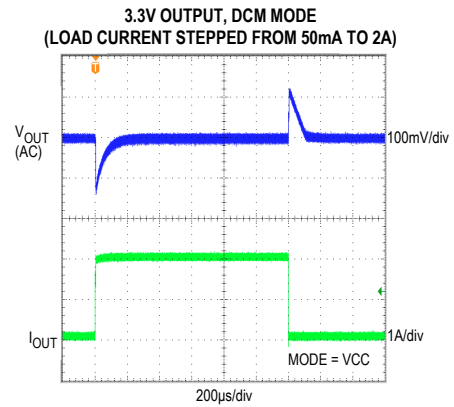
**3.3V OUTPUT, PFM MODE
(LOAD CURRENT STEPPED
FROM 50mA TO 2A)**

V_{OUT} (AC)

100mV/div

I_{OUT}

1A/div

MODE = OPEN

1ms/div

**3.3V OUTPUT, DCM MODE
(LOAD CURRENT STEPPED FROM 50mA TO 2A)**

V_{OUT} (AC)

100mV/div

I_{OUT}

1A/div

MODE = VCC

200µs/div

**3.3V OUTPUT, PWM MODE
(LOAD CURRENT STEPPED
FROM 2A TO 4A)**

V_{OUT} (AC)

100mV/div

I_{OUT}

2A/div

40µs/div

**3.3V OUTPUT, 4A LOAD CURRENT,
BODE PLOT**

GAIN (dB)

PHASE (°)

CROSSOVER FREQUENCY =
57.8KHz,
PHASE MARGIN = 60°

fHz   TR1dB   TR2°
Cursor 1   57.650k   0.000   60.067

FREQUNCY (Hz)

Component Suppliers

SUPPLIER	WEBSITE
Coilcraft, Inc.	www.coilcraft.com
Panasonic Corp.	www.panasonic.com
Renesas Electronics	www.renesas.com
Vishay	www.vishay.com

Note: Indicate that you are using the MAX17536 when contacting these component suppliers.

Component List, PCB Files and Schematic

See the following links for component information, PCB files, and schematics:

- **MAX17536 3.3V EV BOM**
- **MAX17536 3.3 EV PCB Files**
- **MAX17536 3.3 EV Schematics**

Ordering Information

PART	TYPE
MAX17536EVKITA#	EV Kit

#Denotes RoHS compliant.

Revision History

REVISION NUMBER	REVISION DATE	DESCRIPTION	PAGES CHANGED
0	6/15	Initial release	—

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HARDWARE NAME: MAX17536A_EVKIT_A

HARDWARE NUMBER:

DATE: 04/10/2015   ODB++/GERBER: SILK_TOP

MAX17536A EVKIT
888-MAXIM-IC
www.maximintegrated.com
SR 04/15
REV-A

maxim integrated™

HARDWARE NAME:MAX17536A_EVKIT_A

HARDWARE NUMBER:

DATE: 04/10/2015

ODB++/GERBER: TOP

maxim integrated™

HARDWARE NAME:MAX17536A_EVKIT_A

HARDWARE NUMBER:

DATE: 04/10/2015   ODB++/GERBER: L2-SGND

HARDWARE NAME:MAX17536A_EVKIT_A

HARDWARE NUMBER:

DATE: 04/10/2015

ODB++/GERBER: L3-SGND

maxim integrated™

HARDWARE NAME:MAX17536A_EVKIT_A

HARDWARE NUMBER:

DATE: 04/10/2015

ODB++/GERBER: BOTTOM
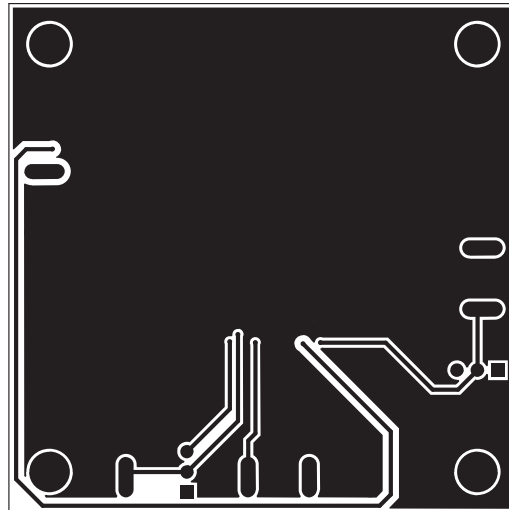
maxim integrated™

HARDWARE NAME:MAX17536A_EVKIT_A

HARDWARE NUMBER:

