METER-BUS TRANSCEIVER

DESCRIPTION

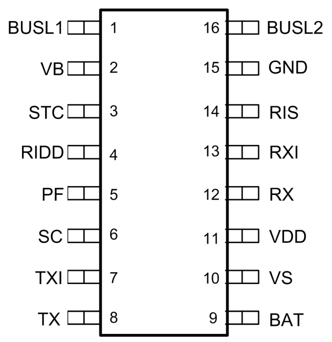
MS721 is a single chip transceiver developed for Meter-Bus standard (EN1434-3) applications.

The MS721 interface circuit adjusts the different potentials between a slave system and the Meter- Bus master. The connection to the bus is polarity independent and supports full galvanic slave isolation with optocouplers.

The circuit is supplied by the master via the bus. Therefore, this circuit offers no additional load for the slave battery. A power-fail function is integrated.

The receiver has dynamic level recognition, and the transmitter has a programmable current sink.

A 3.3-V voltage regulator, with power reserve for a delayed switch off at bus fault, is integrated



SOP16

FEATURE

• Meter-Bus Transceiver (for Slave) Meets Standard EN1434-3
• Receiver Logic With Dynamic Level Recognition
• Adjustable Constant-Current Sink via Resistor
• Polarity Independent
• Power-Fail Function
• Module Supply Voltage Switch
• 3.3-V Constant Voltage Source
• Remote Powering
• Up to 9600 Baud in Half Duplex for UART Protocol
• Slave Power Support
– Supply From Meter-Bus via Output VDD
– Supply From Meter-Bus via Output VDD or From Backup Battery
– Supply From Battery – Meter-Bus Active for Data Transmission Only

Application

■ Meter-Bus

Package

■ SOP16

Functional Schematic

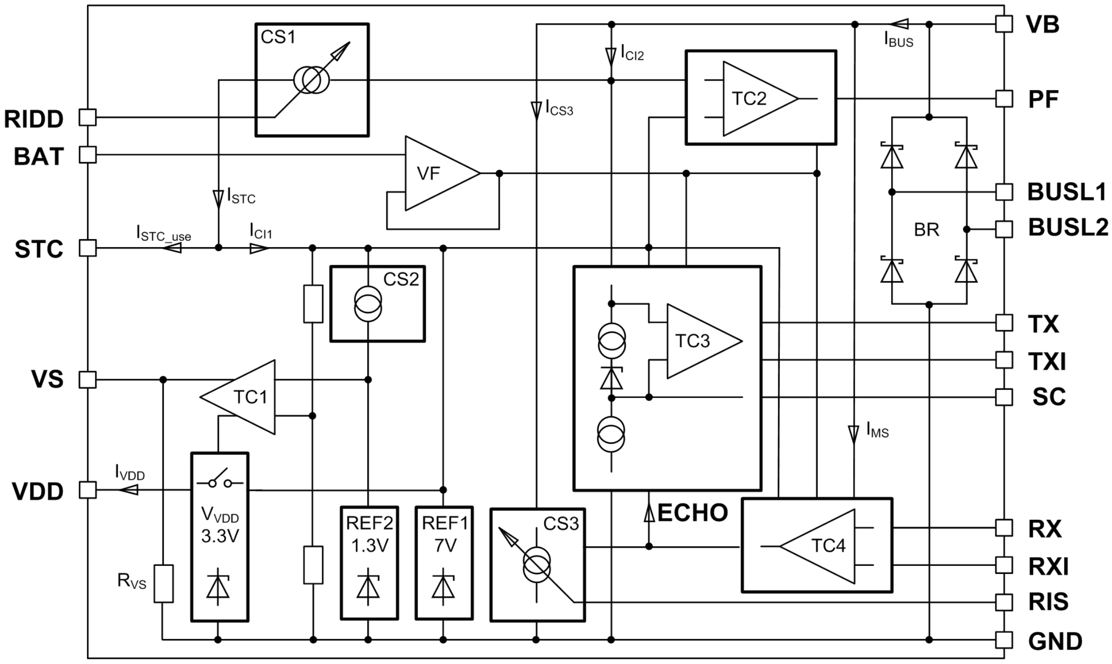


Figure 1：Functional schematic

Terminal Functions

Number	Name	Description
1	BUSL2	Meter Bus interface 2
2	VB	Differential bus voltage after rectifier
3	STC	Support capacitor
4	RIDD	Current adjustment input
5	PF	Power fail output
6	SC	Sampling capacitor
7	TXI	Data output inverted
8	TX	Data output
9	BAT	Logic level adjust
10	VS	Switch for bus or battery supply output
11	VDD	Voltage regulator output
12	RX	Data input
13	RXI	Data input inverted
14	RIS	Adjust input for modulation current
15	GND	Ground
16	BUSL1	Meter Bus interface 1

Data Transmission, Master to Slave

The mark level on the bus lines V_{BUS} = MARK is defined by the difference of BUSL1 and BUSL2 at the slave. It is dependent on the distance of Master to Slave, which affects the voltage drop on the wire. To make the receiver independent, a dynamic reference level on the SC pin is used for the voltage comparator TC3 (see Figure 2).

