NXP Semiconductors
Technical Data

Document Number: A2T21H141W24S
Rev. 0, 06/2018

RF Power LDMOS Transistor

N–Channel Enhancement–Mode Lateral MOSFET

This 36 W asymmetrical Doherty RF power LDMOS transistor is designed for cellular base station applications requiring very wide instantaneous bandwidth capability covering the frequency range of 2110 to 2200 MHz.

2100 MHz

- Typical Doherty Single–Carrier W–CDMA Performance: V_{DD} = 28 Vdc, I_{DQA} = 400 mA, V_{GSB} = 0.65 Vdc, P_{out} = 36 W Avg., Input Signal PAR = 9.9 dB @ 0.01% Probability on CCDF.

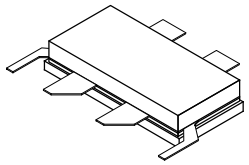
Frequency	G_{ps} (dB)	η_D (%)	Output PAR (dB)	ACPR (dBc)
2110 MHz	17.2	50.6	7.3	–31.9
2140 MHz	17.3	50.1	7.1	–32.2
2170 MHz	17.3	49.6	7.0	–33.0
2200 MHz	17.2	48.2	7.0	–34.1

Features

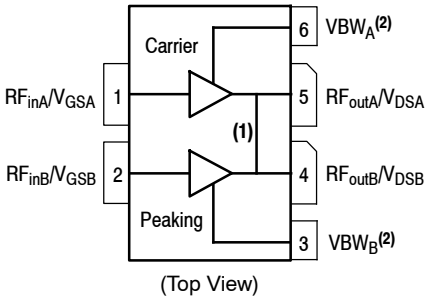
- Advanced high performance in–package Doherty
- Designed for wide instantaneous bandwidth applications
- Greater negative gate–source voltage range for improved Class C operation
- Able to withstand extremely high output VSWR and broadband operating conditions
- Designed for digital predistortion error correction systems

A2T21H141W24SR3

2110–2200 MHz, 36 W AVG., 28 V AIRFAST RF POWER LDMOS TRANSISTOR



NI–780S–4L2L



(Top View)

Figure 1. Pin Connections

1. Pin connections 4 and 5 are DC coupled and RF independent.
2. Device can operate with V_{DD} current supplied through pin 3 and pin 6.

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Table 1. Maximum Ratings

Rating	Symbol	Value	Unit
Drain-Source Voltage	V_{DSS}	–0.5, +65	Vdc
Gate-Source Voltage	V_{GS}	–6.0, +10	Vdc
Operating Voltage	V_{DD}	32, +0	Vdc
Storage Temperature Range	T_{stg}	–65 to +150	°C
Case Operating Temperature Range	T_C	–40 to +150	°C
Operating Junction Temperature Range (1,2)	T_J	–40 to +225	°C

Table 2. Thermal Characteristics

Characteristic	Symbol	Value (2,3)	Unit
Thermal Resistance, Junction to Case Case Temperature 76°C, 36 W Avg., W-CDMA, 28 Vdc, I_{DQA} = 400 mA, V_{GSB} = 0.65 Vdc, 2140 MHz	$R_{\theta JC}$	0.44	°C/W

Table 3. ESD Protection Characteristics

Test Methodology	Class
Human Body Model (per JS-001-2017)	2
Charge Device Model (per JS-002-2014)	C3

Table 4. Electrical Characteristics (T_A = 25°C unless otherwise noted)

Characteristic	Symbol	Min	Typ	Max	Unit
Off Characteristics (4)					
Zero Gate Voltage Drain Leakage Current (V_{DS} = 65 Vdc, V_{GS} = 0 Vdc)	I_{DSS}	—	—	10	μAdc
Zero Gate Voltage Drain Leakage Current (V_{DS} = 32 Vdc, V_{GS} = 0 Vdc)	I_{DSS}	—	—	5	μAdc
Gate-Source Leakage Current (V_{GS} = 5 Vdc, V_{DS} = 0 Vdc)	I_{GSS}	—	—	1	μAdc
On Characteristics - Side A, Carrier					
Gate Threshold Voltage (V_{DS} = 10 Vdc, I_D = 70 μAdc)	$V_{GS(th)}$	0.8	1.2	1.6	Vdc
Gate Quiescent Voltage (V_{DD} = 28 Vdc, I_{DA} = 400 mAdc, Measured in Functional Test)	$V_{GSA(Q)}$	1.4	1.8	2.2	Vdc
Drain-Source On-Voltage (V_{GS} = 10 Vdc, I_D = 0.7 Adc)	$V_{DS(on)}$	0.1	0.2	0.3	Vdc
On Characteristics - Side B, Peaking					
Gate Threshold Voltage (V_{DS} = 10 Vdc, I_D = 100 μAdc)	$V_{GS(th)}$	0.8	1.2	1.6	Vdc
Drain-Source On-Voltage (V_{GS} = 10 Vdc, I_D = 1.0 Adc)	$V_{DS(on)}$	0.1	0.2	0.3	Vdc