DATE: 04/10/2015

ODB++/GERBER: MASK_TOP

maxim integrated™

HARDWARE NAME:MAX17536A_EVKIT_A

HARDWARE NUMBER:

DATE: 04/10/2015

ODB++/GERBER: MASK_BOT

MAX17536

U1

N1

L1
3.3UH

VOUT

VOUT

PGND

C9
0.1UF

C7
47UF
10V

C8
47UF
10V

R7
OPEN

PGND

VIN

VIN

PGND

C4
47UF
80V

C1
2.2UF
100V

C2
2.2UF
100V

C3
OPEN

PGND

PGND

VCC

C5
2.2UF

PGND

SGND

SGND

JU2

SGND

EN/UVLO

EN/UVLO

MODE/SYNC

RESETB

R6
10K

VCC

R5
OPEN

SGND

C10
OPEN

R4
49.9K

SGND

R3
133K

VOUT

C6
0.022UF

SGND

SS

EXTVCC

EN/UVLO

VIN

VIN

R1
3.32M

R2
750K

SGND

JU1

1
2
3

DL 20
LX 19
LX 18
LX 17
BST 16

VIN 1
VIN 2
PGND 3
VCC 4
MODE/SYNC 5

VIN 15
VIN 14
EN/UVLO 13
SS 12
EXTVCC 11

RESET 6
RT 7
SGND 8
CF 9
FB 10
EP

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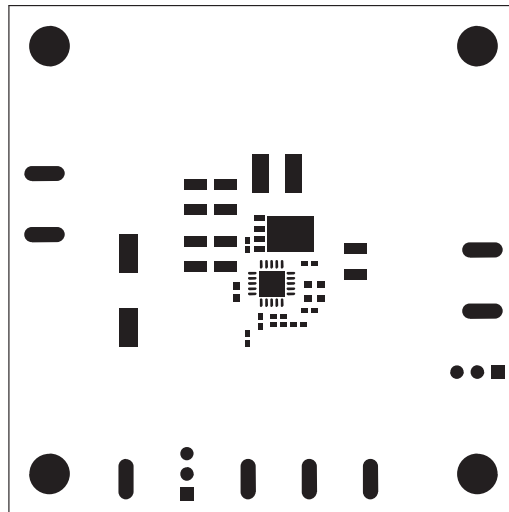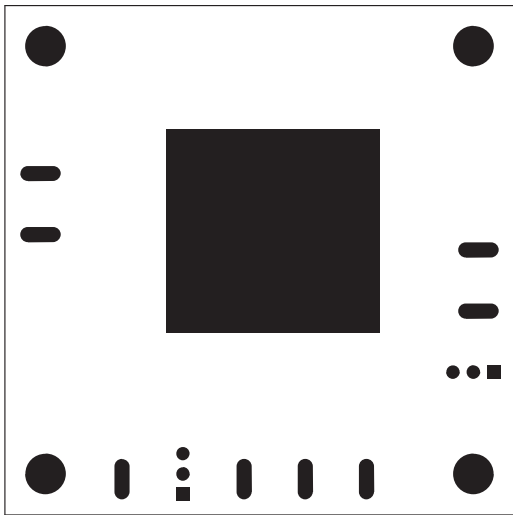
REVISIONS