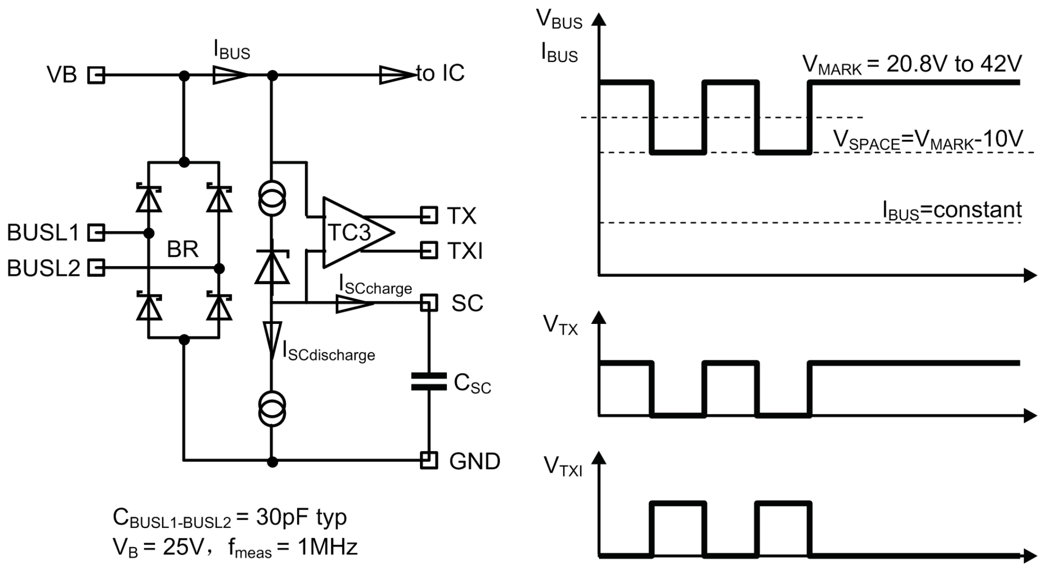


Figure 2：Master to slave

A capacitor C_{SC} at pin SC is charged by a current $I_{SCcharge}$ and is discharged with a current $I_{SCdischarge}$ where:

$$I_{SCdischarge} = \frac{I_{SCcharge}}{40}$$

This ratio is necessary to run any kind of UART protocol independent of the data contents. (for example, if an 11-bit UART protocol is transmitted with all data bits at 0 and only the stop bit at 1). There must be sufficient time to recharge the capacitor C_{SC}. The input level detector TC3 detects voltage modulations from the master, V_{BUS} = SPACE/MARK conditions, and switches the inverted output TXI and the non-inverted output TX。

Data Transmission, Slave to Master

The device uses current modulation to transmit information from the slave to the master while the bus voltage remains constant. The current source CS3 modulates the bus current and the master detects the modulation.The constant current source CS3 is controlled by the inverted input RXI or the non-inverted input RX. The current source CS3 can be programmed by an external resistor R_{RIS}. The modulation supply current I_{MS} flows in addition to the current source CS3 during the modulation time.

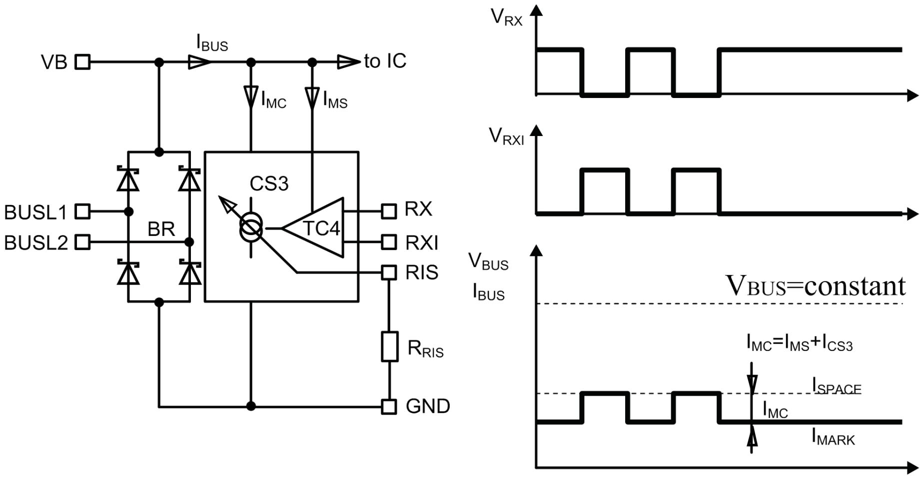
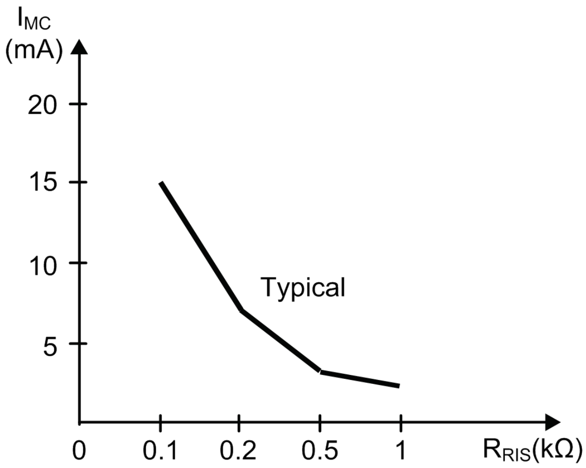


Figure 3: Data transfer, slave to master

Because the MS721 is configured for half-duplex only, the current modulation from RX or RXI is repeated concurrently as ECHO on the outputs TX and TXI. If the slave, as well as the master, is trying to send information via the lines, the added signals appear on the outputs TX and TXI, which indicates the data collision to the slave (see Figure 1).