1. Continuous use at maximum temperature will affect MTTF.
2. MTTF calculator available at http://www.nxp.com/RF/calculators.
3. Refer to AN1955, *Thermal Measurement Methodology of RF Power Amplifiers.* Go to http://www.nxp.com/RF and search for AN1955.
4. Side A and Side B are tied together for this measurement.

(continued)

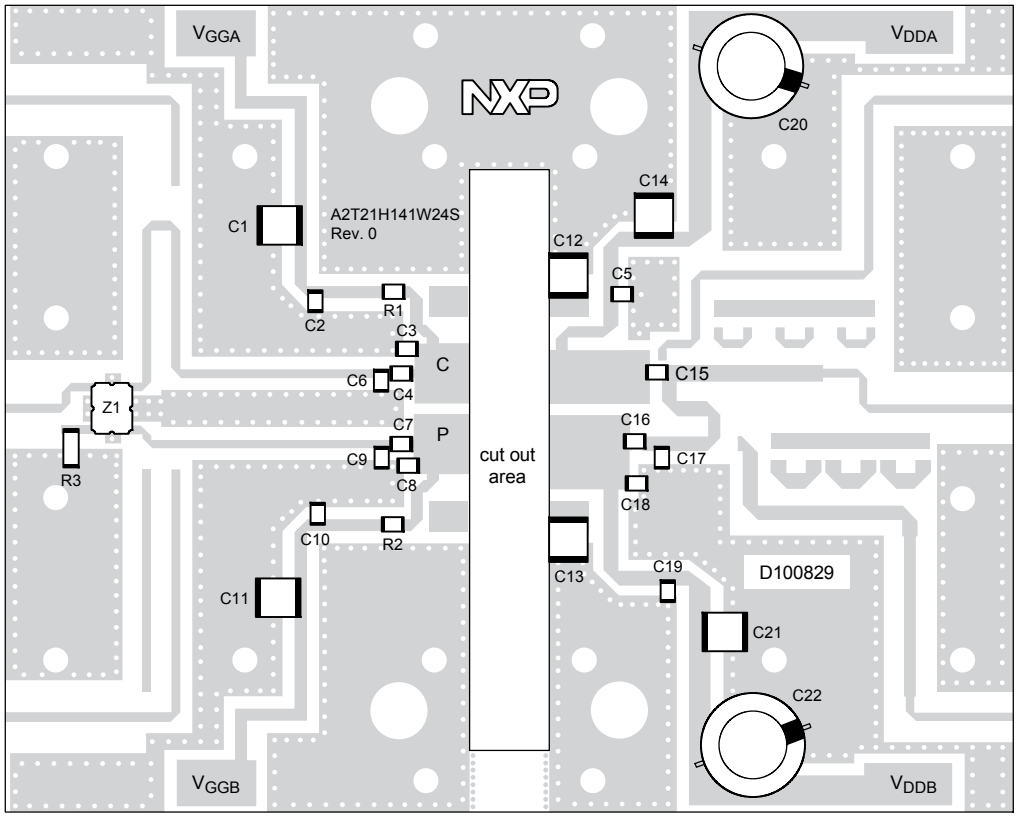
Table 4. Electrical Characteristics (T_A = 25°C unless otherwise noted) **(continued)**