ZONE	LTR	DESCRIPTION	DATE	AUTHOR
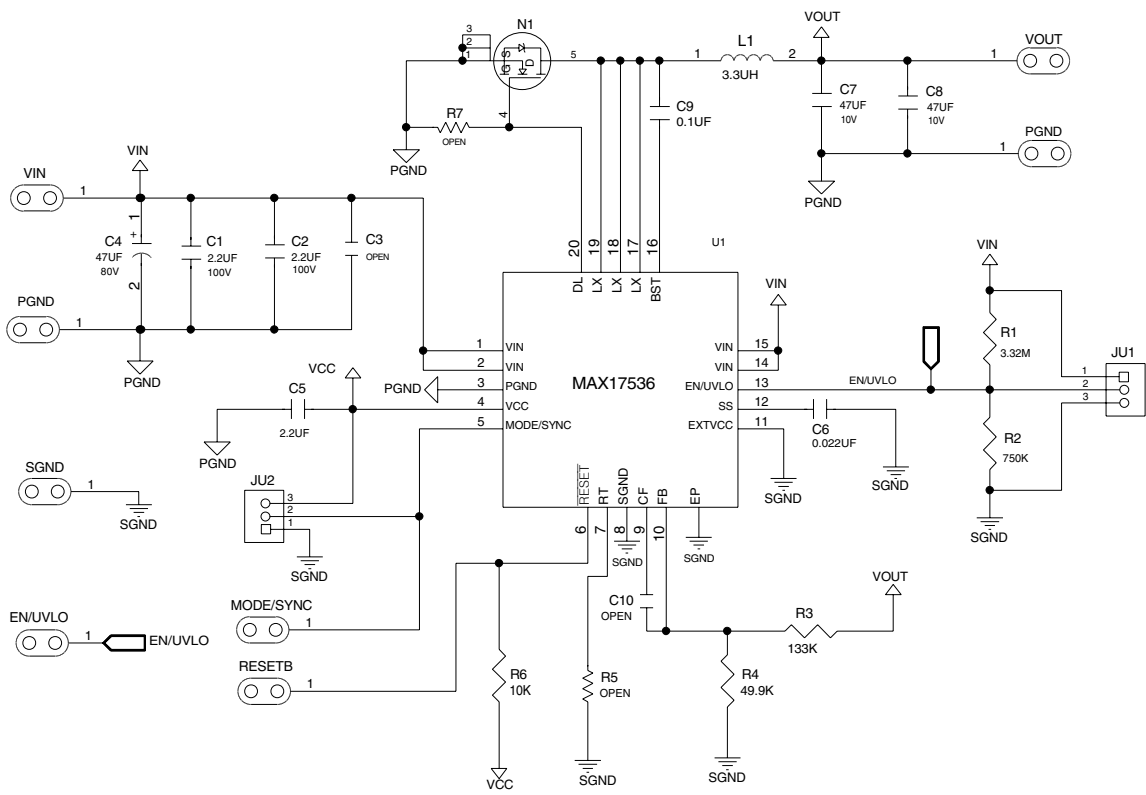
PROJECT TITLE: MAX17536A_EVKIT_A

DRAWING TITLE:

SIZE B HARDWARE NUMBER:

ENGINEER: DRAWN BY: DATE: 08/04/15

TEMPLATE REV: B REV: A

BILL OF MATERIALS (BOM) Revision 6/15

Serial No.	Description	Quantity	Designator	Part Number
1	2.2µF ±10%, 100V X7R ceramic capacitor (1210)	2	C1, C2	MURATA GRM32ER72A225KA35
2	Not installed, OPEN (1210)	0	C3	
3	47uF 80V aluminum electrolytic (D=10mm)	1	C4	PANASONIC EEEFK1K470P
4	2.2µF ±10%, 10V X7R ceramic capacitor (0603)	1	C5	MURATA GRM188R71A225K
5	22000pF ±10%, 50V X7R ceramic capacitor (0402)	1	C6	MURATA GRM155R71H223K
6	47uF ±10%, 10V X7R ceramic capacitor (1210)	2	C7, C8	MURATA GRM32ER71A476K
7	0.1µF ±10%, 50V X7R ceramic capacitor (0402)	1	C9	MURATA GRM155R71H104KE14
8	Not installed, OPEN (0402)	0	C10	
9	3-pin header (36-pin header 0.1" centers)	2	JU1, JU2	Sullins: PTC36SAAN
10	3.3uH Inductor (5.28mm x 5.48mm x 3.1mm)	1	L1	Coilcraft XAL5030-332
11	MOSFET (60V, 25A)	1	N1	Renesas RJK0651-DPB
12	3.32M ohm ±1%, resistor (0603)	1	R1	
13	750k ohm ±1%, resistor (0603)	1	R2	
14	133k ohm ±1%, resistor (0402)	1	R3	
15	49.9k ohm ±1%, resistor (0402)	1	R4	
16	Not installed, OPEN (0402)	0	R5	
17	10k ohm ±1%, resistor (0402)	1	R6	
18	Not installed, OPEN (0402)	0	R7	
19	Buck Converter MAX17536ATP+	1	U1	MAX17536ATP+
20	Shunt	2	See Jumper Table	SULLINS STC02SYAN

Jumper Table

JUMPER	SHUNT POSITION
JU1	1-2
JU2	1