The bus topology requires a constant current consumption by each connected slave.

To calculate the value of the programming resistor R_{RIS}, use the formula shown in Figure 4.



$$R_{RIS}=\frac{V_{RIS}}{I_{CS3}}=\frac{V_{RIS}}{I_{MC}-I_{MS}}$$

V_{RIS}: Voltage on pin RIS
R_{RIS}: programming resister
I_{CS3}: programable current
I_{MC}: modulation current
I_{MS}: modulation supply curent（typical: 220μA）

Figure 4: Calculate programming R_{RIS}

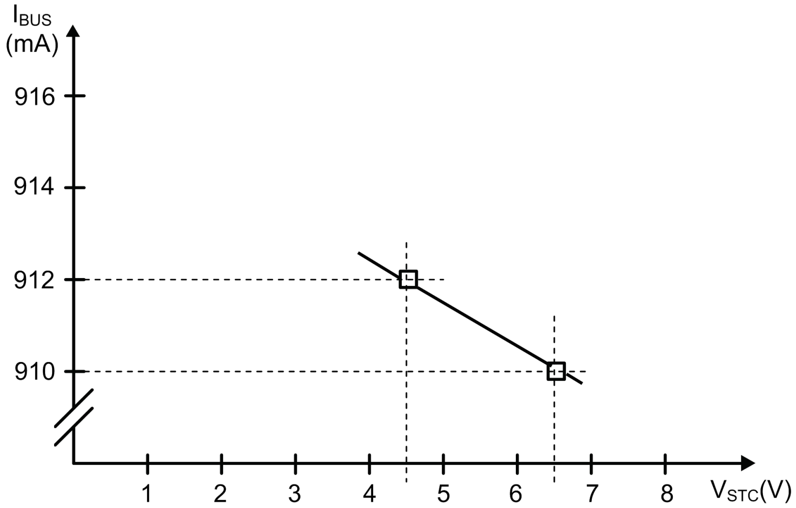


Figure 5: Single model bus load

Slave Supply, 3.3 V

The MS721has an internal 3.3-V voltage regulator. The output power of this voltage regulator is supplied by the storage capacitor C_{STC} at pin STC. The storage capacitor C_{STC} at pin STC is charged with constant current I_{STC_use} from the current source CS1. The maximum capacitor voltage is limited to REF1. The charge current I_{STC} has to be defined by an external resistor at pin RIDD.

$$R_{RIDD} = 25\frac{V_{RIDD}}{I_{STC}} = 25\frac{V_{RIDD}}{I_{STC\_use} + I_{IC1}}$$

I_{STC}: current from current source CS1

I_{STC_use}: charge current for support capacitor

I_{CI}: internal current

V_{RIDD}: voltage on pin RIDD

R_{RIDD}: value of adjustment resistor

The voltage level of the storage capacitor C_{STC} is monitored with comparator TC1. Once the voltage V_{STC} reaches V_{VDD_on}, the switch S_{VDD} connects the stabilized voltage V_{VDD} to pin VDD. VDD is turned off if the voltage V_{STC} drops below the V_{VDD_off} level. Voltage variations on the capacitor C_{STC} create bus current changes (see Figure 5).

At a bus fault the shut down time of VDD (t_{off}) in which data storage can be performed depends on the system current I_{VDD} and the value of capacitor C_{STC}. See Figure 6, which shows a correlation between the shutdown of the bus voltage V_{BUS} and V_{DD_off} and t_{off} for dimensioning the capacitor.

The output VS is meant for slave systems that are driven by the bus energy, as well as from a battery should the bus line voltage fail. The switching of VS is synchronized with VDD and is controlled by the comparator TC1. An external transistor at the output VS allows switching from the Meter-Bus remote supply to battery.