Characteristic	Symbol	Min	Typ	Max	Unit
Functional Tests (1,2,3) (In NXP Doherty Test Fixture, 50 ohm system) V_{DD} = 28 Vdc, I_{DQA} = 400 mA, V_{GSB} = 0.65 Vdc, P_{out} = 36 W Avg., f = 2110 MHz, Single-Carrier W-CDMA, IQ Magnitude Clipping, Input Signal PAR = 9.9 dB @ 0.01% Probability on CCDF. ACPR measured in 3.84 MHz Channel Bandwidth @ ±5 MHz Offset.					
Power Gain	G_{ps}	16.4	17.2	19.4	dB
Drain Efficiency	η_D	47.5	50.6	—	%
Output Peak-to-Average Ratio @ 0.01% Probability on CCDF	PAR	6.7	7.3	—	dB
Adjacent Channel Power Ratio	ACPR	—	–31.9	–27.0	dBc
Load Mismatch (3) (In NXP Doherty Test Fixture, 50 ohm system) I_{DQA} = 400 mA, V_{GSB} = 0.65 Vdc, f = 2140 MHz					
VSWR 10:1 at 32 Vdc, 170 W CW Output Power (3 dB Input Overdrive from 114 W CW Rated Power)	No Device Degradation				
Typical Performance (3) (In NXP Doherty Test Fixture, 50 ohm system) V_{DD} = 28 Vdc, I_{DQA} = 400 mA, V_{GSB} = 0.65 Vdc, 2110–2200 MHz Bandwidth					
P_{out} @ 3 dB Compression Point (4)	P3dB	—	158	—	W
AM/PM (Maximum value measured at the P3dB compression point across the 2110–2200 MHz bandwidth)	Φ	—	–22	—	°
VBW Resonance Point (IMD Third Order Intermodulation Inflection Point)	VBW_{res}	—	160	—	MHz
Gain Flatness in 90 MHz Bandwidth @ P_{out} = 36 W Avg.	G_F	—	0.16	—	dB
Gain Variation over Temperature (–30°C to +85°C)	ΔG	—	0.008	—	dB/°C
Output Power Variation over Temperature (–30°C to +85°C)	ΔP1dB	—	0.006	—	dB/°C

Table 5. Ordering Information

Device	Tape and Reel Information	Package
A2T21H141W24SR3	R3 Suffix = 250 Units, 44 mm Tape Width, 13-inch Reel	NI-780S-4L2L

1. V_{DDA} and V_{DDB} must be tied together and powered by a single DC power supply.
2. Part internally matched both on input and output.
3. Measurements made with device in an asymmetrical Doherty configuration.
4. P3dB = P_{avg} + 7.0 dB where P_{avg} is the average output power measured using an unclipped W-CDMA single-carrier input signal where output PAR is compressed to 7.0 dB @ 0.01% probability on CCDF.



Note: V_{DDA} and V_{DDB} must be tied together and powered by a single DC power supply.

Figure 2. A2T21H141W24SR3 Test Circuit Component Layout

Table 6. A2T21H141W24SR3 Test Circuit Component Designations and Values

Part	Description	Part Number	Manufacturer
C1, C11, C12, C13, C14, C21	10 μF Chip Capacitor	C5750X7S2A106M230KB	TDK
C2, C4, C5, C7, C10, C16, C19	10 pF Chip Capacitor	ATC600F100JT250XT	ATC
C3	1.6 pF Chip Capacitor	ATC600F1R6BT250XT	ATC
C6, C8, C18	0.3 pF Chip Capacitor	ATC600F0R3BT250XT	ATC
C9	0.1 pF Chip Capacitor	ATC600F0R1BT250XT	ATC
C15	9.1 pF Chip Capacitor	ATC600F9R1BT250XT	ATC
C17	0.2 pF Chip Capacitor	ATC600F0R2BT250XT	ATC
C20, C22	470 μF, 63 V Electrolytic Capacitor	MCGPR63V477M13X26	Multicomp
R1, R2	6.2 Ω, 1/4 W Chip Resistor	CRCW12066R20FKEA	Vishay
R3	50 Ω, 10 W Termination Chip Resistor	C10A50Z4	Anaren
Z1	2000-2300 MHz Band, 90°, 5 dB Directional Coupler	X3C21P1-05S	Anaren
PCB	Rogers RO4350B, 0.020″, ε_r = 3.66	D100829	MTL