Power Fail Function

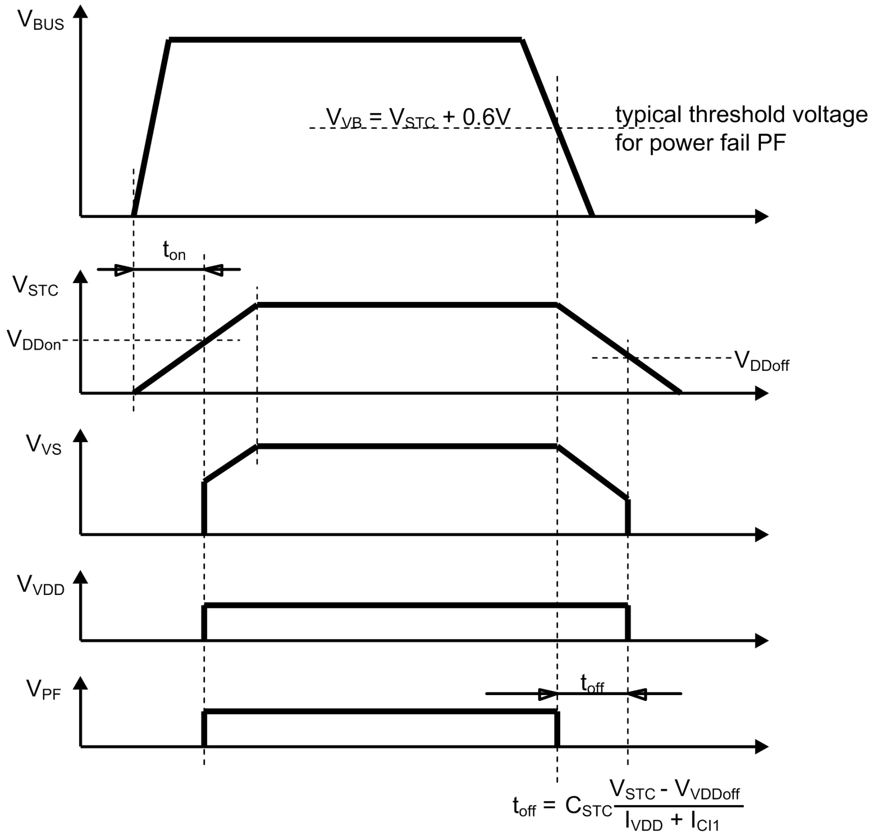


Figure 6: Power up/down timing

Power Fail Function

Because of the rectifier bridge BR at the input, BUSL1, and BUSL2, the MS721is polarity independent. The pin VB to ground (GND) delivers the bus voltage V_{VB} less the voltage drop over the rectifier BR. The voltage comparator TC2 monitors the bus voltage. If the voltage $V_{VB} > V_{STC} + 0.6$ V, then the output PF = 1. The output level PF = 0 (power fail) provides a warning of a critical voltage drop to the micro-controller to save the data immediately.

ABSOLUTE MAXIMUM RATINGS

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

V_{MB}	Voltage, BUSL1 to BUSL2		±50V
V_I	Input voltage range	RX and RXI	-0.3V to 5.5V
		BAT	-0.3V to 5.5V
T_J	Operating junction temperature range		-25℃ to 150℃
T_A	Operating free-air temperature range		-25℃ to 85℃
T_{STG}	Storage temperature range		-65℃ to 150℃
	Power derating factor, junction to ambient		8 mW/℃

RECOMMENDED OPERATING CONDITIONS

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

			MIN	MAX	UNIT
V_{MB}	Bus voltage, ｜BULS2-BUSL1｜	Receiver	10.8	42	V
		Transmitter	12	42	
V_I	Input voltage	VB(receive mode)	9.3		V
		BAT	2.5	3.8	
R_{RIDD}	RIDD resistor		13	80	kΩ
R_{RIS}	RIS resistor		100		Ω
T_A	Operating free-air temperature		-25	85	℃

note: 1. All voltage values are measured with respect to the GND terminal unless otherwise noted.

2. $V_{BAT}(max) \leqslant V_{STC}-1V$

ELECTRICAL CHARACTERISTICS(1)

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

PARAMETER		TEST CONDITIONS		MIN	TYP	MAX	UNIT
ΔV_{BR}	Voltage drop at rectifier BR	I_{BUS} = 3 mA				1.5	V
ΔV_{CS1}	Voltage drop at current source CS1	R_{RIDD} = 13 kΩ				1.8	V
I_{BUS}	BUS current	V_{STC} = 6.5V, I_{MC} = 0 mA	R_{RIDD} = 13 kΩ			3	mA
			R_{RIDD} = 30 kΩ			1.5	
ΔI_{BUS}	BUS current accuracy	ΔV_{BUS} = 10 V, I_{MC} = 0 mA, R_{RIDD} = 13 kΩ to 30 kΩ				2	%

I_{CC}	Supply current	V_{STC} = 6.5 V, I_{MC} = 0 mA, V_{BAT} = 3.8 V, R_{RIDD} = 13 kΩ				650	μA
I_{CI1}	CI1 current	V_{STC} = 6.5 V, I_{MC} = 0 mA, V_{BAT} = 3.8 V, R_{RIDD} = 13 kΩ, V_{BUS} = 6.5 V, RX/RXI = off				350	μA
I_{BAT}	BAT current	V_{BAT}=3.8V		−0.5		0.5	μA
$I_{BAT}+I_{VDD}$	BAT + VDD current	V_{BUS} = 0 V, V_{STC}=0		−0.5		0.5	μA
V_{VDD}	VDD voltage	$-I_{VDD}$ = 1 mA, V_{STC} = 6.5 V		3.1		3.4	V
R_{VDD}	VDD resistance	$-I_{VDD}$ = 2 to 8 mA, V_{STC} = 4.5 V				5	Ω
V_{STC}	STC voltage	V_{DD} = on, VS = on		5.6		6.4	V
		V_{DD} = off, VS = off		3.8		4.3	
		$I_{VDD} < I_{STC\_use}$		6.5		7.5	
I_{STC_use}	STC current	V_{STC} = 5 V	R_{RIDD} = 30 kΩ	0.65		1.1	mA
			R_{RIDD} = 13 kΩ	1.85		2.4	
V_{RIDD}	RIDD voltage	R_{RIDD} = 30 kΩ		1.23		1.33	V
V_{VS}	VS voltage	V_{DD} = on, IVS = −5 μA		VSTC −0.4		VSTC	V
R_{VS}	VS resistance	V_{DD} = off		0.3		1	MΩ
V_{PF}	PF voltage	VSTC = 6.5 V	V_{VB} = V_{STC}+ 0.8 V, I_{PF} = −100 μA	VBAT −0.6		VBAT	V
			V_{VB} = V_{STC}+ 0.3 V, I_{PF} = 1 μA	0		0.6	
			V_{VB} = V_{STC}+ 0.3 V, I_{PF} = 5 μA	0		0.9	
t_{on}	Turn-on time	C_{STC} = 50 μF, Bus voltage slew rate:1 V/μs				3	s

(1) All voltage values are measured with respect to the GND terminal, unless otherwise noted.

(2) Inputs RX/RXI and outputs TX/TXI are open, $I_{CC} = I_{CI1} + I_{CI2}$

RECEIVER SECTION ELECTRICAL CHARACTERISTICS

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

PARAMETER		**TEST CONDITIONS**	**MIN**	**TYP**	**MAX**	**UNIT**
V_T		See Figure 2	MARK−8.2		MARK−5.7	V
V_{SC}	SC voltage				VVB	V
$I_{SCcharge}$	SC charge current	V_{SC} = 24 V, V_{VB} = 36 V	−15		−40	μA

$I_{SCdischarge}$	SC discharge current	V_{SC} = V_{VB} = 24 V	0.3		−0.033× ISCcharge	μA
V_{OH}	High-level output voltage (TX, TXI)	I_{TX}/I_{TXI} = −100 μA ((see Figure 2)	VBAT−0.6		VBAT	V
V_{OL}	Low-level output voltage (TX, TXI)	I_{TX}/I_{TXI} = 100 μA	0		0.5	V
		I_{TX} = 1.1 mA	0		1.5	
I_{TX}/I_{TXI}	TX, TXI current	V_{TX} = 7.5, V_{VB} = 12 V, V_{STC} = 6 V, V_{BAT} = 3.8 V			10	μA

(1) All voltage values are measured with respect to the GND terminal, unless otherwise noted.

TRANSMITTER SECTION ELECTRICAL CHARACTERISTICS(

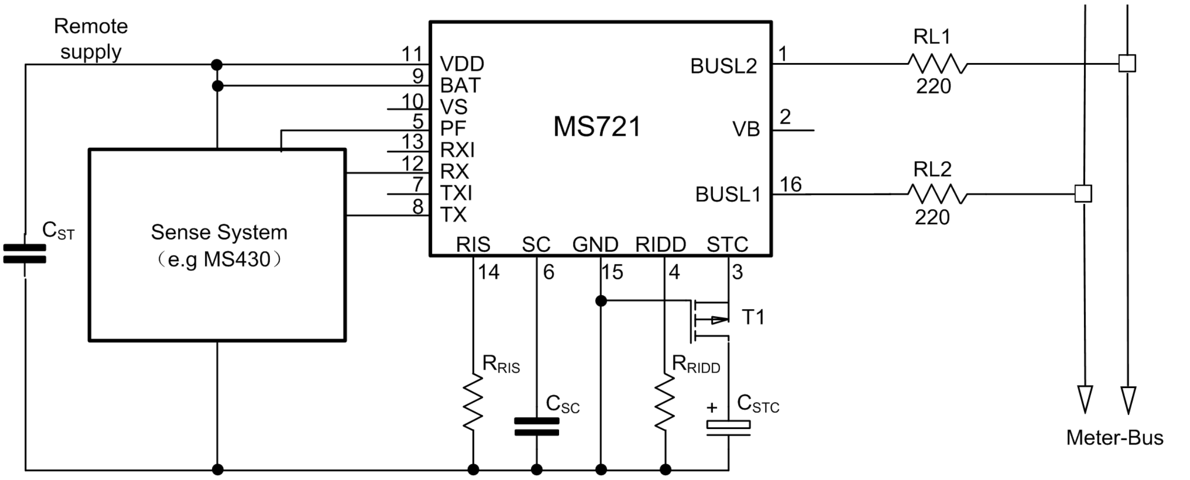
over operating free-air temperature range (unless otherwise noted)

PARAMETER		TEST CONDITIONS	MIN	TYP	MAX	UNIT
I_{MC}	MC voltage	R_{RIS}= 100 Ω	11.5		19.5	mA
V_{RIS}	RIS voltage	R_{RIS}= 100 Ω	1.4		1.7	V
		R_{RIS}= 1000 Ω	1.5		1.8	
V_{IH}	High-level input voltage (RX, RXI)	See Figure 3	VBAT−0.8		5.5	V
V_{IL}	Low-level input voltage (RX, RXI)	See Figure 3	0		0.8	V
I_{RX}	RX Current	V_{RX} = V_{BAT} = 3 V, V_{VB} = V_{STC} = 0 V	−0.5		0.5	μA
		V_{RX} = 0 V, V_{BAT} = 3 V, V_{STC} = 6.5 V	−10		−40	
I_{RXI}	RXI Current	V_{RXI} = V_{BAT} = 3 V, V_{VB} = V_{STC} = 0 V	10		40	μA
		V_{RXI} = V_{BAT} = 3 V, V_{STC} = 6.5 V	10		40	

(1) All voltage values are measured with respect to the GND terminal, unless otherwise noted.