TYPICAL CHARACTERISTICS — 2110–2200 MHz

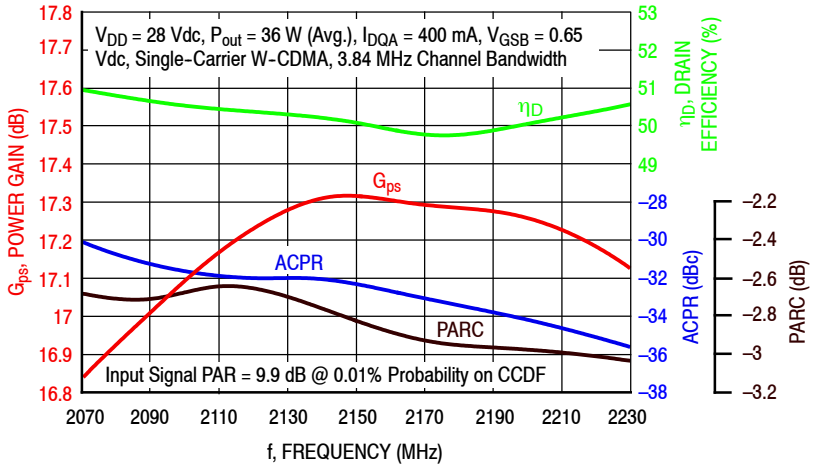


Figure 3. Single-Carrier Output Peak-to-Average Ratio Compression (PARC) Broadband Performance @ P_{out} = 36 Watts Avg.