(2) V_{IH}(max) = 5.5 V is valid only when V_{STC} > = 6.5 V.

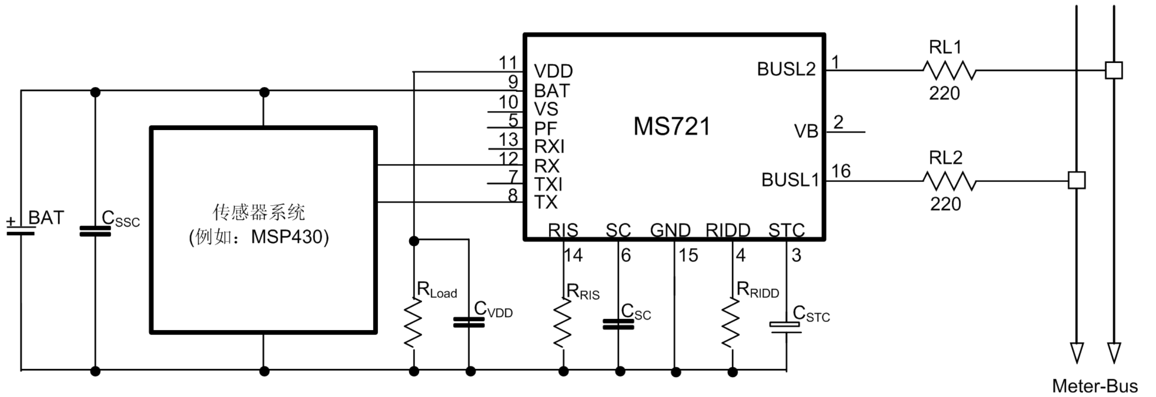
Application circuit



R_{RIDD} = 30k Ω	C_{STC} <= 220 μF	Singel load 1UL
R_{RIDD} = 13k Ω	C_{STC} <= 470 μF	Double load 1UL

NOTE: Transistor T1 should be a BSS84.

Figure 7：Basic Application circuit using support capacitor CSTC > 50 μF



C_{SSC}：system stabilising capacitor

C_{STC}：support capacitor

C_{SC}：sampling capacitor

C_{VDD}：stabilising capacitor (100 nF)