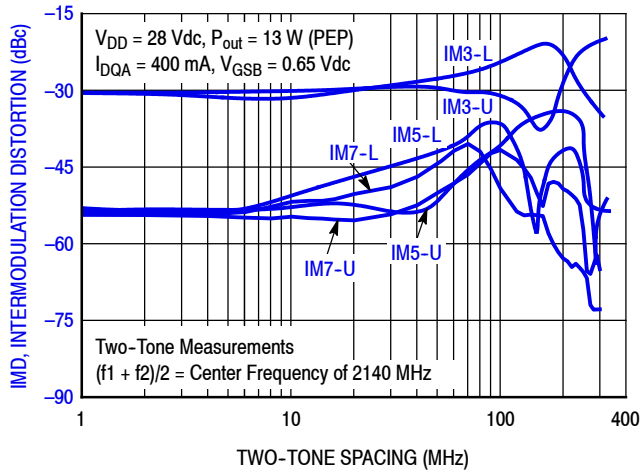


Figure 4. Intermodulation Distortion Products versus Two-Tone Spacing

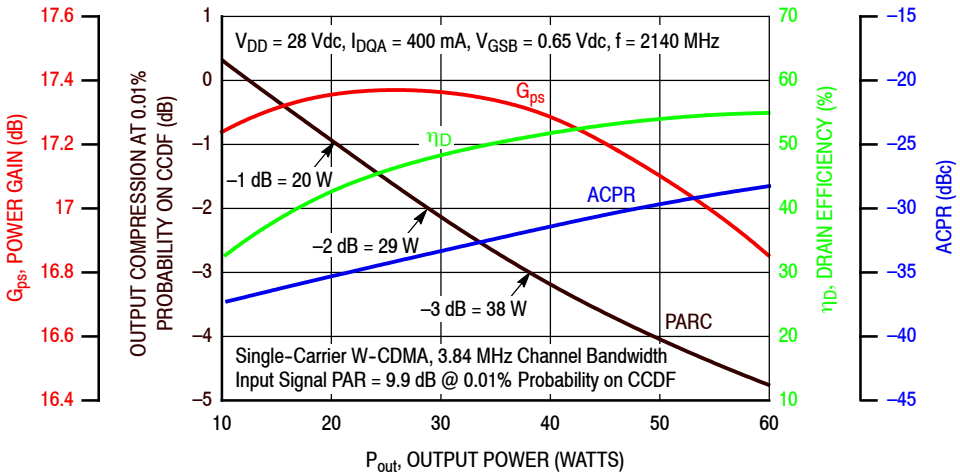


Figure 5. Output Peak-to-Average Ratio Compression (PARC) versus Output Power

TYPICAL CHARACTERISTICS — 2110–2200 MHz

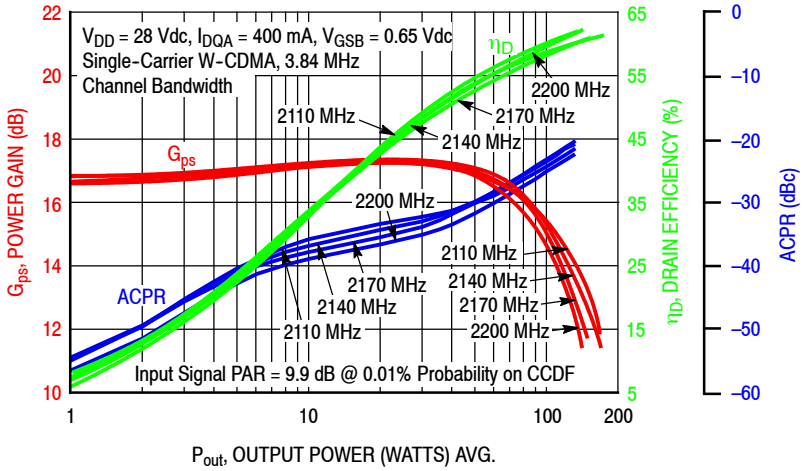


Figure 6. Single-Carrier W-CDMA Power Gain, Drain Efficiency and ACPR versus Output Power

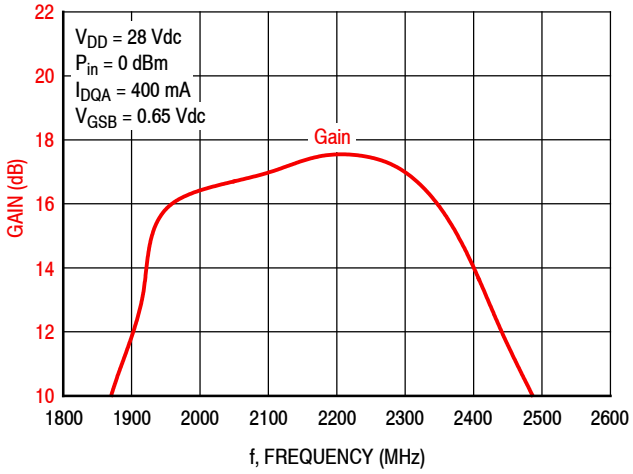
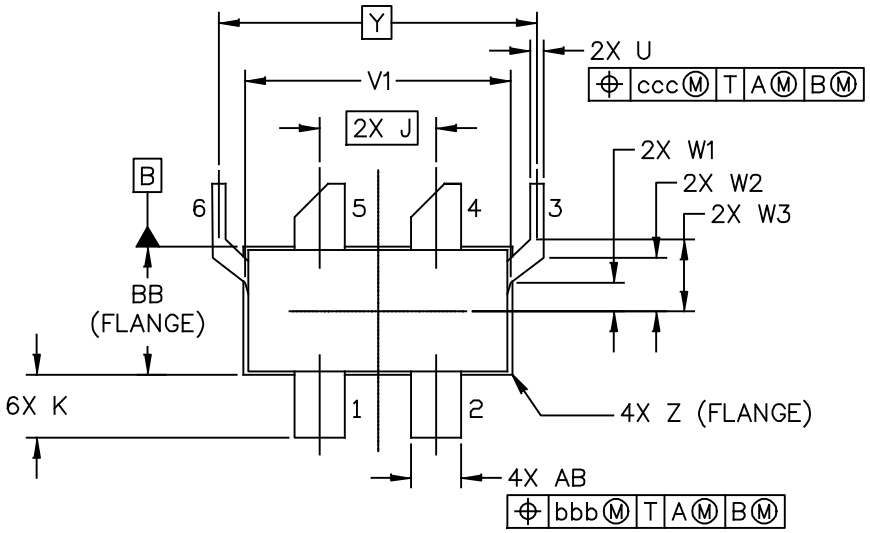
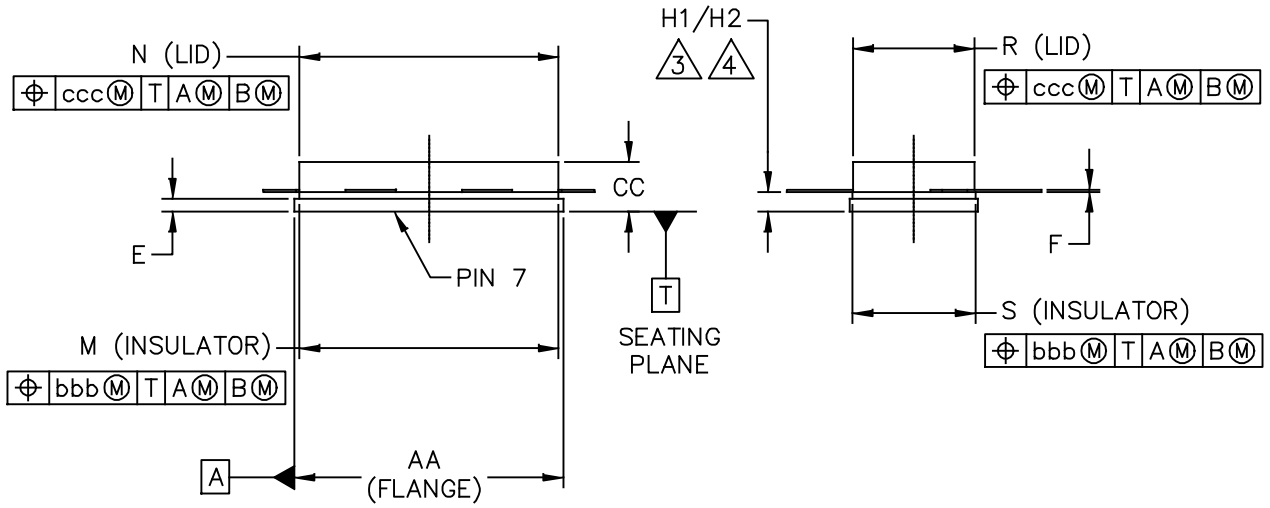