C_{STC}：C_{VDD} >= 4:1

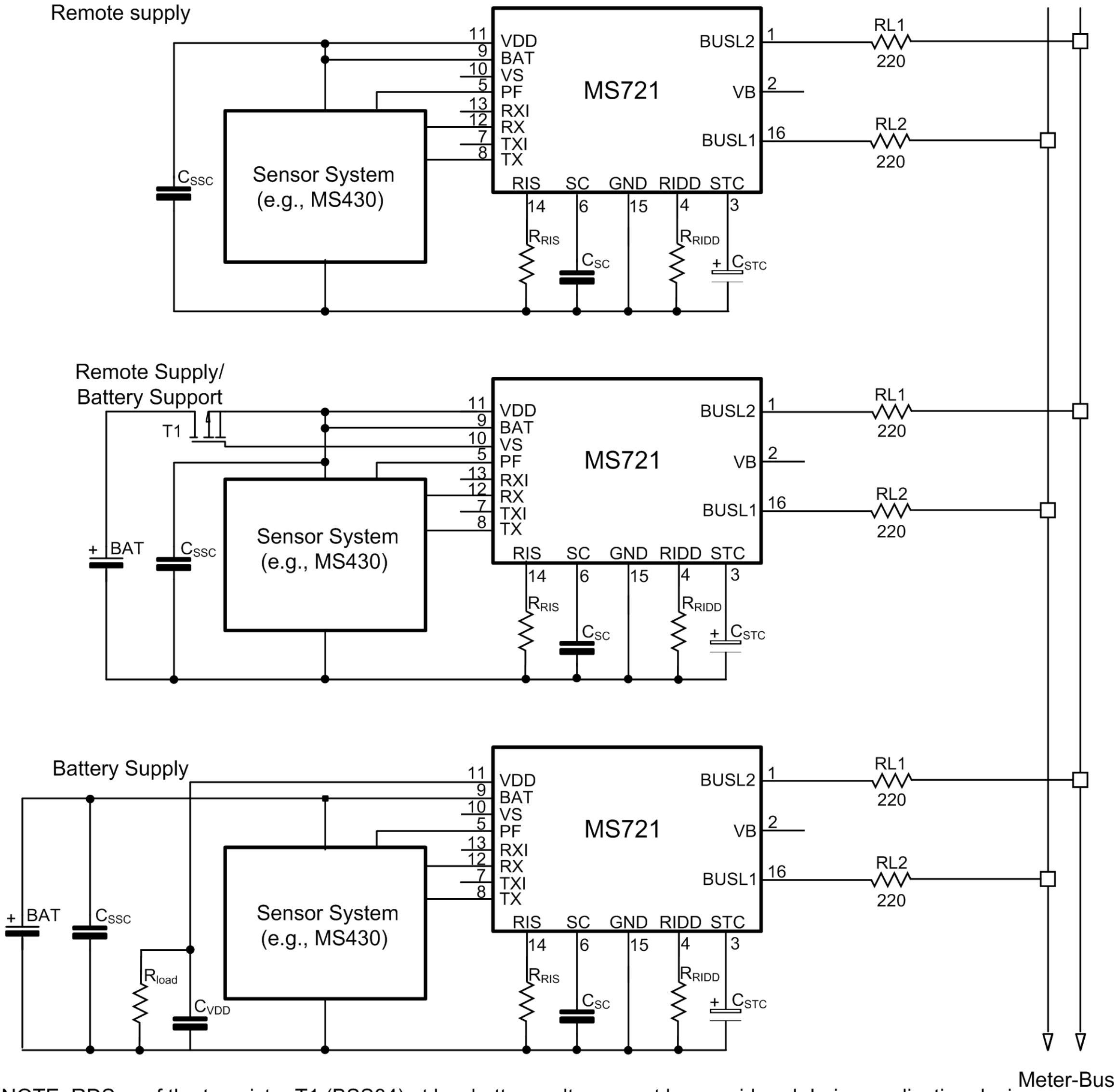
RRIDD：slave-current adjustment resistor

RRIS：modulation-current resistor

RL1，RL2：protection resistors

Rload：discharge resistor (100 k recommended)

Figure 8：Basic Application Circuit for Supply From Battery



NOTE: RDSon of the transistor T1 (BSS84) at low battery voltage must be considered during application design.

Figure 9:Basic Applications for Different Supply Modes

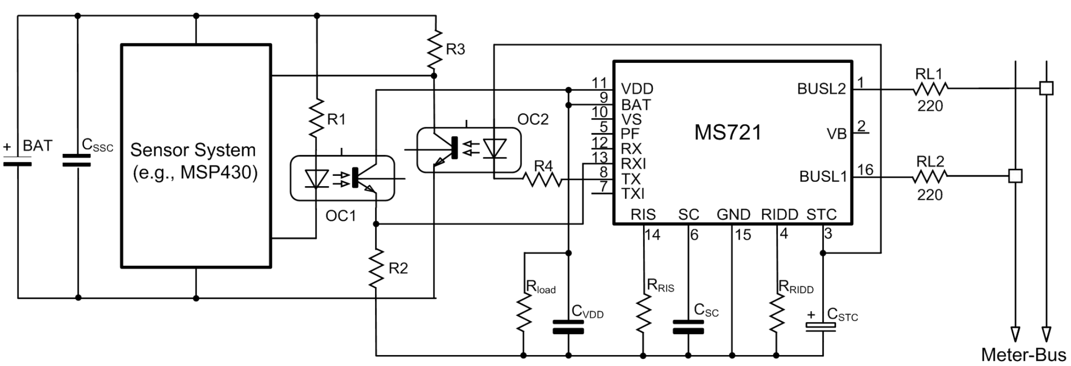
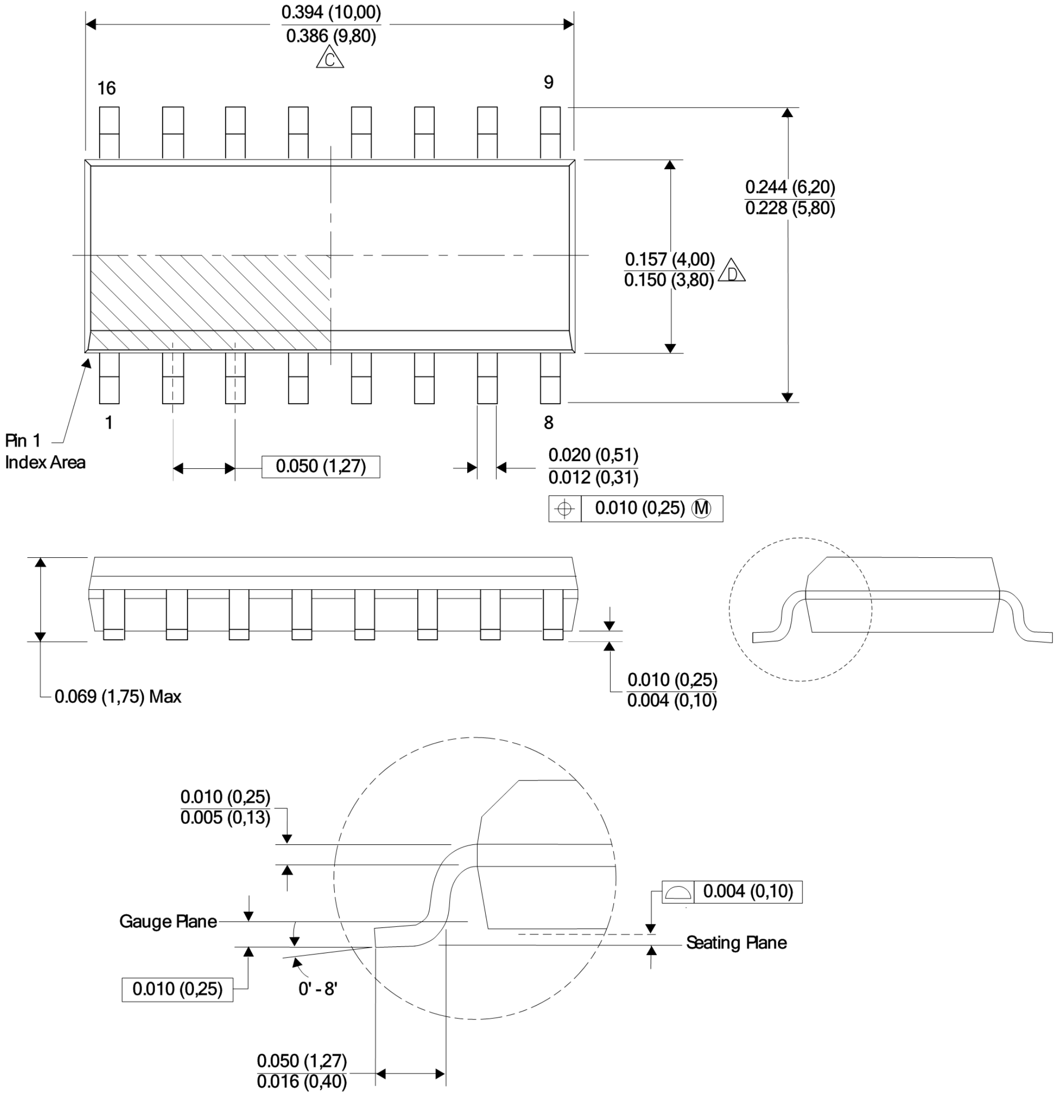


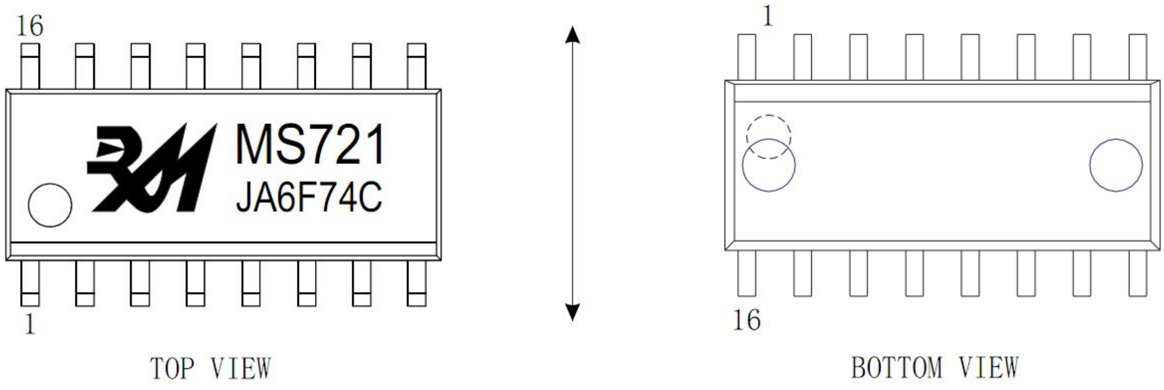
Figure 10：Basic Optocoupler Application

Package Information

SOP16



Marking drawing criterion

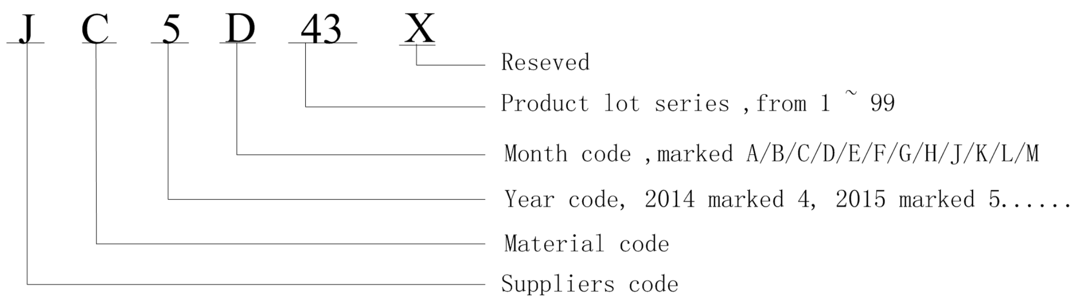


一，Marking drawing description

MS721：product name

Product code

example：JC5D43



二，Marking drawing pattern

Laser printing，contents in the middle, font type Arial

三，Package pattern

product	Pieces/group	group/plate	pieces/plate	plate/box	piece/box
MS721	2000	1	2000	8	16000