Figure 7. Broadband Frequency Response

PACKAGE DIMENSIONS





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NOTES:

1. CONTROLLING DIMENSION: INCH.
2. INTERPRET DIMENSIONS AND TOLERANCES PER ASME Y14.5M–1994.
3. DIMENSIONS H1 AND H2 ARE MEASURED .030 INCH (0.762 MM) AWAY FROM FLANGE PARALLEL TO DATUM B. H1 APPLIES TO PINS 1, 2, 4 & 5. H2 APPLIES TO PINS 3 & 6.
4. TOLERANCE OF DIMENSION H2 IS TENTATIVE.

DIM	INCH MIN	INCH MAX	MILLIMETER MIN	MILLIMETER MAX	DIM	INCH MIN	INCH MAX	MILLIMETER MIN	MILLIMETER MAX
AA	.805	.815	20.45	20.70	R	.365	.375	9.27	9.53
BB	.380	.390	9.65	9.91	S	.365	.375	9.27	9.53
CC	.125	.170	3.18	4.32	U	.035	.045	0.89	1.14
E	.035	.045	0.89	1.14	V1	.795	.805	20.19	20.45
F	.004	.007	0.10	0.18	W1	.080	.090	2.03	2.29
H1	.057	.067	1.45	1.70	W2	.155	.165	3.94	4.19
H2	.054	.070	1.37	1.78	W3	.210	.220	5.33	5.59
J	.350 BSC		8.89 BSC		Y	.956 BSC		24.28 BSC	
K	.170	.210	4.32	5.33	Z	R.000	R.040	R0.00	R1.02
M	.774	.786	19.66	19.96	AB	.145	.155	3.68	3.94
N	.772	.788	19.61	20.02	aaa	.005		0.13	
					bbb	.010		0.25	
					ccc	.015		0.38	

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PRODUCT DOCUMENTATION, SOFTWARE AND TOOLS

Refer to the following resources to aid your design process.

Application Notes

- AN1908: Solder Reflow Attach Method for High Power RF Devices in Air Cavity Packages
- AN1955: Thermal Measurement Methodology of RF Power Amplifiers

Engineering Bulletins

- EB212: Using Data Sheet Impedances for RF LDMOS Devices

Software

- Electromigration MTTF Calculator
- .s2p File

Development Tools

- Printed Circuit Boards

To Download Resources Specific to a Given Part Number:

1. Go to http://www.nxp.com/RF
2. Search by part number
3. Click part number link
4. Choose the desired resource from the drop down menu

REVISION HISTORY

The following table summarizes revisions to this document.

Revision	Date	Description
0	June 2018	• Initial release of data sheet

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